busworld academy

KNOWLEDGE PLATFORM
FOR THE WORLDWIDE
BUS & COACH SECTOR

Fire prevention for bus and coach interiors

Kasturirangan Kannah, Chairman, FRAI

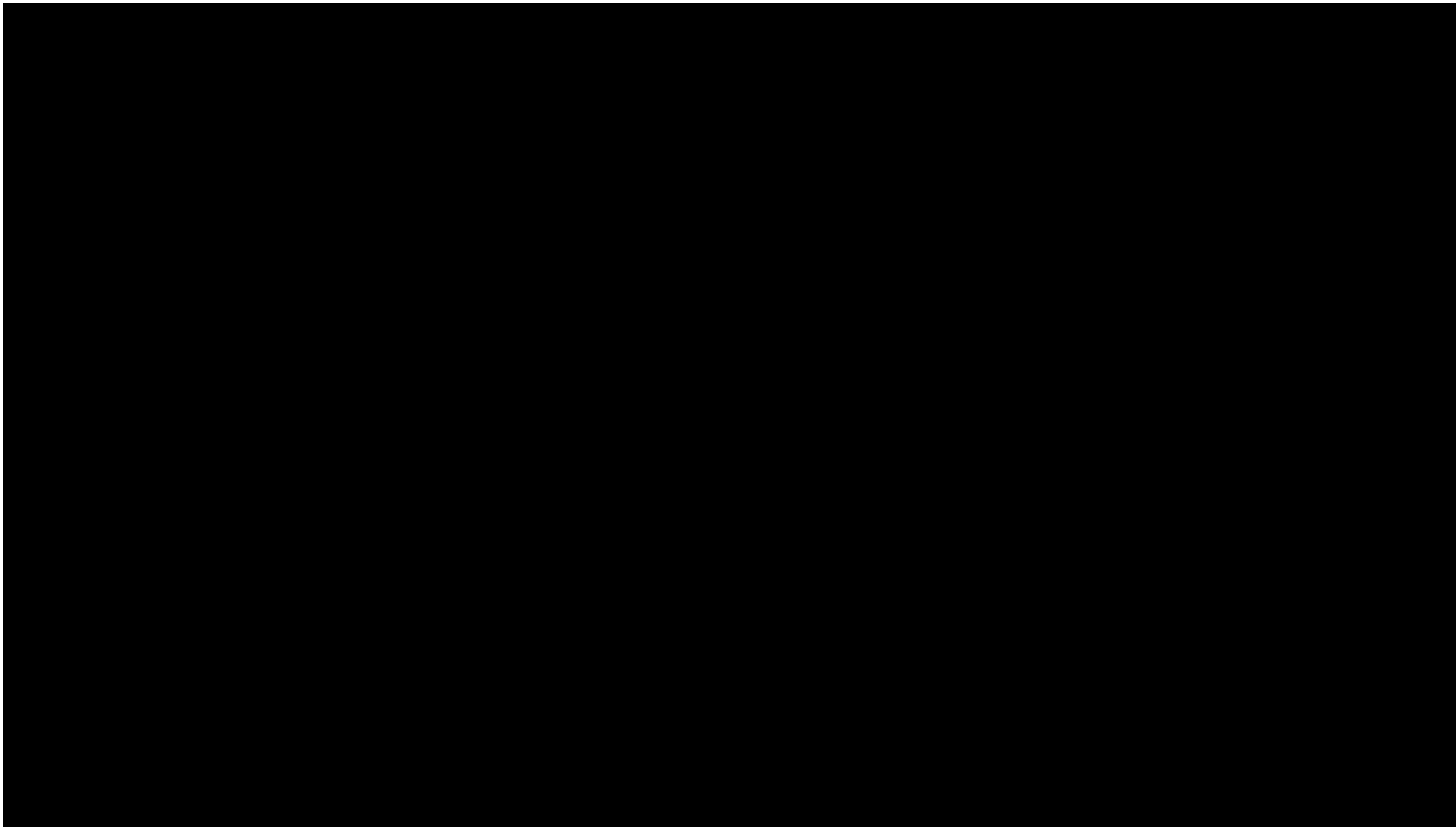
Fire prevention for bus and coach interiors

Kasturirangan Kannah,

Chairman, FRAI

Busworld Mumbai, 29th April 2015

Flame Retardants
Association of India



Contents

- Introduction
- Standards for bus fire safety – global context
- Fire safety standards for buses in India
- Gap analysis
- Hazard identification and Risk assessment
- Fire prevention - role of flame retardants
- Conclusions

Fire safety of buses and coaches

(slide courtesy Dr Jurgen Troitzsch, Fire & Environment Protection Services)

