Approval approach for Fire Safety on Rolling Stock in Germany

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TÜV SÜD Rail offers designers and manufacturers, authorities and operators a broad range of services in regard to the aspects of fire safety in railway systems.
Agenda

1. Historical review
2. Homologation in Germany (general)
3. Approval approach for Fire Safety
Introduction

General Railway Act (AEG, Allgemeines Eisenbahngesetz)
Railway Construction and Operations Act (EBO) – dated on 31.10.2006

§2 General Requirements

(1) Rolling Stock and railway equipment shall be designed such that they meet the requirements of safety and public order. These requirements are met when the Rolling Stock as well as the railway equipment meet the requirements of this Regulation and, insofar no explicit requirements are specified, the generally accepted codes of practice are fulfilled.

(2) A deviation from the generally accepted codes of practice is allowed if, at least, the same level of safety is provided as in compliance with these codes of practices.
The material verification requirements in respect to fire safety on rolling stock (passenger transport) was specified before 1988 in **TL 918 433** by Deutsche Bundesbahn.

At the time of Deutsche Reichsbahn there were requirements from different TGL and contractual arrangements.

The vehicles used in international passenger traffic, the requirements of OSShD and UIC were used.
The arson and the subsequent full scale fire of an S-Bahn train BR 472/473 in Hamburg Altona in 1980 led to a national standardization projects of DIN for fire safety for Rolling Stock.

„On 8 April 1980, there was in this new station to a fire disaster caused by arson at a seat in a car of the first Class. Through the fire, the station was significantly affected, the renovations of the completely smoke-blackened station withdrew many months.”
The fire safety for railway vehicles was regulated since 1988 in the standards DIN 5510.

The standard DIN 5510, part 2, was repeatedly published as a draft until its final completion in May 2009, and repeatedly revised.

The standard DIN 5510-3 part should be created at the beginning of the 1990's, but was not pursued because of the initiated harmonization on the European level (i.e. EN 45545).

The series of standards DIN 5510 remained an incomplete set of rules, the absence of Part 3 of this standard was compensated by application of UIC 564-2.
The first vehicles designed and manufactured according to the design principles of all available parts of DIN 5510 as well as the UIC 564-2 were the intermediate cars of the ICE 1.

The main innovation were:

- Definition of safety objectives
- Introduction of fire safety levels
- Seats have to be considered as a complete component for fire testing
- In case of composite materials, the end-use configuration shall be tested instead of each single material
- Floors, seats, wall and ceiling coverings shall be designed as flame retardant and self-extinguishing elements
Since the introduction of DIN 5510 no person died due to a fire on a railway vehicle, which was designed and produced according to the requirements of this standard.

However, spectacular fire events led to the further development of fire safety standards, especially at the international level (also in respect of their harmonisation).

06.11.2002 · Twelve people died when a fire broke out in the night train operated between Paris and Munich.
From the late 1990’s the first deficits of the standard series become obvious. The state-of-the-art made significant progress, but the development of national fire safety standards was prohibited due to harmonization projects.

To manage this challenge EBC released additional fire safety regulations called: “Fire protection on railway vehicles” Afterwards the EBA, VDV, VDB and DB AG elaborated further arrangements for “Fire safety assessment of rail vehicles in Germany”
In Europe the applicable fire protection standards for rolling stocks, including relevant requirements for the development, design and qualification, follow different concepts as well as national and historical aspects.

Based on varied approach and concepts of fire safety in respective country (e.g. fire risk due to vandalism or technical failure) adequate guidelines and test procedures have been established.
Agenda

- Historical review
- Homologation in Germany (general)
- Approval approach for Fire Safety
Homologation in Germany

EC directives for member states:
- EC-Directives e.g.
  - 2004/49/EG (SiRiLi)
  - 2008/57/EG (TopRiLi)
  - …

EC Regulations

Examples (extract):
- 352/2009 EC (CSM on Risk Evaluation)
- 2009/409/EC (CST Decision)
- 2002/735/EG (TSI RST HS)
- 2006/679/EG (TSI ZZS KV)
- 2002/731/EG (TSI ZZS HS)

National Laws

National Regulations / Authority Rules

Code of Practice / Standards

TEIV  AEG  EBO  VV BAU-STE  VV IBG  VV IST  UIC  SIRF  DIN/EN/ …
Reality in recent projects

YESTERDAY

- International agreements (COTIF, AGC, AGTC, etc.)
- International rules (UIC, RIV, RIC, EN standards)
- National rules
  With or without mutual recognition

