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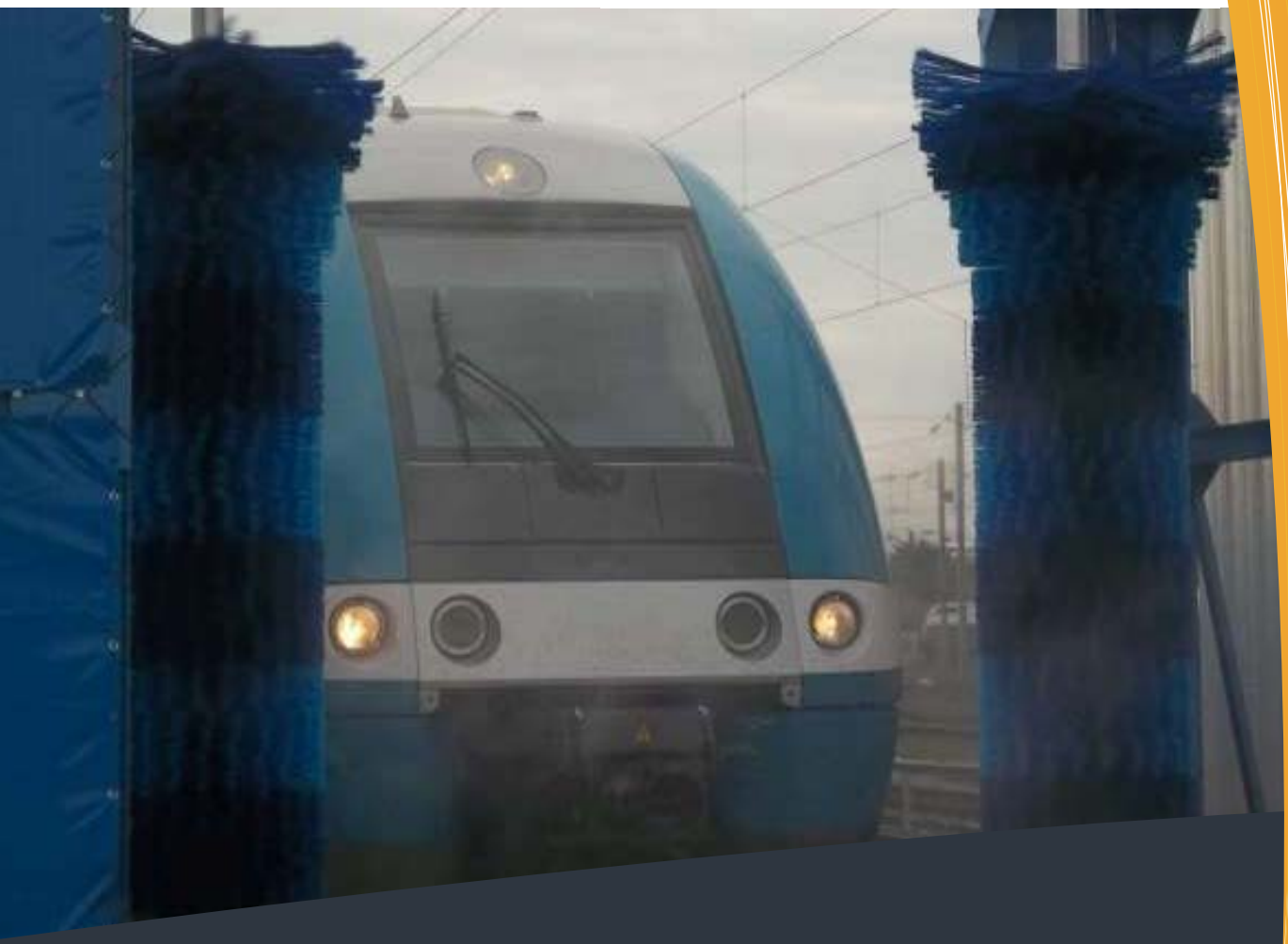

Watertightness test specification for rolling stock

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Table of Contents

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1	October 2020	First draft of the specification	EuroSpec "Watertightness test specification for rolling stock"

Revision History

Version	Date	Change
1	October 2020	

1 FOREWORD

EuroSpec is a group of European train operating companies providing harmonised product specifications for use in train procurement and refurbishment.

The main target is to align train operator's needs in order to reduce the whole life cycle cost of the train, shorten the delivery time and speed up the innovation cycle and the deployment of innovations.

