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The European Fire Safety Standard CEN TS 45545

Railway Interiorsexpo Amsterdam November 2008

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Introduction

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Situation in the beginning :

-National Railway companies were responsible for operation and certification

-Each country had different levels and used not comparable test methods of fire safety regulations

-The relationship between national operators and suppliers was stronger than today

-Each country defended its own national methods and the related test equipment

Introduction

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Working Process on the Fire Safety Standard

First stage :

- Agreement on the content of the seven parts
- Reaching common targets against the different opinions of national experts
- Develop common test methods and fire safety levels

Second stage :

- Description of development objective to CEN Starr
- Test of most critical scenarios inside FIRESTARR
- Change of responsibility from national operators to national safety authorities

Introduction

Final stage：

- Redesign of all 7 parts according to fire safety guideline issued by FIRESTARR
- National enquiry of prEN 45545 part 1, 3, 5
- National voting of parts 1, 3 and 5
- Harmonising the standards with measures for TSI (HS, RST and SRT)
- Redesign of all parts as technical specification
- Comment review meeting of TS 45545 part 1 to 7

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Main show stoppers :

- Delay of FIRESTARR project
- Change of the Fire safety behaviour in accordance with TSI (RST, HS, SRT)
- Non consistent delegations of experts at the working groups

Introduction

Finally :

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Fire protection of railway vehicles

May 2008 : Positive vote

Introduction

Future :

EUROPEAN STANDARD

EN 45545

“Fire protection of railway vehicles”

History

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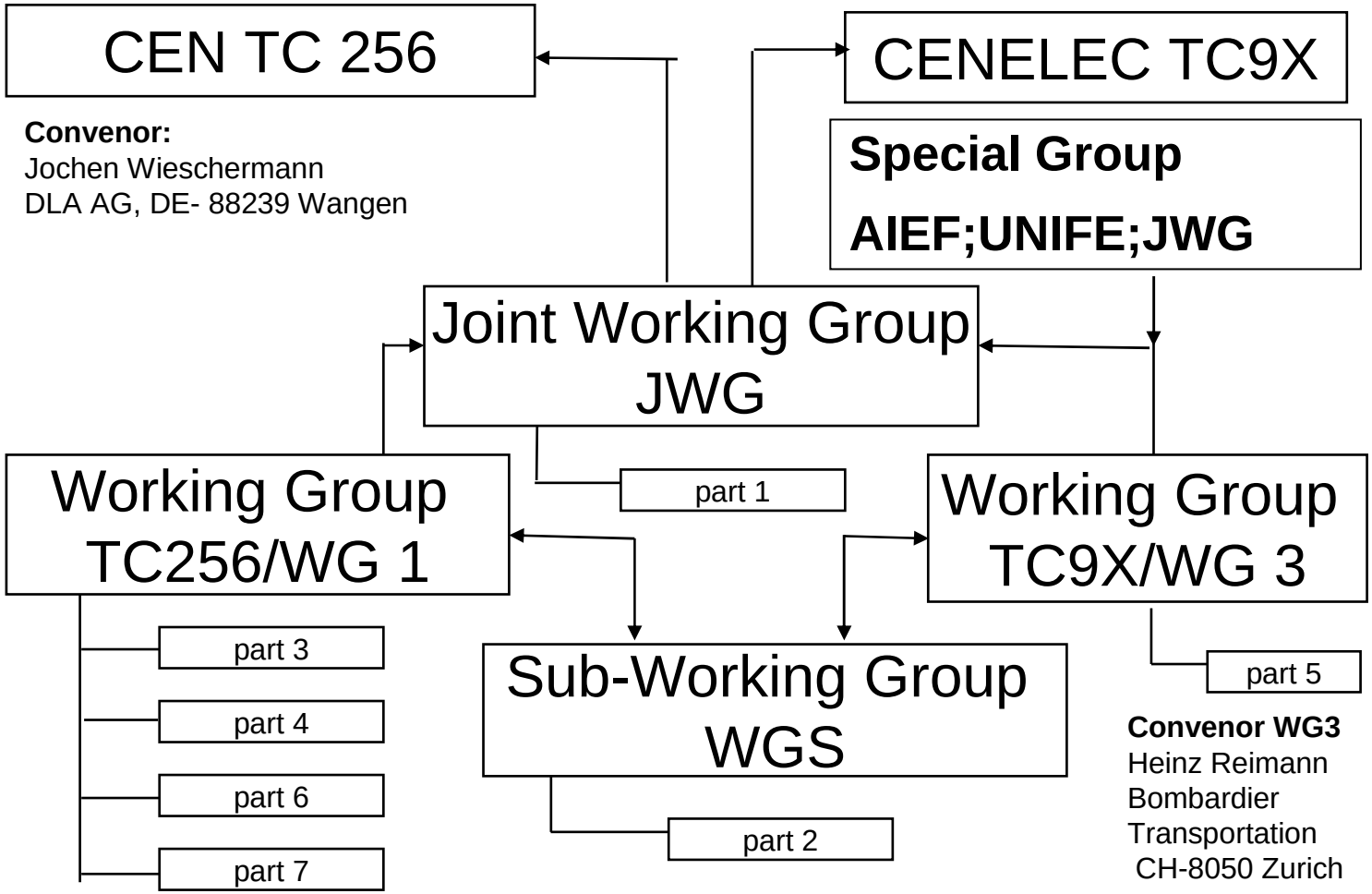
Founding of JWG :

