

GUIDELINE

Verification in the application of the Clause 4.7 of EN 45545-2

Change index

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1. General

1.1 Introduction

In order to meet the safety objectives "personal protection" according to DIN EN 45545-1 [N01], DIN EN 45545 defines different measures. One of these measures defines requirements for materials in part 2 of DIN EN 45545 [N02].

It is very difficult to define general, normative requirements that include all possible and individual applications. This also applies to future designs. When preparing the DIN EN, the author of the standard was aware that components have to meet many different requirements, so that material requirements of DIN EN 45545-2:2013-08 [N02] cannot always be met, if additional requirements on the material (e.g. safety-relevant functional requirements) are contradicting. Therefore, Clause 4.7 of DIN EN 45545-2:2013-08¹ [N02] provides a possibility for materials that do not meet the requirements of Clause 4.2 to 4.5 of DIN EN 45545-2:2013-08 [N02] to be approved due to their functional necessity. However, the unconsidered use of materials should be avoided. Therefore, appropriate conditions for the use of the material and the verification were defined. This is intended to enable legally compliant use and to limit the scope for interpretation.

This guideline provides information on the performance of a step-by-step analysis for the application of Clause 4.7 of DIN EN 45545-2:2013-08 [N02]. The use of Clause 4.7 of DIN EN 45545-2:2013-08 [N02] is applied to components that shall be used in rail vehicle construction due to their functional necessity.

The guideline is in accordance with the CSM Regulation².

The exact definition and the resulting requirements for compliance with Clause 4.7 can be seen in the following figure.

¹ With regard to the application of Chapter 4.7, the output versions DIN EN 45545-2:2013-08 [N02] and DIN EN 45545-2:2016-02 [N03] are identical, so that the procedure described here can be applied to both standard versions.

² Implementing Regulation (EU) 2015/1136 of the Commission of 13 July 2015 amending Implementing Regulation (EU) No. 402/2013 on the common safety method for the evaluation and assessment of risks with the correction of Implementing Regulation (EU) 2015/1136

4.7 Products to be approved on functional necessity

If it can be shown that any of the requirements specified above are not technically achievable with functionally suitable products, then existing commercially available products can be used until and unless a suitable product is developed. There shall be no requirement to consider products made available after the date of the contract.

The use of this paragraph has the following conditions:

- essential requirements in 4.1 shall not be compromised;
- this shall be verified by assessment; taking the proposed design into consideration; including the functional reason and limitation for using the material in question (e. g. climate and/or infrastructure).

NOTE It can be necessary to use this process in respect of products such as:

rubber tyres; rubber suspension components; intercommunication gangways, electronics devices on printed board, flexible metal/rubber units; window seals; seals for doors; brake hoses; pneumatic hoses; flexible fuel hoses; high voltage cables; data bus cables, the anti-spall layer for windscreens on the driver's cab, windscreen washer water containers.

Figure 1 - Clause 4.7, DIN EN 45545-2:2013-08, Source [N02]

1.2 Definition of terms

1.2.1 Functionally suitable and necessary

A functionally suitable component is defined according to DIN EN 45545-1 [N01], 3.25 as follows:

“functionally suitable product is one which will meet the required static, dynamic and mechanical properties for use in the specified operating environment, (e. g. temperature, chemicals, humidity) and have a life consistent with normal industry maintenance schedules”

1.2.2 Customary

Customary components are:

- available on the rail vehicle market and have been tried and tested for the specific application³ as well as suitable and used in accordance with the up to now national regulations;
- from suppliers with agencies, distributors or sales opportunities within the scope of the European Economic Area.

1.2.3 Date of contract

Date of the contract between the contractor (for vehicle manufacture/maintenance/rebuilding) and the customer (e. g. operator, leasing company).

1.2.4 Vehicle owner

Vehicle owner is the natural or legal person who, as the owner or legal entity of the vehicle, uses a vehicle as a means of transport . The vehicle owner is responsible for the safe state of the vehicle.

³ See e.g. TSI LOC&PAS (1302/2014/EU) clause 7.1.1.5

1.2.5 Railway companies

Railway companies (RCs) are public institutions or private legal entities providing railway transport services⁵. The RCs carry the responsibility for the safe operation of vehicles.

1.2.6 Vehicle manufacturers

The vehicle manufacturer is responsible for the overall production of the vehicle. In the event of modifications or rebuilding work, the responsible company can become the vehicle manufacturer.

1.2.7 Component manufacturers

Designer and manufacturer of a component consisting of materials which they do not produce themselves. The vehicle manufacturer is also a component manufacturer for in-house designs or directly purchased materials.

1.2.8 Material manufacturers

Manufacturer of individual materials/raw materials.