The benefits of EuroSpec:

- Increase of reliability by sharing good practice and experience;
- Simplification of the tender process in time and cost as a result of fewer variations in requirements between tenders;
- Standardised products and cost reduction due to harmonisation of train operators' requirements.
- Reduction of diversity in request to the industry for more competitive and mature products;
- To provide to the industry free "Customer needs" for their future R&D program, through requirements that are not yet fulfilled by existing product nor solution.
- To promote through our common requirements to the industry the availability of information required for improving operation performance and ensuring long term sustainability of our assets, supporting open interfaces.

The EuroSpec specifications comprise merged functional and product basic requirements. All EuroSpec specifications focus on technical aspects based on lessons learned and on foreseen developments.

A EuroSpec specification is a voluntary specification designed to be used within the European region. The primary field of application is the European rolling stock domain and all associated interfaces.

Regarding the hierarchy this common specification can be positioned as follows, in order of prevalence:

- EN standards
- UIC Codes (leaflets)
- EuroSpec Specifications
- Company Specifications

2 INTRODUCTION

This document is a voluntary specification, produced by SNCF-VOYAGEURS, Rail Delivery Group (RDG), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB).

Individual companies may choose to mandate it through internal instructions/procedures or contract conditions.

Purpose of this document

This document provides a voluntary specification for Watertightness routine test for rolling stock for use by companies in the rail sector if they so choose.

The purpose of this document is to provide a common specification for Watertightness routine testing for rolling stock between train operators. This document is to replace individual company specific functional requirements and constitutes a common reference being used for tendering and verification.

The document is set out in the same format as EN standards in order to facilitate the interface with ENs.

Application of this document

- This specification is voluntary. Individual companies may however elect to mandate all or part of its use through company procedures or contract conditions. Where this is the case, the company concerned must specify the nature and extent of application.
- Specific compliance requirements and dates of application have therefore not been identified since these will be the subject of the internal procedures or contract conditions of those companies that choose to adopt this standard.

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Approval and authorisation of this document

- The content of this document was approved for publication by the technical bodies of SNCF-VOYAGEURS, Rail Delivery Group (RDG), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB).

3 SCOPE

This specification is applicable for all types of passenger railway vehicles including locomotives.

This specification contains routine water tightness testing requirements for rolling stock and its components, and unifies the requested performances of the different operators. In addition to this specification additional operator specific requirements might be defined.

For this issue of the specification, the scope is limited to identifying unintended water ingress caused by process or operator errors during manufacturing and assembly of the train body.

This specification does not consider dust or snow tightness nor drainage of water / condensation collected in the carbody structure

This specification is not intended to block innovation or to prevent improvement. For this purpose each requirement is followed by a rationale.

Unintended water ingress or insufficient drainage of water in components, sub-assemblies and vehicles can cause a substantial risk of loss of reliability and increased cost for repair / overhaul during the lifetime of the rolling stock.

Often the effect of water ingress, expresses itself a long time after the ingress actually occurred, causing a great deal of degradation before detection.

In order to be effective in eliminating unwanted water ingress it is important that the aspect of water tightness / drainage is addressed during several stages from design until commercial use of the rolling stock:

- **Design:**

  During the **design** process the risk of unwanted water ingress should be analysed and eliminated as much as possible by reliable design solutions. Verification of the design's ability to avoid unwanted water ingress (compliance) is to be demonstrated by specific type testing.

  The design and type testing is not in the scope of this specification.

- **Manufacturing:**
  The manufacturing process must be analysed specifically for any risk that can cause unwanted water ingress. Each risk is to be eliminated by a fool proof process and / or elimination of possible operator error.
  The risk mitigation of the production process with regard to unwanted water ingress is not in the scope of this specification.

- **Factory testing:**
  Despite an optimised design and manufacturing process, some risks for water ingress will remain and they are to be detected by routine water leakage testing. Again a risk analysis should identify the leakage critical areas / processes in order to design a specific routine test.

  It is advisable to perform water tightness tests as early as possible in the process on component and sub-assembly level. (early detection).
  However component and sub-assembly routine testing are outside the scope of this specification.

  The **final level of routine testing** is on a completed **vehicle** and the **completely assembled train**.

  It is these two levels of testing that this specification covers.

The goal is to avoid unwanted water ingress during train operation, caused by process or operator errors occurring during the manufacturing process.