The Joint Working Group was founded from

- CEN TC 256 Working Group 1
- CENELEC TC 9X Working Group 3

History


CEN TC 256
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CENELEC TC9X
Special Group
AIEF;UNIFE;JWG
Joint Working Group
JWG
part 1
Working Group
TC256/WG 1
part 3
part 4
part 6
part 7
Sub-Working Group
WGS
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Working Group
TC9X/WG 3
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History

Support to the development of the European Standard ‘Fire protection of railway vehicles’

FIRESTARR PROJECT

History

The FIRESTARR project was a European Commission funded research program

- established 1997

- assist: Joint Working Group in drafting part 2

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Scope of the EN 45545

This European Standard specifies:

- measures on railway vehicles for fire protection
- verification of these measures

The objective of the measures and requirements specified in this European Standard is to protect passengers and staff in railway vehicles in the event of a fire on board.

It is not within the scope of this standard to describe measures which ensure the preservation of the vehicles in the event of a fire.

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CEN TS 45545 : Scope of the parts

- part 1: General
- part 2: Requirements for fire behaviour of materials and components
- part 3: Fire resistance requirements for fire barriers
- part 4: Fire safety requirements for railway rolling stock design
- part 5: Fire safety requirements for electrical equipment
- part 6: Fire control and management systems
- part 7: Fire safety requirements for flammable liquid and flammable gas installations

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Definition of railway vehicles

Railway vehicles in this standard are:

- locomotives
- multiple units
- coaches
- light rail vehicles
- underground vehicles
- Trams
- trolley buses (only in relation to the electrical equipment);
- magnetic levitation vehicles

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Objectives of the standard

The objectives are considered in the context of the operation categories and design categories where appropriate in train sections.

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Objectives for the following possible scenarios

- Fire resulting from accident or arson

Typical ignition models involving newspaper, matches, cigarettes and gas lighters shall be taken into consideration in any position freely accessible to passengers and staff.

- Fire resulting from technical defects

Ignition models, comparable to electric arcs or abnormal temperatures shall be taken into consideration.
The effects of any flammable gases or flammable liquids which may be present shall also be taken into account.

- Fire resulting from larger ignition models

To reduce the hazards to passenger and staff, the following requirements, which are defined in all parts of this technical Specification, are intended to cover cases with bigger ignition models e.g. passenger clothes or passenger luggage.

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General Objectives for CEN TS 45545

General	The objectives of this standard is to minimize the risk of a fire starting and fire spreading within railway vehicles and their effects on passenger and staff and to offer, as a consequence, the best level of protection against the occurrence of a fire on board
Objective 1	Minimising the risk of a fire starting in passenger and staff areas of railway vehicles by accident or arson

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General Objectives for CEN TS 45545 (continued)

Objective 2	Minimising the risk of a fire starting as a result of technical defects on railway vehicles.
Objective 3	Allowing for the safety of passengers and staff on board railway vehicles, in such cases where objectives 1 and 2 do not give an acceptable level of protection.

