General Overview of the standard EN-45545

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Centre d'Ingénierie du Matériel
- Who are we?

Rolling Stock Engineering Centre

Part of the SNCF Rolling Stock Division, located at Le Mans

Over 70 years of experience in railway rolling stock engineering

250 technicians & engineers with cutting-edge technical skills covering 90 technological and scientific railway disciplines

Comprehensive know-how
Specification, support to development, design and installation of railway rolling stock and its equipment,

Assistance to project management for all rolling stock
Know-how upgraded by analysis of operational feedback and technology watch

Clients: Operators - Manufacturers - Equipment suppliers - Rolling stock and wagon operators - Wagon owners - Organising Authorities - Institutional bodies - Infrastructure managers
What we do

Centre d’Ingénierie du Matériel
Rolling Stock Engineering Centre

Technical responsibilities

• Project Management
• Safety and braking equipment
• Diesel engine
• Bogies and bearing equipment
• Propulsion and energy conversion
• Body structure and interior fittings
• Systems engineering and transverse functions
What we do

**Centre d'Ingénierie du Matériel**
Rolling Stock Engineering Centre

**Services**
- Procurement and refurbishment of rolling stock
- Assessment and diagnostics
- Functional and technical standards drafting
- Safety equipment integration and qualification
- Verification of component compliance with standards & regulations
- Assistance and advice for rolling stock design and homologation

*All engineering services available with* EURAILTEST & masteris
Fire safety for rail vehicles - Summary

- Development chronology
- Overview of prEN45545-1 to 7
- Next steps
- Technical Specifications for Interoperability from ERA
- Conclusions
Overview of prEN45545-1 to 7

→ EN 45545: Railway applications — Fire protection on railway vehicles

→ in 7 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 including that of trolley buses, track guided buses and magnetic levitation vehicles
  → Part 6: Fire control and management systems
  → Part 7: Fire safety requirements for flammable liquid and flammable gas installations
Overview of prEN45545-1 to 7

- Operating Conditions
  - Part 1

- Materials
  - Part 2

- Train Design
  - Part 4
  - Part 5
  - Part 7

- Fire Safety
  - Fire Detection
  - Fire Suppression
    - Part 6

- Barriers
  - Part 3
Overview of prEN45545-1

EN 45545 Scope states:

‘The measures and requirements specified in EN 45545 are intended to protect passengers and staff in railway vehicles in the event of a fire on board. The protection of passengers and staff is essentially based on measures to:

- prevent fires occurring due to technical faults and due to equipment design or vehicle layout
- minimise the possibility of ignition of materials installed on railway vehicles due to accidents or vandalism
- ...

The ultimate objective in the event of a fire on board is to allow passengers and staff to evacuate the railway vehicle and reach a place of safety.

It is not within the scope of EN 45545 to describe measures that ensure the preservation of the vehicles in the event of a fire beyond what is required to fulfil the objective to protect passengers and staff’

- Note: I have used Bold to Highlight Key Points
Overview of prEN45545-1

- Objectives:
  ‘… to minimize the probability of a fire starting, to control the rate and extend of fire development and through this, to minimize the impact of the products of fire on passengers and staff’

- Considers
  - Fire resulting from accidental ignition or arson
  - Fire resulting from technical defects

- Key Features
  - Ignition Models
  - Vehicle Classification using Operation Categories Design Categories
Overview of prEN45545-1

- Ignition Model 1 - ‘...typical ignition source due to arson or vandalism, for example newspapers or rubbish, a flaming source is 3 min duration and average power output of 7 kW generating a flux of 25 to 30 kW/ sq m’ (The paper cushion)

- Ignition Model 2,3,4 increasing in size

- Ignition Model 5 – ‘...more severe than ignition models 1 to 4, for example luggage fires, and arson. For these fires the ignition model is a flaming source generating a radiant flux of nominal value in the range 20 to 25 kW/ sq m’ applied to an area of 0,7 sq m with an average heat of 75 kW for a period of 2 min...flux of nominal value in the range 40 kW/ sq m’ to 50 kW/ sq m’ applied to the same 0,7 sq m area with an average heat of 150 kW for a period of 8 min. (‘a small suitcase’)

- Events Larger than Ignition Model 5 – ‘The requirements...in EN 45545 are intended to mitigate the effects of fires larger than (Ignition Model 5)’
Overview of prEN45545-1

 aç Operation Category 1 – ‘Surface Operation’
 aç No Tunnels/ Elevated Sections Longer Than 1 km
 aç Vehicle Can Stop Immediately

 aç Operation Category 2 – ‘Metro - Tunnel Operation’
 aç No Tunnels/ Elevated Sections Longer Than 5 km
 aç Side Evacuation Possible
 aç Max. Running Time – 4 minutes

 aç Operation Category 3 – ‘Inter-City Tunnel Operation’
 aç Tunnels/ Elevated Sections Longer Than 5 km (Up to 20 km)
 aç Side Evacuation Possible
 aç Max. Running Time – 15 minutes

 aç Operation Category 4 – ‘Metro - Tunnel Operation – Restricted Evacuation’
 aç No Tunnels/ Elevated Sections Longer Than 5 km
 aç Side Evacuation NOT Possible (London Underground Tube Operation)
 aç Max. Running Time – 4 minutes
Overview of prEN45545-1

- **Design Category**
  - 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).