Since final routine testing is the last inspection step before handover to the the customer, it has to be performed at all times under all expected conditions (including during sub-zero climatic conditions).

Commercial use:
Finally during **commercial use** any remaining risk not mitigated by the final inspection or caused by the actual use of the rolling stock, shall be covered by an appropriate maintenance inspection program.

Figure-1 shows the integral approach as well as the scope of this specification (Yellow)

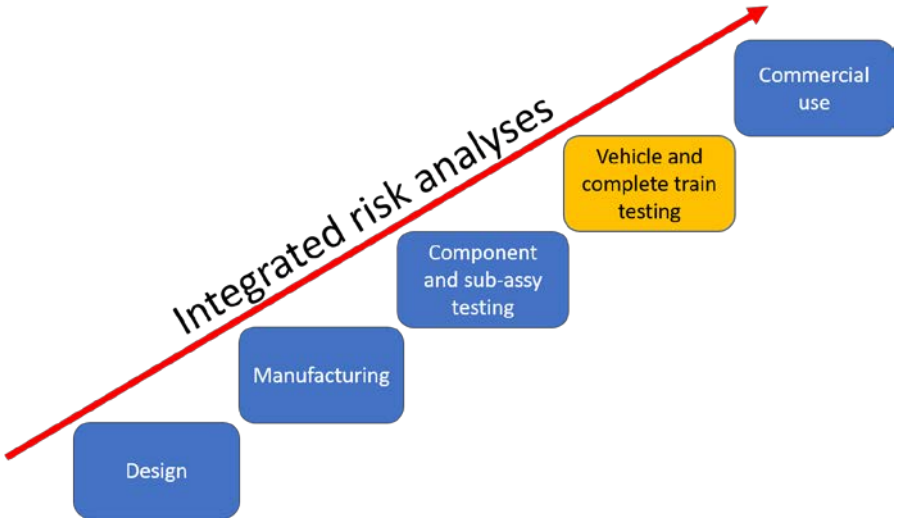


Figure-1 Integral approach on elimination of unwanted water ingress.

The risk analysis is an input for the quality and test plan. The quality and test plan is an input for the production engineering process in order to guarantee that for each test suitable testing, equipment is installed and an inspection process is performed. It is recommended that the result of the integral risk analysis is documented and discussed with the customer.

4 NORMATIVE REFERENCES

The following referenced documents are indispensable for the application of this document. ENs are developed by CEN[1] or CENELEC[2] , UIC leaflets are developed by UIC[3] and are made available from their members.

EN 14752 – August 2015	Body side entrance systems for rolling stock

5 TERMS, DEFINITIONS AND ABBREVIATIONS

EN	EuroNorm
Rolling stock	Finished vehicle or trainset
Vehicle	Coach, locomotive or individual vehicle of a trainset
Finished vehicle	Coach or locomotive in final assembled state
Coach[4]	Trailer to carry passengers
Locomotive[5]	Traction vehicle for pushing or pulling rolling stock
Trainset[6]	Self-propelled fixed formation
Sub assembly	A unit assembled separately but designed to be incorporated with other units into a larger manufactured product. Examples – Roof section of a vehicle - Vehicle with fitted windows and doors but without interior linings
CCTV	Closed-circuit television
HVAC	Heating, ventilation and air-conditioning

6 SPECIFICATIONS

Not applicable

[1] Comité Européen de Normalisation / European Committee for Standardization - www.cen.eu

[2] Comité Européen de Normalisation Électrotechnique / European Committee for ElectrotechnicalStandardization - www.cenelec.eu

[3] Union internationale des chemins de fer / International Union of Railways - www.uic.org

[4] Definition extracted from prEN17343

[5] Definition extracted from prEN17343

[6] Definition extracted from prEN17343

7 INSPECTION STRATEGY FOR WATER TIGHTNESS ROUTINE TESTING OF ROLLING STOCK

7.1 Water ingress routine testing: early detection and early recovery of process variations and operator error.

The existing landscape of testing specifications, regulations and processes is scattered, lacks an integral approach and is sometimes contradictory. Each supplier makes their own interpretation and implementation resulting in major differences in the way water tightness testing is implemented. The aim of this specification is to create uniformity, transparency and an integrated approach by combining best practices both on the side of regulation as well as implementation by the industry. As a basis the test process in EN 14752 is used.