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EN 45545 Part 1, General

This Part of CEN TS 45545 covers :

- Principal definitions
- Operation categories
- Design categories
- Fire safety objectives
- General requirements for fire protection measures and their evaluation of conformity

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Operation Categories for Railway vehicles

Operation category 1:

Vehicles that are not designed or equipped to run on underground sections, tunnels and/or elevated structures and which may be stopped with minimum delay, after which immediate side evacuation to a place of ultimate safety is possible.

Remark : Annex B defines the infrastructure

Operation Categories for Railway vehicles

Operation category 2:

Vehicles that are designed or equipped to run on underground sections, tunnels and/or elevated structures with side evacuation available and where there are stations or emergency stations that offer a place of ultimate safety to passengers, reachable within a short running time.

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Operation Categories for Railway vehicles

Operation category 3:

Vehicles that are designed or equipped to run on underground sections, tunnels and/or elevated structures, with side evacuation available and where there are stations or emergency stations that offer a place of ultimate safety to passengers, reachable within a long running time.

Operation Categories for Railway vehicles

Operation category 4:

Vehicles that are designed or equipped to run on underground sections, tunnels and/or elevated structures, without side evacuation available and where there are stations or emergency stations that offer a place of ultimate safety to passengers, reachable within a short running time.

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Design categories

All vehicles are classified due to their design as follows:

- A: Vehicles forming part of an automatic train having no emergency trained staff on board
- D: Double decked vehicles
- S: Sleeping and couchette vehicles
- N: All other vehicles (standard vehicles)

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Ignition models within the scope of the standard (Annex A)

- Flaming source with 3 minutes duration and average power output of 7 kW generating an flux of 25 to 30 kW/m^2.
- A radiant flux of nominal value 25 kWm^{-2} applied to an area of 0,1 m^2.
- A radiant flux of nominal value 50 kWm^{-2} applied to an area of 0,1 m^2.
- Flaming source of power 1 kW and 30 sec. duration.
- A flaming source generating a radiant flux of nominal value in the range 20 – 25 kWm^{-2} applied to an area of 0.7 m^2 with an average heat of 75 kW for a period of 2 minutes followed immediately by a flux of nominal value in the range 40 – 50 kWm^{-2} applied to the same 0,7 m^2 area with an average heat of 150 kW for a period of 8 minutes.

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Requirements for fire behaviour of materials and components

The content of part 2 is:

- Functional description of the fire safety objectives
- The generic material classes and the requirement classes
- Test methods according to the generic material classes
- Characteristic requirement of the system test
- Requirements in principle for selection of testing and test samples
- Interior material construction

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Relation between operation categories and design categories (Fire Hazard levels values)

Fire hazard levels values (HL 1 to HL 3) as a result from operation and design categories defined in part 1 shall take into account the different dwell times defined in part1.

Relations between operation categories and fire hazard levels (=HL)

Table

Design Category / Operation Category	N: Standard vehicles	A: Automatic vehicles having no emergency	D: Double decked vehicle	S: Sleeping and couchtette cars Double decked or single deck
1	HL1	HL1	HL1	HL2
2	HL2	HL2	HL2	HL2
3	HL2	HL2	HL2	HL3
4	HL3	HL3	HL3	HL3

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Evaluation of material reaction to fire

The 5 parameters for evaluation of reaction to fire are :

- Spread of flame;
- Ignitability;
- Heat release;
- Smoke;
- Toxicity.

And the fire behaviour is evaluated on materials and components, in end-use condition as far as it is possible.