- **Vehicle Classification**
  - Combines Operation Category Plus Vehicle Class
    - Operation Category 2/standard vehicle: 2 – N;
    - Operation Category 3/double decked sleeping car: 3 – DS.

- **EN 45545-2 Hazard Level – Combination of Operation & Design Category**

<table>
<thead>
<tr>
<th>Operation category</th>
<th>Design category</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td>1</td>
<td>HL1</td>
</tr>
<tr>
<td>2</td>
<td>HL2</td>
</tr>
<tr>
<td>3</td>
<td>HL2</td>
</tr>
<tr>
<td>4</td>
<td>HL3</td>
</tr>
</tbody>
</table>
Overview of prEN45545-2

- Requirements follow FIRST principles
  - Flame Spread
  - Ignitability
  - Heat Release Rate
  - Smoke Emissions
  - Toxic Gas Emissions
prEN 45545-2 Material requirements

- Based on 4 parameters that describe fire behaviour
  - Ignitability – spread of flame (CFE: critical flux at extinguishment)
  - Heat release (MAHRE)
  - Smoke (loss of visibility: DS4, VOF4)
  - Toxicity (CIT)

- 2 possibilities:
  - Listed products
  - Non-listed products
Overview of prEN45545-2

- Performance Requirements are classified according to vehicle hazard level (HL1, 2 or 3), and Product Class (eg Interiors IN 1/ 2 etc, Exteriors (EX), Furnishings (F), Electrical (E) and Mechanical (M))

- There are a number of application rules, and a flow chart for assessment of minor items

- Material Requirements (R1 – R26), are defined using a series of test methods, with different acceptance limits for Flame Spread/ Ignitability, Heat Release Rate, Smoke Emission and Toxic Gas Emissions

- Test Methods (eg T03.01) include
  - Standard ISO test methods (eg ISO 5658, 5659, 5660),

- Bespoke Requirements for Seats (EN 45545-2 Annex A & B), and Toxic Gas Emissions (EN 45545-2 Annex C) Tests
Overview of prEN45545-3

Fire Barriers

- Reduce the effect of a fire on other areas
- Provision of a place of safety on board.

Barrier Requirements are defined to give protection before evacuation (to increase RSET)

RSET: Required Safe Escape Time (given by Operation Category)
Overview of prEN45545-3

EN45545-3 Barriers
- manage Passenger/ Staff Protection from Key Fire Risks
- Reduce time at risk

Requirements Based on Existing Standard Test Methods

Requirements follow a pattern Ex lx
- E – Integrity, or burn through time
- I – Insulation performance
- (x – requirement in minutes e.g. E15 I15)

Requirements vary based on Operation Category
- Least Onerous for OC1
- Most Onerous for OC3 - long tunnels mean extended time at risk.
Fire Resistance Test

Train Vehicle End

Fire Test Heating Curve

ISO - 834, Cellulolic, Buildings

\[ T = 20 + 345 \times \log(t + 1) \]

Temperature [°C]

Time [min]

SNCF
Overview of prEN45545-4

EN45545-4 gives a comprehensive design ‘Code of Conduct’ to minimise the risk of a Fire Starting in Non-Electrical Applications

Key Topics:
- Running Capability (Refers to EN50553)
- Emergency Exits
- Evacuation and Escape Measures
Overview of prEN45545-5

EN45545-5 gives comprehensive design ‘Code of Conduct’ to minimise the risk of a Fire Starting in Electrical Applications

Key Topics:
- Management of risk areas for key equipment.
- Electrical Overload Protection
- Protection from Electrical Arc
- Requirements for Cabinets/ Ducting
Overview of prEN45545-6

- Historically, Fires on trains are Detected and Reported by Passengers and Staff. – This remains the usual situation

- EN45545-6 requires more comprehensive Fire Detection systems than previously

- 9 Possible Detector Locations (e.g. Passenger Areas, Toilets, Technical Cabinets)
  - Requirement for Automatic Detection changes, based on Operational Category and Design Category

- EN 45545-6 defines requirements for Portable Fire extinguishers on trains

- (Note that EN45545-6 does not specify requirements for Automatic extinguishers on trains)
Overview of prEN45545-7

EN45545-7 specifies key requirements for management of flammable liquids on board trains

Key Areas include:
- Flammable liquid tanks and pipework requirements
- Requirements for Internal Combustion engines
Methodology used to convert TS into EN

- 2010: Enquiry to convert TS into EN + comments
- December 2010: Classification of comments in 3 categories
  - Class 1 (editorial) solution in step 1
  - Class 2 (technical) solution in step 1
  - Class 3 (technical) solution in step 2 (after approval of EN)
- Completion of tables of comments and final draft (done in January 2012)
- CRM by correspondence (done in March 2012)
- Translation to German and French (in progress up to August 2012)
- Formal vote enquiry (September and October 2012)
- Result? (7th November 2012)
Methodology used to convert TS into EN

- If Yes, publication by CEN (begin of 2013).

- Immediately after start revision process for the 7 parts to take into account:
  - “Class 3” comments
  - Technical comments resulting from the formal vote enquiry.
  - Results of transfeu
Conclusion/ my wishes

EN 45545 series will be published begin of 2013

Revision of EN 45545 series will start soon after publication

but revision subject area by subject area with an enquiry for the affected parts - in order to not have to wait 20 years more for the 2nd version!

For example:

- Subject area a) Transfeu results
- Subject area b) Seat testing
- Etc.
Thank you