The difficulty of water ingress routine testing is:

- Adequate simulation of realistic testing conditions representative for the operational conditions of the rolling stock within the limited time available in a manufacturing process.
- Reliable inspection / detection of the ingress.

The most common test method at the moment is to expose the test object to water using a test rig / shower consisting of a number of nozzles. Through determination of the number, positioning and type of the nozzles, the water pressure and the time the test object is exposed to the water, the test can be standardized in order to simulate realistic and repetitive conditions. See chapter 8 for the suggested test rig including parameters (Table 1).

The advised test and inspection concept is shown in Figure-2. Routine testing starts at component level, through sub-assemblies, vehicles and finally testing of a complete trainset or finished vehicle(s).

As already explained: the scope of this specification is limited to the Final test on a vehicle and a complete train.

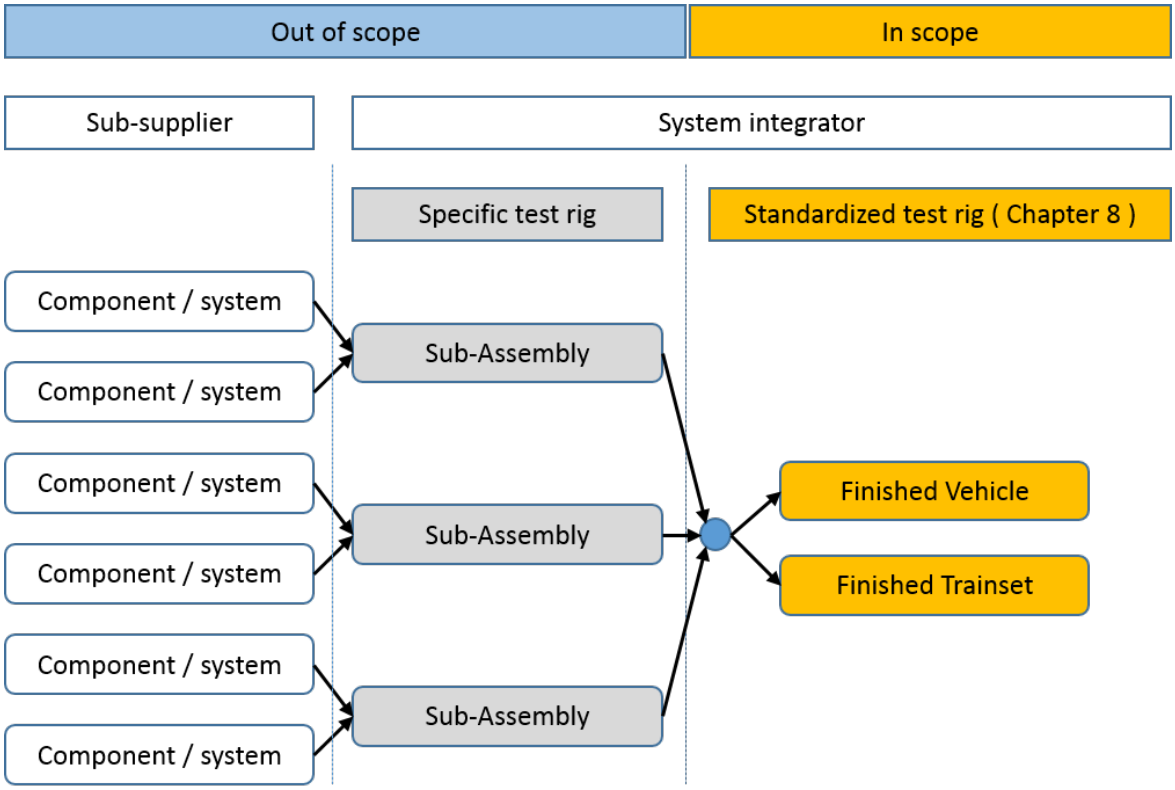


Figure-2 Test and inspection concept

Inspection is mainly done by visual inspection and occasionally by use of moisture detection equipment. Therefore, the area to be inspected has to be visible to the eye or at least be accessible by a small camera or endoscope. As a result of these limiting factors the conclusion should be that water ingress testing should be performed as early as possible in the manufacturing process as soon as water ingress critical parts or processes have been installed but still are uncovered by panels, linings etc. See chapter 9 for the advised inspection method.

The number of consecutive tests will be a result of the risk analysis and the accessibility for inspection.