The test methods are unique, taking in account the different material classes like:

- Structural surface related products
- Furniture products
- Electrical equipment
- Mechanical equipment

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Implementing compliant fire safety measures

- ➔The small scale test methods for testing the fire safety properties are checked to be in consistence with the real scale tests in the vehicle
- ➔The flame spread test is also used in the IMO regulation.
- ➔Smoke and Toxic measurement uses the European smoke chamber EN ISO 5659

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Test Methods

Material classes	Spread of flame	Ignitability	Rate of Heat release	Smoke	Toxicity
Interiors and exterior located products	ISO 5658-2 Radial panel	ISO 5660-1 Cone calorimeter		ISO 5659-2 NBS chamber	
Furniture products	Full scale product testing ISO 9705 Furniture calorimeter with level of vandalisation				
	—	Sample testing ISO 5660-1 Cone calorimeter		Sample testing ISO 5659-2 NBS chamber	
Electro technical products	ISO 4589-2 LO		—	ISO 5659-2 NBS	NFX70-100 or ISO 5659-2 NBS
Mechanical products	ISO 4589-2 LO		—	ISO 5659-2 NBS	NFX70-100 or ISO 5659-2 NBS
Non Listed products	ISO 4589-2 LO		—	ISO 5659-2 NBS	NFX70-100 or ISO 5659-2 NBS

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CEN TS 45545 : part 3, Fire resistance requirements for fire barriers

- Requirements and testing methods for fire barriers in railway vehicles
- The objective of this part is to protect passengers and staff in railway vehicles in the event of a fire on board by containing fire

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The following points shall be taken into consideration for the verification of functionality:

1. Origin of fire
2. Size of fire
3. Material involved in fire
4. Nature of detector
5. Air blow

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e. g. extract from table – Fire barrier requirements

No.	Fire Origin	Protected Location	Remarks	Operation category	Requirements
1	Under floor high power electrical cabinet containing supply or traction circuits expect brake resistor	Passenger and staff area including driver's cab	Tested in accordance with EN 1364-2 The requirement applies from the inside to the outside surface of the top of the box Where there is a requirement between the cabinet and the passenger or staff area there shall be a type A arc barrier CEN TS 45545-5 require a type A arc barrier to be fitted if an electric arc is possible during normal operation	1 – 4	E15
2	Under floor placed traction transformers or reactors filled with insulation fluid	Passenger and staff area including driver's cab	Tested in accordance with EN 1364-2 Whole cross section and 1 m longer than the object on each longitude direction Requirements are defined from underfloor to the top of the floor covering	1 and 2 3 and 4	E15 E15; I15
3	Underfloor combustion engine equipment (including heating equipment, fuel tank and pipe work)	Passenger and staff area including driver's cab	Tested in accordance with EN 1364-2 Whole cross section and 1 m longer than the objection each longitude direction Requirements are defined from underfloor to the top of the floor covering	1 and 2 3 and 4	E15 E15; I15
4	Underfloor	Passenger and staff area including driver's cab	Tested in accordance with EN 1364-2 Requirements are defined from underfloor to the top of the floor covering	1 and 2 3 and 4	No requirement E15

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CEN TS 45545 : part 4, Fire safety requirements for railway rolling stock design

This part specifies aims to protect passengers and staff in railway vehicles in the event of a fire on board by minimising the risk of a fire starting, delaying the fire development and aiding evacuation.

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Systems for running

For ignition models there is no significant risk for the strength of the body structure to enable the running capability.

For relevant ignition models, the following shall be demonstrated for vehicles of operation categories 2, 3 & 4:

Vehicles shall be designed in such way that, in the event of a fire on board, they will remain capable of running for a time or a distance to an evacuation point in accordance with CEN TS 45545-1 clause 6.

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The demands on modern design come from:

- Passengers
- Operators
- Certification authorities

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Additional demands come from:

- Styles
- Materials
- Shape opportunities of using standard equipment
- Types of tooling
- Finishing technologies
- Manufacturing
- Low cost
- Assembly concepts

All of these factors shall be taken into consideration

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CEN TS 45545 : part 5, Fire safety requirements for electrical equipment

This part specifies the objective of protecting passengers and staff in railway vehicles in the event of a fire on board by means of:

- Minimising the risk of starting a fire during operation and as a result of technical defect of the electrical equipment and wiring.

General requirements

- The normal electrical design requirements used for railway vehicles are supplemented by the design requirements of this standard.
- In addition to the design requirements of this standard, electrical equipment shall be designed to withstand the mechanical, electrical and thermal stresses which are likely to be encountered in operation. (see EN 50125-1).