⁴ see 2008/110/EG (Railway Safety Directive)

⁵ see General Railway Act (AEG)

2. Evaluation scheme

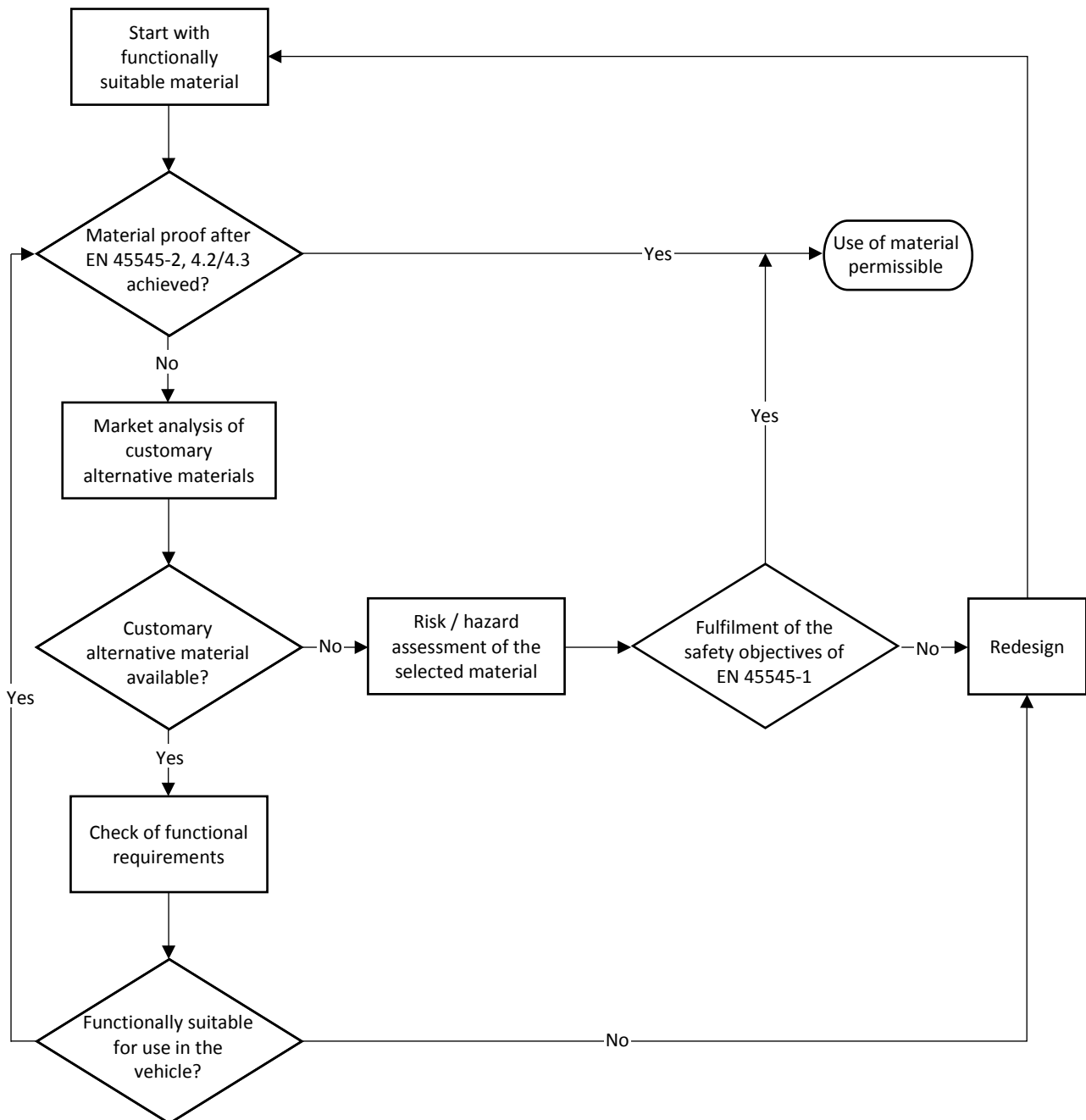


Figure 2 Flowchart evaluation scheme

3. Procedure

3.1 Component description

In the first step, the component⁶ is explained, which should be used based on its functional necessity.

The following criteria are necessary with regard to the component description:

- Functional description of the component.
- Description of the installation area of the component.
- Description of the intended accessibility of the installation area for staff, passengers and third parties.

In addition, the following criteria should be taken into account:

- Identification of maintenance- / servicing intervals with regard to the life time of the vehicle.
- Further component properties, if applicable.

3.2 Description of the requirements in the specific application case

3.2.1 Set of requirements

The sets of requirements to be applied according to DIN EN 45545-2 [N02] chapters 4.2 and 4.3 shall be determined. These support the assessment within the scope of the risk analysis.