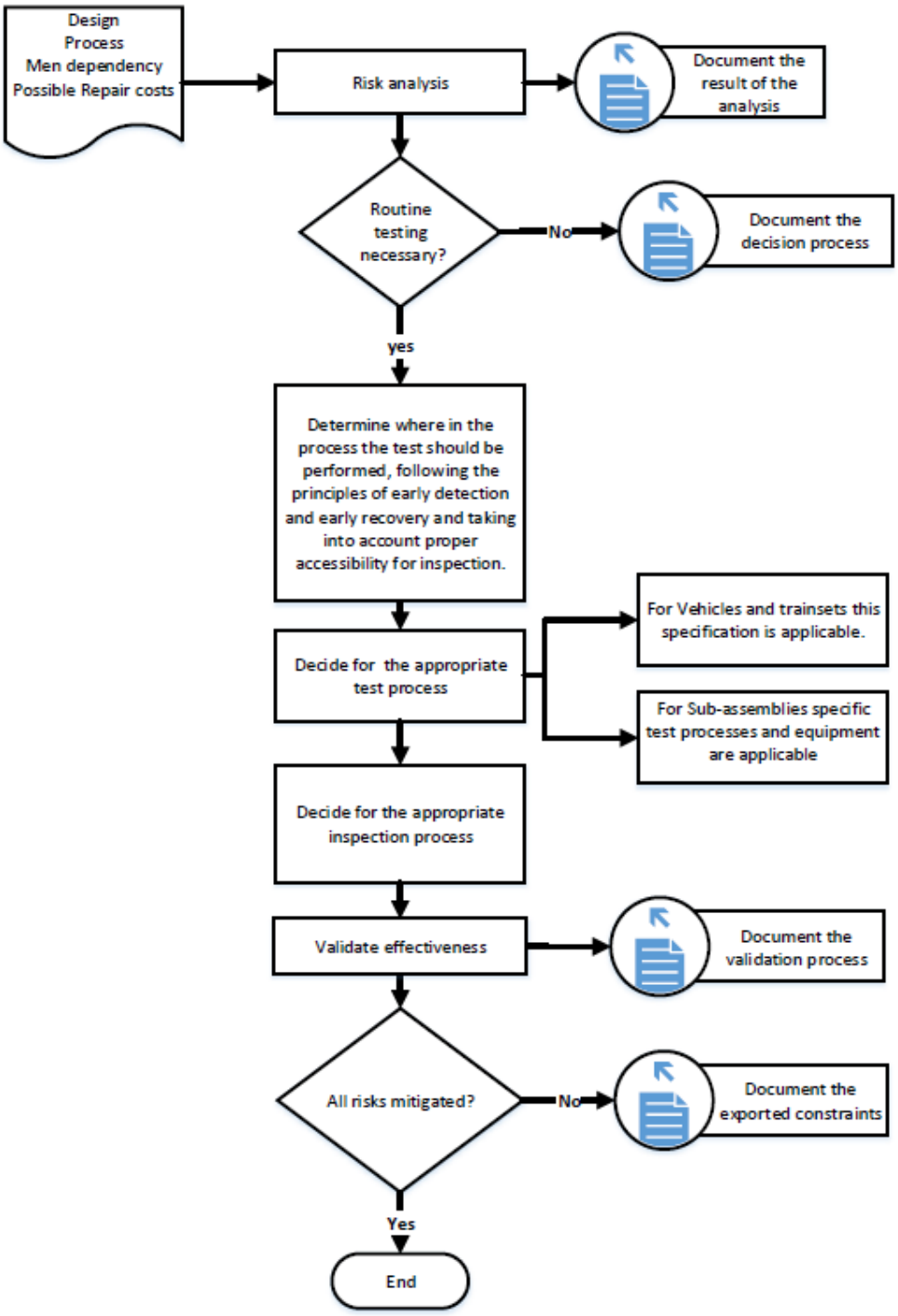


Figure-3 – Risk mitigation process

Figure 3 shows the steps to be followed and documented and should be followed for each assembly step as illustrated in Figure 1.

7.2 Repair, rework or final adjustments...

When reworks, repairs or final adjustments have been performed after the routine test has been executed it needs to be determined whether the outcome of the test is possibly affected. If yes, the test needs to be repeated. Either in its full extent or in an alternative, however representative way.