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This part of the standard deals with the following design requirements for fire safety measures like :

- **Overload protection**
  - **Overload protection between current collectors (e.g. Pantograph) and consumers of a vehicle**
  - **Overload protection devices**
  - **Installation rules of the unprotected parts of circuits**
- **Integrity of connection**
  - **Electrical conductors**
  - **Temperature rise**
  - **Soldering instructions**
  - **Instruction for wire wrap techniques**
  - **Instruction for flat, quick connected terminations**
- **Wiring (rules for cable distribution)**
  - **Instruction for size of cables**
  - **Installation instruction for high power cables**
  - **Installation instruction for supply line cables**

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This part of the standard deals with the following design requirements for fire safety measures like :

- Enclosures
- Cable ducts
- Batteries and battery supply circuits
- Switchgear
- Electrical emergency equipment
- Bonding
- Resistors and heating equipment
- Locations exposed to current collection arcing
- Forced ventilated equipment
- Container filled with mineral oil

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EN 45545 Part 6 Fire control and management systems

Requirements for:

- fire detection
- alarm systems
- equipment shutdown
- fire fighting systems

The requirements specify aims to protect passengers and staff in railway vehicles in the event of a fire on board by:

- alerting staff and passengers to a fire
- delaying the fire development
- control the movement of smoke

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Table 1	Passenger Area	Sleeper compartment	Toilets	Staff area	Cooking or catering area	Technical cabinets	HVAC Unit	Combustion engines under the car	Electric traction equipment under car	Combustion engines inside	Electric traction equipment inside	Engine compartment on locomotives	Luggage Compartment
Design categories N&D								1		1	1	1	1
			2					2	2	2	2	2	2
	3		3				3	3	3	3	3	3	3
	4		4	4	4		4	4	4	4	4	4	4
Design categories S&DS	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4
Design category A								1	1	1	1	1	1
			2					2	2	2	2	2	2
	3		3			3	3	3	3	3	3	3	3
	4		4	4	4	4	4	4	4	4	4	4	4

Excluding remarks

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EN 45545 : part 7, Fire safety requirements for flammable liquid and flammable gas installations

This part specifies the objective of protecting passengers and staff in railway vehicles in the event of fire on board, by:

- Minimising the risk of fire during operation and as a result of technical defect.

This minimising of risk is valid for the installation of

- flammable liquid parts and
- flammable gas parts.

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EN 45545: part 7, General requirements

- In each area where flammable fluids, vapours or gases might escape by leakage, appropriate means must be available to minimize the probability of ignition as well as the resultant hazards if ignition does occur.
- Compliance shall be shown by analysis or tests.

Impact of approved CEN TS on national standards for fire protection

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Basis for the compilation of EN 45545

Legal Basis of the JWG

EC – Directives

- Council Directive 9648EC of 23 July 1996 on the interoperability of the Trans-European high-speed rail system
- Directive 200116EC of the European Parliament and of the Council of 19 March 2001 on the interoperability of the Trans-European conventional rail system

Impact of approved CEN TS on national standards for fire protection

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Relationship between EN 45545 and TSI

Annex ZA

(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 9648EC of 23 July 1996 on the interoperability of the European high-speed train network.

