Three have become one - RISE

The RISE institutes Innventia, SP and Swedish ICT have merged in order to become a stronger research and innovation partner for businesses and society.
Facts about RISE

- 2016 RISE had a turnover of just ≈ 250 MEuro
- 2,200 employees, 30% with a PhD
RISE Fire Research

- Staff: About 165 comprising 4 professors, 21 PhD:s, 10 PhD students, MSc:s, engineers and administrative personnel

Sweden (Borås laboratory)  Norway (Trondheim)
Outline

- Bus fires background

- Recent fire safety development
  - Interior materials
  - Fire suppression
  - Fire detection
  - Prevention/Safety management

- Ideas for further development
  - Toxicity
  - Fire detection
  - Protection of energy storage
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Background

In Sweden fires are reported for 1% of buses annually, and 10% of all buses are involved in a fire during their service life.

This means that, in percentage, about 5-10 times as many buses catch fire as do heavy goods vehicles.
Background

Start of bus fires 2005-2013 in Sweden, known cases

- Engine room: 71%
- Wheel well: 24%
- Interior: 4%
- Other: 1%
Background

Before 2004:
Approximately six to seven complete burnouts of buses each year in Sweden due to fires that started in the engine compartment.

2004:
Swedish insurance companies requested that all buses should be equipped with an approved fire suppression system in the engine compartment.

2004-2012:
No complete burnouts of buses due to such fires

Regulations and legislation works!
24.01.2018

BUS FIRE SAFETY – INTERIOR MATERIALS

Anja Hofmann-Böllinghaus
Fire causes

Fire origin: in 80 % the engine area

Electrical failure

Wheels
Statistics

Bus fires in Germany:
- every second/third day (own web search)
- 161 fires in 2009 in busses with insurance (GDV)
- approx. 350 – 400 Busse per year (PUPA 2010)

- Sweden: 80 busses (Swedish Transport Agency)
- USA: 0.8% per 100,000 busses (GBH International)

- Internal investigation of a German bus association: 1% of the busses per year
Fire safety standards

- Fire safety for buses: *EU guideline 95/28/EG*
- Fire tests: *FMVSS 302*
- Worldwide harmonized standard
- FMVSS 302 was developed in the 1960ties
Operation conditions

Operation conditions of buses and trains are widely comparable.

Bus interior materials were tested according to CEN/TS 45545-2.

Coaches and long distance trains

City buses and trams
Post-collision fires

- In U.S.A. 31 vehicle fires are reported per hour and these are responsible for around 300 deaths. These fires are involved in 12% of fire deaths.

- Trends indicate that the survivable collision energy will continue to increase and, at the same time, the probability of post-crash fires rises with the collision energy.

- As crashes are expected to become more survivable with advanced technology, fire events might become even more relevant.
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Ensuring fire safety in buses

Michael Först, Asbjørn Hagerupsen, Jan Petzäll

Belgium 2003
11 dead

US Texas 2005
24 dead

Poland 2005
12 dead

Switzerland 2006
3 dead
Problem: Regulation No. 118 – burning rate test

- (See documents GRSG 94-33, 94-17, 93-15, 92-18, 91-19, 90-32, 90-16, 89-33, 89-23, and 88-21)
- Test of horizontal flame spread (ISO 3795, FMVSS 302)

- The test only considers horizontal flame propagation, and contains additional technical shortcomings such as interrupted combustion when test object burns too fast and falls apart.
Are matches fire safe?
Solution: Proposed fire tests for Reg. No. 118

- Use of four established ISO/CEN tests, applied world-wide:
  1. Flame spread for surface linings
  2. Flame spread for floorings
  3. Test for production of smoke and toxic gases
  4. Measurement of heat release from a seat

- These are established test methods in transportation (e.g. trains – EN 45545-2)
- → Complying materials exist on the market
1. Proposed alternative test for Flame Spread

- Flame spread test for surface linings

- Criterion for trains: Critical Flux at Extinguishment ≥ 20 kW/m²
2. Proposed alternative test for Flame Spread

- European harmonised flooring test

- Criterion: Critical Heat Flux at extinguishment $\geq 6 \text{ kW/m}^2$. Same as for floors on trains.
3. Proposed test for Smoke and Toxic Gas production

- Smoke test and analysis of toxic gases

- Criteria: Requirements on smoke density and concentration of toxic species.
4. Proposed test for Seats

- Measurement of heat release

- Criterion: Maximum Average Rate of Heat Emission < 50 kW. Same as for seats on trains.
Observations

**Bus upholstered seat**
- Before fire
- After 20 sec
- After 2 min
- After fire

**Railway upholstered seat**
- After 20 sec
- After 5 min
- After 20 min
- After fire
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Conclusions

• Lack of requirements for an acceptable level of fire safety for interior materials. (Replacement of horizontal burning rate test with vertical burning rate test was however a step in the right direction.)

• This can be accomplished using established international fire tests, already used for train interiors. Therefore **complying materials already exist on the market**

• A proposed solution was presented in draft amendment to Reg. No. 118 in informal document GRSG 95-19.
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  - Protection of energy storage
Automatic fire suppression systems for engine compartments in coaches and buses: regulations and standards.

Presentation at GRSG 98, May 3-7, 2010

Asbjørn Hagerupsen¹, Jan Petzäll² and Michael Försth³

¹Norwegian Public Roads Administration
²Swedish Transport Agency
³SP Technical Research Institute of Sweden
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Regulations and legislation works!

Amendment of Regulation No. 107
Test method – a new approach

- New approach: Combine repeatable test methods with realistic fire scenarios

Identified properties which are important to include in the test:

- Complex geometry with many obstructions
- High air flow
- Multiple fire locations
- Different fire scenarios
- Hot surfaces with re-ignition potential
- Two parts of the project:
  - Fire suppression performance (finalized in 2013) → Amendment of Regulation No. 107
  - Fire detection capability (finalized 2016)
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SP method 5320 – testing of fire detection systems

- Test method for fire detection systems installed in engine compartments of heavy vehicles
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Preventive fire safety
Safety Management with regard to fire

P-certification for vehicle manufacturers, operators and service centers (workshops) with regard to fire safety

- vehicle manufacturer
- operator
- workshop
SPCR - Certification rules

SPCR 191 - Certification rules for operators with respect to vehicle fire safety

- Co-operation with IRU
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Gap analysis

Prevention, detection, fire hardening, prolonging tenability conditions in passenger compartment

Prevention, detection, suppression

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Focus on the production of toxic gases, starting from the side of the expected fire.
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Requirement for improved protection of energy storage (e.g. fuel tanks)
Acknowledgements

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THANK YOU, QUESTIONS?
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