3.2.2 Safety objectives

In clause 4.1 of DIN EN 45545-2 [N02], safety objectives are specified as follows:

The design of rolling stock and the products used shall incorporate the aim of limiting fire development should an ignition event occur so that an acceptable level of safety is achieved.

If the objectives defined in Clause 4 of EN 45545-1:2013 are met, then there should be a high probability that in the event of a fire, passengers and staff will be able to escape from the fire unaided and be able to reach a place of safety.

Note: According to the scope of application of DIN EN 45545-1 it has to be considered that it does not fall within the scope of DIN EN 45545 to describe measures which ensure the preservation of vehicles in case of fire and which go beyond what is necessary for the protection of passengers and personnel.

The rail vehicles are assigned to the respective operating and design categories in accordance with Clause 5.2 and Clause 5.3 of DIN EN 45545-1 [N01].

⁶The term "component" used in this guide covers products, assemblies, components....

3.3 Market analysis

Another important measure is to carry out a market analysis for an alternative of the component to be used.

The alternative component shall meet the requirements defined as functionally necessary.

Market availability requires proof of suitability⁷.

The result of the market availability shall be documented.

Consideration of component and supplier qualification is necessary⁸.

Basic procedure for market analysis:

- Preparation of an inquiry drawing and a component specification with reference to compliance with EN 45545-2 [N02].
- Inquiry to suppliers with representations or distributors or distribution possibilities in the European Economic Area, from which the fulfilment or partial fulfilment of the component specification can be assumed. The following proofs for the functional requirements have to be requested:
 - Test results of fire protection tests of the material
 - Results of the tests of the defined functional requirements

3.4 Ignition model

The five ignition models to be considered are defined in EN 45545-1 [N01], Annex A and assigned to the following three different fire origin categories.

With regard to the performance of the risk and hazard analysis for the considered component, the relevant fire resulting risks with the associated fire ignition models has to be taken into account.

3.4.1 Accidental ignition or arson

This type of fire typically includes ignition of the component by newspapers, cigarettes and gas lighters. Normally, these areas are freely accessible to passengers, staff and third parties.

Ignition models 1 and 2 according to Annex A of EN 45545-1 [N01] shall be considered.

3.4.2 Technical defect

This type of fire typically involves the ignition of a component by an electrical defect and thus an overheating of the component.

The ignition models 3 and 4 according to Annex A of EN45545-1 [N01] shall be considered.

3.4.3 Major fire events

This type of fire event is larger than those described in chapter 3.4.1 and chapter 3.4.2. incipient fires.

⁷ This can include, for example, test certificates in the field and on the test bench.

⁸ This does not exclude the use of new suppliers.

The ignition model 5 according to Annex A of EN45545-1 [N01] shall be considered.

3.5 Risk / hazard analysis

The evaluation scheme for determination of a risk priority number in the risk / hazard analysis based on the standards DIN EN 60812 [N04] and DIN EN 50126 [N05] is suitable.

In order to confirm the statement regarding the necessity of using the functional component in rail vehicle construction, the following information, among others, shall be taken into account in the assessment:

- Definition of safety objectives according to DIN EN 45545-1 [N01];
- Design / operating categories of the vehicle and the derived hazard level;
- Set of requirements and, if possible, deviations from the limit values;
- Presentation of the results obtained under Chapter 3.1 "Component description";
- Demonstration of the fire behaviour of the components in the form of an analysis of the results of already performed fire tests (national or European fire safety standards);
- Similar to DIN EN 45545-1 [N01], a description of the potential ignition source is made in the installation area of the necessary functional component;
- Identification of risk minimisation measures;
- If necessary, further criteria have to be listed.

3.5.1 Evaluation scheme

The basis of the risk / hazard analysis for the functionally necessary components is an adapted evaluation scheme based on DIN EN 60812 [N04] and DIN EN 50126 [N05].

The classification for the application purpose is carried out according to DIN EN 60812 [N04] and is divided into the following categories.

- Severity / meaning **B**
- Occurrence / probability of occurrence **A** and
- Detection / probability of detection **E**

The abbreviation used for the categories correspond to those given in the specialist literature written in German.

The risk priority number **RPZ** for the evaluation scheme is determined by multiplying the three categories ($RPN=A \times B \times E$).

Table 3 of DIN EN 50126 [N05] provides the reference for the meaning **B**

Meaning / B	Criteria	Grade
	insignificant; possible, minor injury minor damage to the system	1
	marginal; minor injury and/or notable environmental threat serious damage to the system(s)	3

	critical; few fatal accidents and/or seriously injured and/or significant environmental damage, loss of a major system	5
	catastrophic; fatal accidents and/or numerous seriously injured and/or serious environmental damage	10

Table 2 of DIN EN 50126 [N05] gives the reference for the probability of occurrence **A**.