8 TEST ARRANGEMENT (for vehicle and complete train)

The rolling stock shall be complete externally with all relevant exterior fittings, equipment and covers.

The test shall be performed under the following atmospheric conditions:

- Temperature: ≥ 5°C

- Wind speed: ≤ 10 km/h

- Rain – no constraint

Measured temperature of rolling stock's outer surfaces shall be greater than 5°C.

Water used during tests need not be potable but shall be clean – range of the ph: 6 to 8. It is possible to recycle it only if the water is treated to keep the same quality.

The access doors are closed and locked as in service. If an active sealing (inflatable seal) is provided, it shall be disabled.

In case of test realised on a single vehicle of a trainset, conditions, and if equipped with gangways, gangways shall be closed with plates to prevent water ingress into the vehicle.

Testing shall not be carried out until all applications of sealants and adhesives have cured for a minimum of 24 hours.

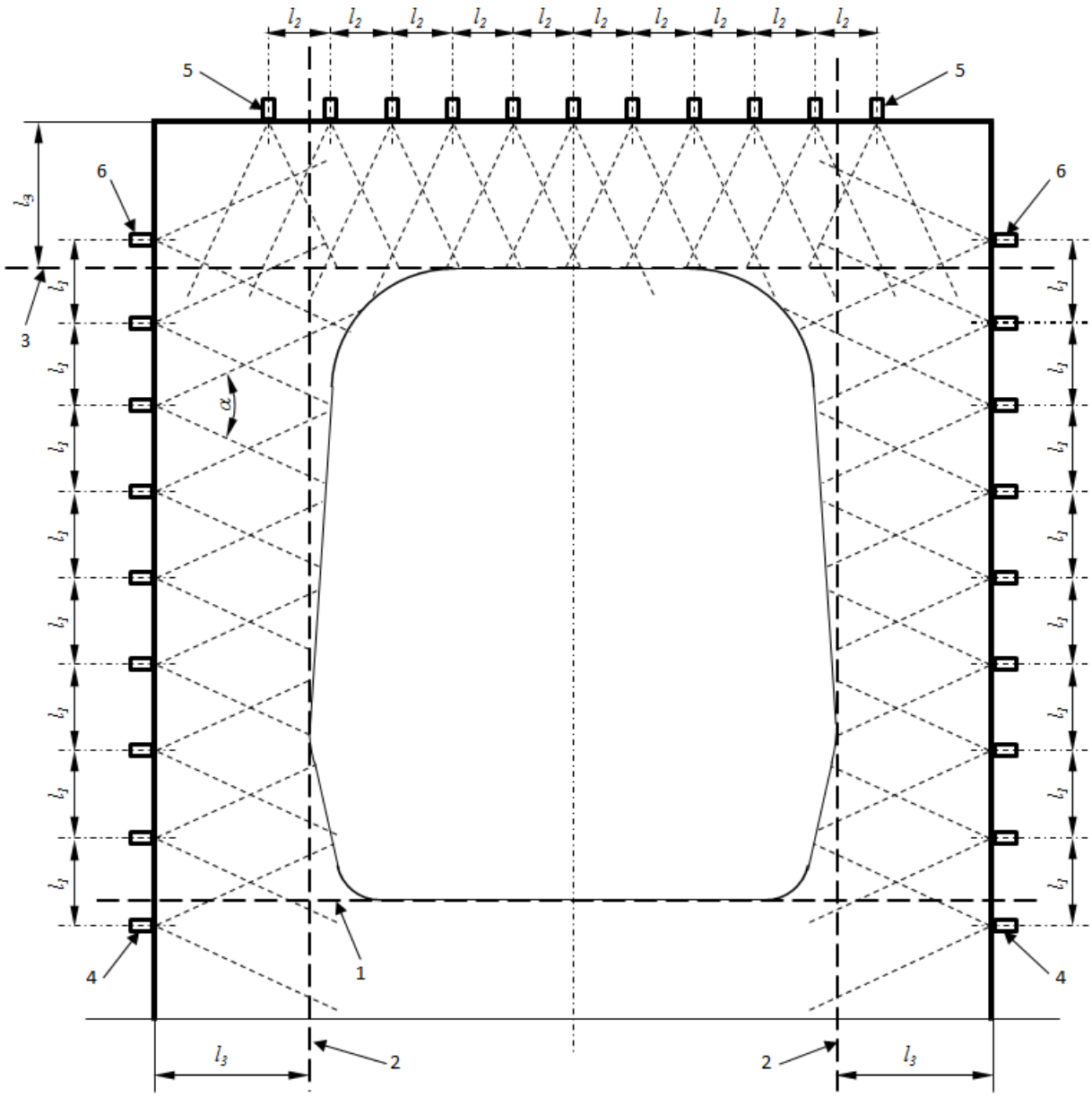
HVAC systems should not be working during tests.