Impact of approved CEN TS on national standards for fire protection

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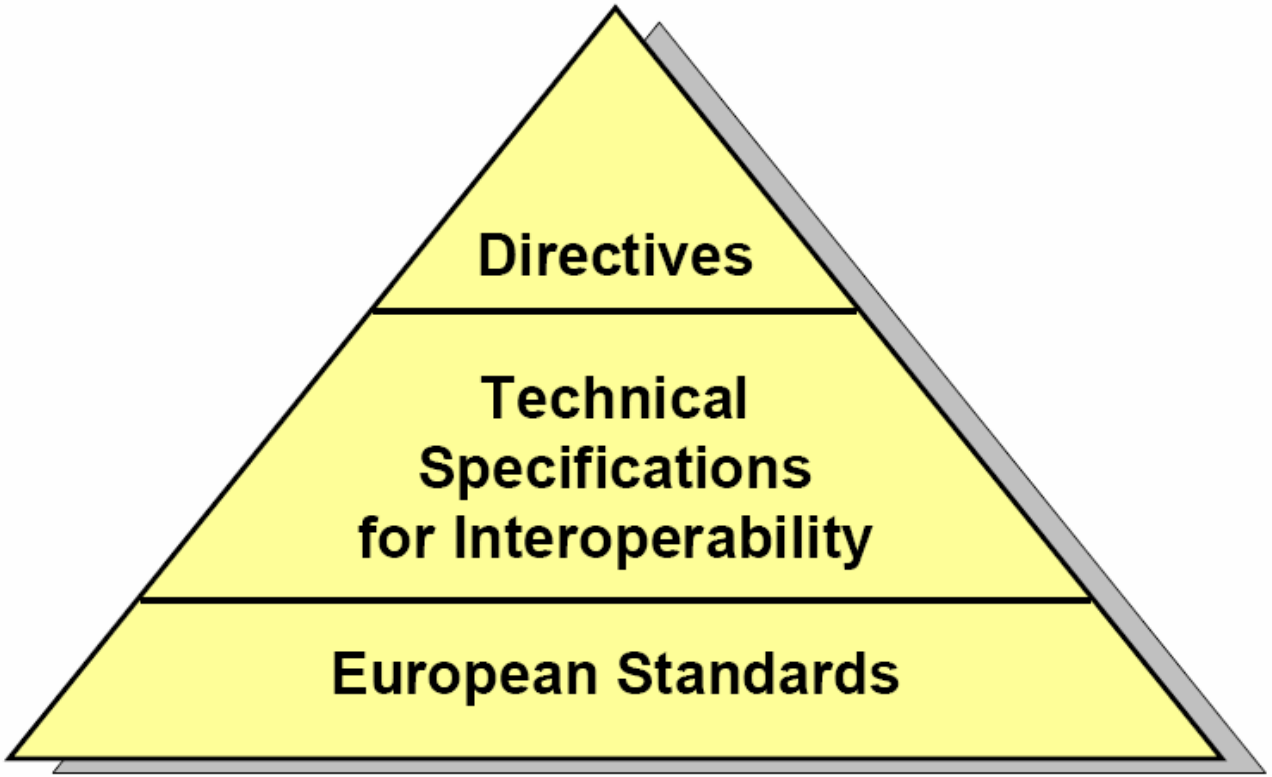
Legal Basis- Hierarchy



Economic impact of CEN TS 45545 on rail operators

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Balancing cost vs. benefit of CEN TS 45545

Kind of material in passenger area	Material properties	Test methods CEN TS 45545-2	Test methods National	Savings test costs % / €	Savings Sample preparation % / €
Horizontal downward and upward facing surface Surfaces within cavities; Walls - vertical surfaces	Flame spread Rate of heat release	EN ISO 5658-2 ISO 5660-1 50 KW /m^2	EDIN 54837; DIN 53438 ➔ DIN NFP 92-501; NFP92-503 ➔AFNOR UNE 23721 ; UNE 23723 ➔UNE UNI 8457; UNI 9174 ➔ UNI BS 6853 D8.5; BS476-6 ➔ BS	77	85
	Smoke and toxic gas emission	EN ISO 5659-2 + FTIR	EN ISO 5659-2 + FTIR ➔ DIN NFX10-702; NFX70-100-1➔AFNOR NFX10-702; ABD 0031 ➔ UNE NFX10-702; NFX70-100-1 ➔ UNI BS6853D3; BS6853 A2 ➔ BS	13350	3540

Economic impact of CEN TS 45545 on rail operators

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Balancing cost vs. benefit of CEN TS 45545

Kind of material in passenger area	Material properties	Test methods CEN TS 45545-2	Test methods National	Savings test costs % / €	Savings Sample preparation % / €
Floor composite interior	Flame spread Rate of heat release	EN ISO 9239-1 ISO 5660-1 25 KW /m2	EN ISO 9239-1; DIN 53438 ➔ DIN NFP 92-501; NFP92-503 ➔AFNOR UNE 23721 ; UNE 23723 ➔UNE EN ISO 9239-1; UNI 8457 ➔ UNI EN ISO 9239-1; BS6853 D8.4 ➔ BS	76	85
	Smoke and toxic gas emission	EN ISO 5659-2 + FTIR	EN ISO 5659-2 + FTIR ➔ DIN NFX10-702; NFX70-100-1 ➔AFNOR NFX10-702; ABD 0031 ➔ UNE NFX10-702; NFX70-100-1 ➔ UNI BS6853D3; BS6853 A2 ➔ BS	13050	3530