TODAY

- TSIs
- European standards
- National rules
  + national laws and regulations

TOMORROW

- TSIs
- European standards
- National rules
Process and Procedure Overview

Europe
• EC-Verification of Subsystems
• EC Conformity Assessment of Interoperability Constituents
• Risk Management according to CSM Regulation (352/2009/EC)

National
• Procedure for the authorization of putting rolling stock vehicles into service according to VV IBG Fzg. (EBA) „Rolling Stock Approval“
  – Usage of e.g. „SIRF“ (National Safety Directive for Rolling Stock)
• Memorandum of Understanding

Multilateral Agreements:
• „Cross Acceptance“
Stakeholders and Responsibilities

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Administrative Regulation concerning the authorization for placing in service of rolling stock vehicles

Verordnung über die Interoperabilität des transeuropäischen Eisenbahnssystems (Transeuropäische-Eisenbahn-Interoperabilitätsverordnung - TEIV)

Ausbereitungsdatum: 05.07.2007

Verwaltungsvorschrift für die Genehmigung zur Inbetriebnahme von Eisenbahnbähren gemäß §§ 6 ff TEIV im Zuständigkeitsbereich des Eisenbahn-Bundesamtes (VV IBG Fahrzeuge)

Präsident
Eisenbahn-Bundesamt
Stand: 15.03.2010

Zuständigkeit:
- Referat 31 (IBG Teilsystem Fahrzeuge)
- Referat 33 (Bahnrügerzulassung nach Kapitel 6.6 RID)
- Referat 34 (Probefahrten mit Ausnahmen zur EBO)
- Referat 22 (Zurarbeit der IBG fahrzeugseitig Teil Teilsystem ZZS)

Fußnote


Erster Teil
Allgemeine Vorschriften

§ 1 Anwendungsbereich

(1) Diese Verordnung gilt für den aus der Annahme 1 ursprünglichen deutschen Teil des transeuropäischen Eisenbahnssystems mit den darin festgelegten Infrastrukturen und den auf diesen Infrastrukturen verkehrenden Fahrzeugen.

(2) Diese Verordnung gilt nicht für...
Homologation in Germany

• requirements splitted into 24 sections
  † Chapter 16: Fire-Safety and Evacuation

• requirements / standards / proofs / documentation are listed in checklists

• for each section:
  assessment report made by an EBA-accredited assessor
Brief Overview – EBA Procedure for Approvals

1. Provide Evidence
   - Evidence
   - Ass. Report
   - Techn. Section Dossier

2. Independent Assessment
   - Evidence
   - Ass. Report
   - Techn. Section Dossier

3. Assuring Internal Coherence
   - Evidence
   - Ass. Report
   - Techn. Section Dossier

4. Checked by Authority
   - Extensive Check of all Technical Dossiers acc. to Clearness and Completeness
   - Extensive Check of a selection of Technical Dossiers acc. to Traceability and Correctness

5. Vehicle Dossier Evaluation of internal Coherence

Applicant / Manufacturer

EBA-accredited Assessors

Safety Manager

Applicant

EBA
• Each Section / Department / Chapter (24 different Sections [„FG“]) has to setup a specific homologation (evidence or verification) plan (according to checklists)

• It has to include:

  • All planned validation/verification and homologation procedures
  • All planned homologation activities (commissioning tests, calculations, simulations etc.)
  • All involved parties, bodies or institutions (inspection bodies, laboratories, assessors etc.);
  • All involved EBA accredited assessors
  • Milestones and project schedules

These documents must be agreed by the NSA (EBA)!
Single Section (Chapter) Dossier

- A document showing for each section how the requirements are fulfilled and showing that the planned activities and evidence results have been achieved.
- It shall cover at least:
  - All documents giving evidence (test reports, etc.)
  - Results of the evidence (Vmax, fire protection class etc.)
  - Safety relevant conditions (e.g. operational restrictions)
  - All Input and Output Values (e.g. weight, passenger numbers, standards, external assessment reports)
  - Interfaces to other departments
  - Used parameters (assumptions etc.)

These documents must be agreed by the EBA-accredited Assessor.
Vehicle Dossier

- A document showing the fullfillment of all requirements for the entire vehicle assembly (subsystem rolling stock)
- It shall cover at least:
  - All applications for commissioning / type approval
  - All EC declaration of conformity / verification / technical dossiers
  - Derogations if applicable
  - Complete homologation plan(s) for all departments
  - All single dossiers for all departments
  - Complete interface assessment (internal coherence/compatibility)

This document must be agreed by the Safety Manager
Agenda

Historical review

Homologation in Germany (general)

Approval approach for Fire Safety
• **requirements:**
  "Fire safety assessment of rail vehicles in Germany"