Water pressure	(3 ± 0,5) bar
Flow rate/nozzles	(14 ± 2) l/min
Distribution of nozzles	side $l1$ = (500 ± 20) mm roof and front end $l2$ = (300 ± 20) mm (see Figure 4)
Distance to vehicle	$l3$ = (1 000 ± 50) mm $l4$ = (300 ± 50) mm
Spray pattern: Fan form oval	Fan angle: α = 50° ± 10° Maximum fan width: 200 mm at vehicle distance $l3$

Nozzles orientation	90 ° to the vehicle
Duration of test	One single passage with a pause of 3 minutes at each particular zone (door seal, junction between cab and carbody, etc …) [7]
Speed of longitudinal displacement	(3 ± 1) cm/s

Table 1 — Details concerning the water test

[7] To be confirmed or determined and documented in the risk analysis and test plan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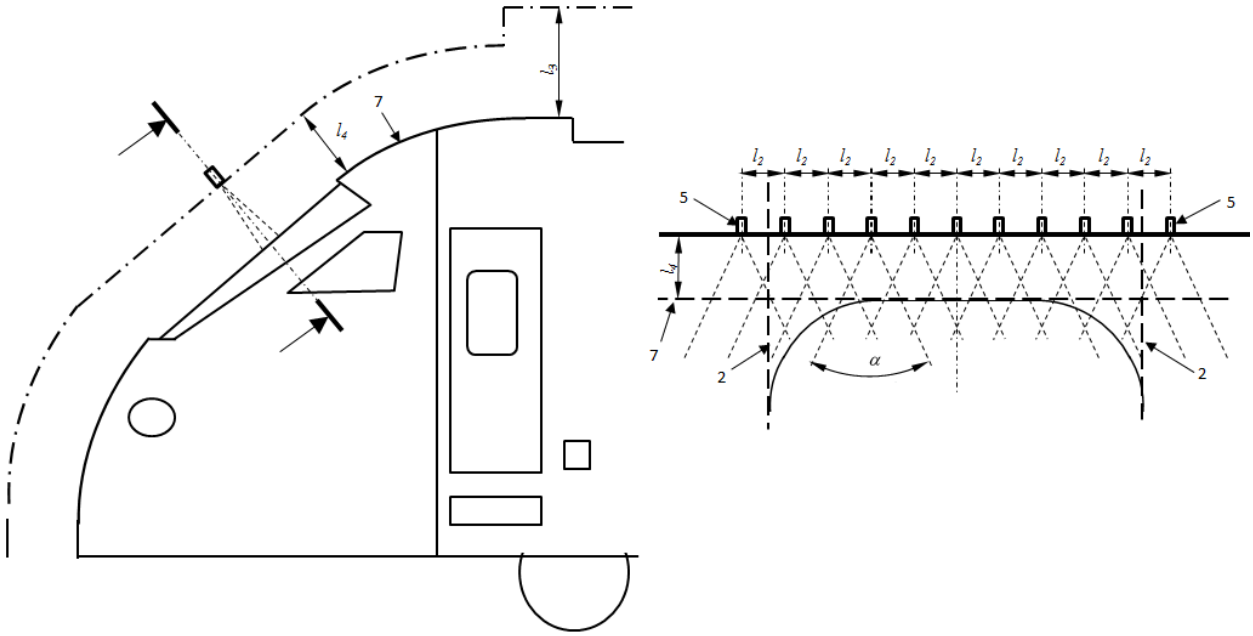

Figure 4 — Water test arrangement

Keys

1 Bottom of the body

2 Body sides

3 Top of roof

4 Nozzles below the bottom of the body

5 Nozzles outside the body sides

6 Nozzles above the roof

7 Front end

Note 1:

In order to have a spray pattern all over the surface ot the train:

1. the lowest nozzle (4) should be just below the lowest part of the train and the upper nozzle (6) just above the highest point. The exact position is the decision of the supplier.
2. in order to guarantee a stable distance between the nozzles and the front of the train, the horizontal nozzles should be able to follow the contour of the front (nose) of the train.