Pre-empting the economic impact of CEN TS 45545 on rail operators

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Balancing cost vs. benefit of CEN TS 45545

Kind of material in passenger area	Material properties	Test methods CEN TS 45545-2	Test methods National	Savings Test costs % / €	Savings Sample preparation % / €
Passenger seat	Ignitability Rate of heat release	EN ISO 9705 ISO 5660-1 25 KW /m2	DIN 54341; ➔ DIN UIC 564-2 A13 ➔ AFOR UIC 564-2 A13 ➔UNE UIC 564-2 A13 ; UNI 9175 ➔UNI BS 5852; BS 6853 D 8.5 ➔ BS	21	85
	Smoke and toxic gas emission	EN ISO 5659-2 + FTIR	EN ISO 5659-2 + FTIR ➔ DIN NFX10-702; NFX70-100-1 ➔AFNOR NFX10-702; ABD 0031 ➔ UNE NFX10-702; NFX70-100-1 ➔UNI BS6853D3; BS6853 A2 ➔ BS	2968	63860

Economic impact of CEN TS 45545 on rail operators

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Balancing cost vs. benefit of CEN TS 45545 Conclusions

By using harmonised Railway applications, international accepted test methods and standardised materials for all European countries, the cost savings of test costs and sample preparation for a passenger car homologation is 100.000.- Euro or a reduction of 76% of the actual costs for fire safety material certifications.

Economic impact of CEN TS 45545 on rail operators

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Balancing cost vs. benefit of CEN TS 45545 Conclusions

By using the EN 45545

- The homologation process according fire safety measures for the different European countries will be more efficient.
- The laboratories for material test can reduce the test equipment and have a possibility for cost reductions
- The passengers are assured that they have the same safety against fire impact in trains all over Europe

New input for the final standard EN 45545

- Change from CEN-Standard procedure to a CEN TS
- Implementation of a special group (JWG/AEIF) for discussion of the standard text
- Restart of CEN-standard after carry out of CEN TS

New input for the final standard EN 45545

European Fire safety Standards CEN TS 45545

After the negative vote of the majority of the European member states of part 1 and part 3, the analysis shows, that the following arguments shall be taken into account.

- Ask for an advisory team containing CEN/CENELEC and AEIF responsibilities
- Word description of the operation categories in addition with the description of the interfaces to the infrastructure
- Eliminate the hazard levels
- Complete revision of part 3
- Technical specification
- The whole technical specification shall be voted completely

New input for the final standard EN 45545

Guidance from Chairman and secretariat of CEN/TC 256 on new procedure with the JWG – documents:

- work only on the English version until November ‘06
- final versions have to be agreed by the JWG
- Part 5 is closed as a TS
- all parts are closed as TS
- May 2008 positive vote on complete CEN TS 45545
- start of the implementation stage

New input for the final standard EN 45545

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Open Points :

After a resolution 17/04 the standstill is kept as the publication as TC is only an interim step before transformation of the whole series of TC into ENs. Therefore all 7 parts are changed into EN.

New input for the final standard EN 45545

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Open Points (continued)

- Support and guidance for toxicity testing methods.
- Checking both the individual and overall parts to achieve optimum security for persons in accordance with technical aspects.
- Consideration of system approaches for assessments according to Fire safety in Passenger vehicles.
- Assess the comments of pr TS
- Produce a transcript giving aid for a proposed end version off CEN TC 256

Actual Status

All parts of the TS 4545 have been accepted by the majority of the European national committees by an official vote.

JWG proposed the following activities :

-Give an application guide to all 7 parts of the TS 45545

-Consider the system aspects for cables according to fire safety in rolling stock

-Accreditation of Fire safety laboratories

New input for the final standard EN 45545

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Time frame :

- Publication from CEN TS 256
- Restart of EN (base TS) approximately one year later
- EN 45545 approximately 2010

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Thank you for your attention

Jochen Wieschermann