Probability of occurrence / A	Criteria	Grade
	unlikely; the occurrence is unlikely, but possible. It may be assumed that this danger only occurs in exceptional cases.	1
	rare; may sometimes occur during life cycle. It is advisable to be aware of occurring danger.	3
	occasional; may occur more than once. It is expected that danger occurs more than once.	5
	frequent; will occur frequently. The danger is always present.	10

The probability of detection **E** does not refer to the given Table 4 of DIN EN 50126 [N05]. The probability of detection was determined as follows.

Probability of detection / E	Criteria	Grade
	high; the incident is identified during formation in time by technology (BMA) or people.	1
	little; the incident is detected delayed or detected by secondary incidents (e. g. smoke, smell).	3
	unlikely; the incident is hard to detect	5

The evaluation of the risk priority number is carried out by introducing four levels. The three low levels differ by a factor of two. In order to strengthen the significance for "intolerable" all values greater than 60 are used. The denotation are also taken from DIN EN 50126 [N05], Table 5.

Risk priority number	Value range	Category	Consequence
	> 60	Intolerable	shall be excluded

A x B x E	60....31	Undesirable	may only be accepted if a risk reduction is practically not feasible and an agreement of both, the railway company and the responsible supervisory authority for safety and security is available
	30....16	Tolerable	acceptable with suitable monitoring and with the consent of the railway company
	15....1	Negligible	acceptable without further approval of the railway company

3.5.2 Installation situation

Explanation of the component description (see also chapter 2.1 and chapter 2.3 of the document) with the following information:

- Combustible mass;
- Installation area;
- Ignition sources in the installation area;
- Accessibility of the source of the fire (enclosure yes/no);
- Fire detection system/monitoring system;
- Fire-fighting system.

3.5.3 Implementation of the risk / hazard analysis

Execution of the risk / hazard analysis in relation to the functionally necessary components in the installation area.

- Showing the results of the available test certificates;
- Presentation of the ignition model;
- If necessary, pointing out compensation measures⁹;
- Influence on the required running capability of the vehicle;
- Probability of occurrence: Operating experience with burning components in the installation space (frequency of fires);
- Justification of the values selected in each category and determination of the RPN.

⁹Normatively required systems do not serve as compensation measures, but can be used, for example, within the framework of the risk assessment should be taken into account in the probability of detection.

4. Responsibilities

For the procedure described in Chapter 3, particular preparatory work is required for each evaluation step. In principle, the company placing the product on the market is responsible for the completeness and consistency of the documents in relation to the whole product. During the preparatory work, a distinction shall, however, be made between the companies which are responsible for the integration of the component in the end product, design and material selection of a component, and the production of the material. It can happen that a company is simultaneously responsible for several tasks.

The following table shows the responsibilities for the various evaluation steps. It also defines who is responsible to support the respective evaluation step with information and input.

The market analysis takes place at the respective direct supplier level.

Table 1 Overview responsibilities

Involved company Evaluation step	Vehicle manufacturers		Component manufacturers		Material manufacturers	
	Responsible	Support	Responsible	Support	Responsible	Support
Component description		X	X			X
Requirements in specific application	X			X ¹⁰		
Market analysis		X	X			X
Ignition model	X			X ¹¹		
Risk- /Hazard analysis	X			X ¹²		

Examples are given in the annex.

¹⁰ For project-independent evaluations, the component manufacturer can define requirements.

¹¹ For project-independent evaluations, the component manufacturer can define the ignition model.

¹² For project-independent assessments, the component manufacturer shall make assumptions about the risks and installation conditions in the vehicle.

5. Annex

Designation	File name
Assessment according to clause 4.7	Evaluation_acc_clause_4_7.xlsx

6. Standards and directives

Ref. No.	Name	Title	Issue
[N01]	DIN EN 45545-1: 2013-08	Railway application – Fire protection on railway vehicles – Part 1: General	2013-08-01
[N02]	DIN EN 45545-2: 2013-08	Railway application – Fire protection on railway vehicles – Part 2: Requirements for fire behavior of materials and components	2013-08-01
[N03]	DIN EN 45545-2: 2016-02	Railway application – Fire protection on railway vehicles – Part 2: Requirements for fire behaviour of materials and components	2016-02-01
[N04]	DIN EN 60812	Analysis techniques for system reliability Procedure for failure mode and effects analysis (FMEA)	2000-04-01
[N05]	DIN EN 50126	Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 1: Basic requirements and generic process	2006-11-01