• **Documentation:**
  – Fire Safety Concept  (incl. certificates for materials and components)
  – Evacuation Concept: Concept for Emergency Exit / Access and Rescue
  – assessment report of  EBA-accredited assessor
Requirements Fire Safety in checklist 2014 for chapter 16

| Requirement | TSI LOC & PAS | EC-verification | Assessment Report of EBA-accredited assessor | Other
|-------------|--------------|-----------------|---------------------------------------------|-------
| Yellow:     |              |                 |                                             |       
| White:      |              |                 |                                             |       
| Red:        |              |                 |                                             |       

TSI LOC & PAS has not been implemented yet
Requirements Fire Safety in checklist 2014 for chapter 16

- **Fire Safety Concept** (incl. certificates for materials and components)

- **National requirement:** "Fire safety assessment of rail vehicles in Germany"

- **Evacuation Concept:** Concept for Emergency Exit / Access and Rescue

- **National requirement:** *administrative direction for windows as emergency exit / access (VwV NEA)*
Fire Safety Concept

- Fire prevention measures
  - Fire protection technology
  - Material-specific fire protection
  - Organizational fire protection

- Measures to prevent the spread of fire
  - Sealed areas
  - Control measures
  - Fire detection technology
  - Prevention of fire breach

- Measures to maintain functionality
  - Driving capability
  - Running capability
  - Communication capability

- Fire-fighting measures
  - Technical equipment for active fire-fighting
  - Operational organization
  - Special notes for rescue personnel deployment
Concept for Emergency Exit / Access and Rescue

• Self Rescue / Evacuation:
  – Escape of affected people from an area with a working fire
  – Reaction depends on recognizing the danger
  – panic situations have to be avoided
  – On board staff has to initiate the self rescue process

• Rescue by Responders:
  – alarmed by operators staff
  – support self rescue, carry out fire fighting and technical rescue

• Sicherheitseinrichtungen:
  – Communication (bidirectional)
  – safe and reliable function of tools / tactics
“Fire safety assessment of rail vehicles in Germany”

Requirements:

- Putting into force CEN/TS 45545 parts 3 to 7 from 2009 with concretions (changes and addition)
- Defining requirements for all railway vehicles in Germany in respect to:
  - documentation
  - material requirements (can be proven acc. to CEN/TS 45545-2 or DIN 5510-2)
  - fire barriers
  - rolling stock design
  - electrical equipment
  - flammable liquid and gas installations
  - fire detection, fire containment and control systems
• Fire Detection, Fire Containment and Control Systems have to be proven acc. to “ARGE Guideline” parts 1 to 3:

  Part 1: “Fire detection in rolling stock”

  Part 2: "Fire fighting in Rolling Stock“

  Part 3: "System functionality fire detection and fire fighting systems in rolling stock"
Functional proof for alarm and control of system functions

- alarm functions such as
  - local alarm
  - transmission to staff
  - necessary shut off (i.e. ventilation)

- operating functions such as
  - monitoring of system state
  - error processing
ARGE Guideline Part 1 “Fire Detection in Rolling Stock”

Functional proof procedure for the positioning of fire detectors

- Tests for smoke detectors:
  - real scale tests in the vehicle under all possible operating conditions
  - fog from a fog machine with thermal lift
  - representing a burning paper cushion / beginning electrical ignition

Test layout with methanol container and stack – areas accessible to persons
source: ARGE Guideline
ARGE Guideline  Part 1 “Fire Detection in Rolling Stock”

• proof for thermal detectors:
  – for small installation spaces design specifications are given
  – for large installation spaces: simulation with a field model

• maximum detection time:
  – 60s for areas accessible for persons
  – 120s for electrical cabinets
  – 60s for areas with combustion engine
Functional assessment procedure for the effectiveness of fire fighting systems in rooms accessible to persons, electric cabinets and areas of combustion engines

proof of extinguishment with real scale tests in a representative mock-up

- electrical cabinets
  - beginning electrical fire represented by a stack of cables / a fire pan with heptane + toluene

- areas of combustion engines
  - spray fire at injecting line
  - pool fire in drip pan
  - pool fire above engine
ARGE Guideline Part 2 "Fire fighting in Rolling Stock"

- Rooms accessible to persons
  - burning passenger bag ignited with a paper cushion
    (bag can be represented with IMO cushions)
National Requirements for Railway vehicles in Germany

• EN 45545:2013
  (possibly addressed via a revision of “Regulations Fire Safety RST”)

• Fire Detection, Fire Containment and Control Systems
  (function / efficiency / reliability as safety related function)
  ⊥ ARGE Guideline
  (will possibly be replaced by the results for FCCS in future EN 45545)

• Emergency Exit Windows
  ⊥ Regulatory Directive for Windows as Emergency Exit and Access