Note 2:

If a fully assembled cab is subjected at sub-assembly level to specific tests, front end tests are not mandatory.

INSPECTION AND CRITERIA

The inspection method shall be based on an inspection sheet. It shall be specific for the actual design of the rolling stock. An example is shown in Figure 5 and Table 2.The following elements are given as a guideline

An inspection for water ingress shall be carried out from the inside of the rolling stock during the duration of the test. The inspection position shall be in line with the position of the test rig.

Once the test has been completed, review the rolling stock X minutes (X to be determined based on the risk analysis) after completion of the test to ensure that no standing water is present and that no water has seeped in since the test.

The interior of every exterior box shall be checked after testing – if it is necessary to open them, carefully dry the covers (paper or cloth) to prevent water entering when the covers are opened.

Acceptance levels are given in Table 3.

During and after test, special attention shall be taken to items referenced on Table 2.

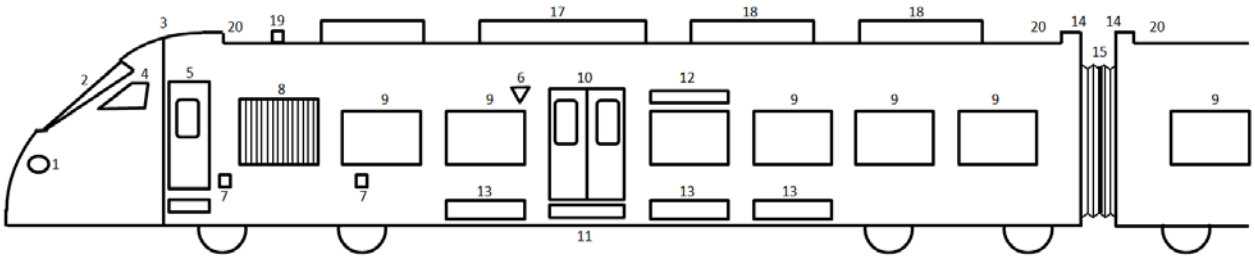

Figure 5 — Example of Trainset to test

	Item to check on Figure 4	Type of checking See Table 3	OK / NOK
1	Head, marker and tail lamps	3	
2	Front windscreen	3	
3	Cab to carbody seal	3	
4	Cab window	3	
5	Cab door	3	
6	CCTV cover, door indicator,..	3	
7	Sand box cover	3	
8	Ventilation louvers	1	
9	Passengers window	3	
10	Passengers access door	2 1 on the silland on the seals	
11	Movable step / Gap filler	1	

12	External display	3	
13	Under floor cover	3	
14	Gangway end to carbody seal	3	
15	Gangway to gangway	3	
16	HVAC	3	
17	Power pack	3	
18	Roof electrical box	3	
19	Antenna	3	
20	Roof drainage	1	

Table 2 — Sample Test result sheet

Type of checking	Description of the checking	Level of infiltration permitted
1	Visual inspection if it is possible, otherwise type of check N° 2 or 3	Puddles or drops
2	Wiping with hand showing tracks of humidity on a finger	Small traces of humidity
3	Wiping with blotting paper showing traces of humidity	No traces of humidity or seepage

Table 3 — Acceptance conditions

Inspection points and inspection criteria will always be depending on the design of the trains and its specific property's. Therefore it is advisable to review the acceptance conditions after the production and testing of the first 4-5 trains in order to incorporate practical experience..

During the test, the moisture contained inside the enclosure may partly condense. The dew which may thus deposit shall not be mistaken for an ingress of water.

9 APPENDIX

Not applicable.

10 BIBLIOGRAPHY

EN 50215 – April 2010	Testing of rolling stock on completion of construction and before entry into service
EN 60529 – October 1992	Degrees of protection provided by enclosures (IP code)
EN 16286-1 – May 2013	Gangway systems between vehicles — Part 1: Main applications
EN 12082 – September 2017	Axle boxes - Performance testing
NF F 01-492 – May 2013	Windows

EuroSpec

"EuroSpec" stands for European Specifications for railway rolling stock. The activity is an initiative of several European train operating companies (TOC). The main focus is on trains consisting of self-propelled carriages, using electricity as the motive power (EMU).

Paris, London, Munich (München), Utrecht, Vienna (Wien), Bern

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