- A series of bus fire catastrophes in Europe (Germany, Nordic countries, China and India) has sensitized public opinion to improve fire safety
- Buses EU very low fire safety (MVSS 302 + vertical curtain + drip tests)
- Studies made on fire safety of materials and components meeting new railway requirements show that bus fires can be avoided or dramatically reduced
- Medium term adjustment of fire safety in buses to European railway requirements under discussion

Bus fire Hannover, November 2008

(slide courtesy Dr Jurgen Troitzsch)

- A German tour bus caught fire on a German highway killing 20 people, injuring 13 others
- Fire broke out in the bathroom of the bus due to electrical malfunction
- When the door was opened, flames shot out and quickly engulfed the bus
- The fire propagated so quickly because the materials’ fire safety level was too low

Hensies fire, Belgium, 2003

Flame Retardants Association of India

Hensies: 20.12.2003
11 deaths
37 passengers injuried

Hannover coach fire, Germany, 2008

Hannover : 4.11.2008
20 deaths
13 passengers injuried

Texas bus fire, 2005

Wilmer (Texas): 23.9.2005
23 deaths
? passengers injuried

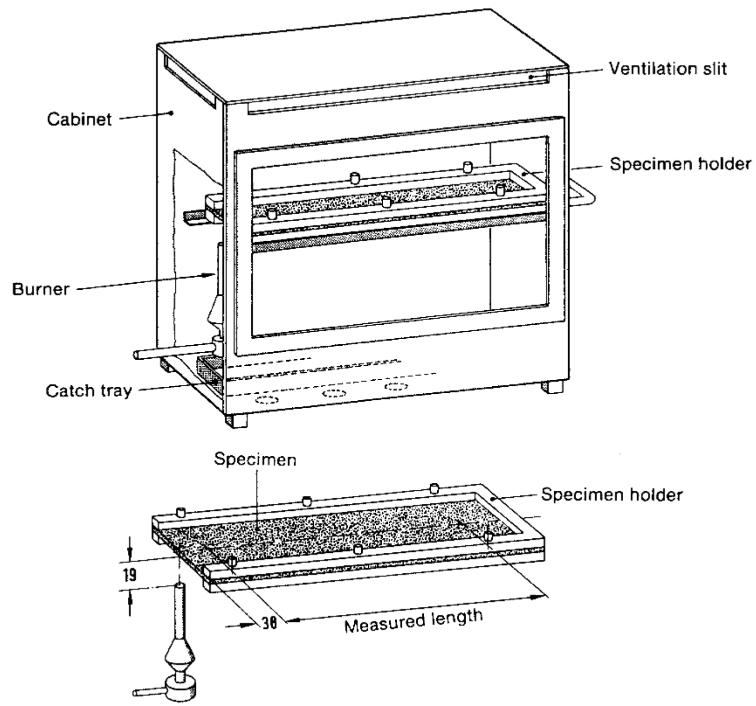
Bus fires - statistical review

(slide courtesy Dr Jurgen Troitzsch)

- 1.0 - 1.5 % of buses in Norway and Sweden are involved in a fire incident every year
- Largest risk of severe fire starting in engine compartment

What are the fire safety tests for buses used in Europe?

International Flammability
Test for Road Vehicles to FMVSS 302



US Safety Standard FMVSS 302 rate of flame spread test for motor vehicle interior components

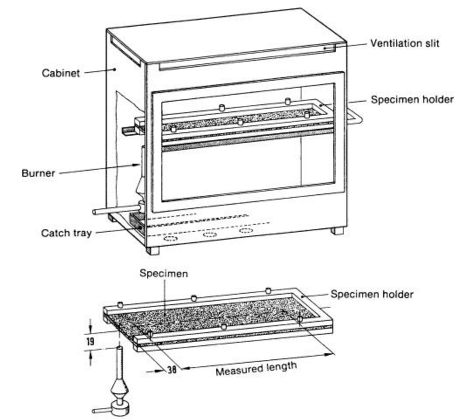
- Also ISO 3795, DIN 75200
- Car interior
- Bunsen burner 38 mm flame
- Horizontal flame propagation max. 100 mm/min or less

EU Flammability Tests for Buses to EU Directive 95/28/EC

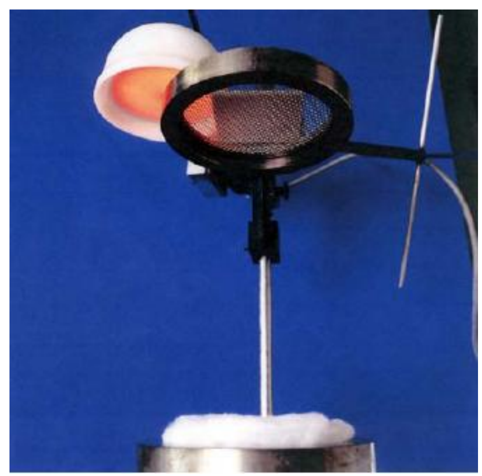
- **Interior materials**
  Horizontal
  to ISO 3795

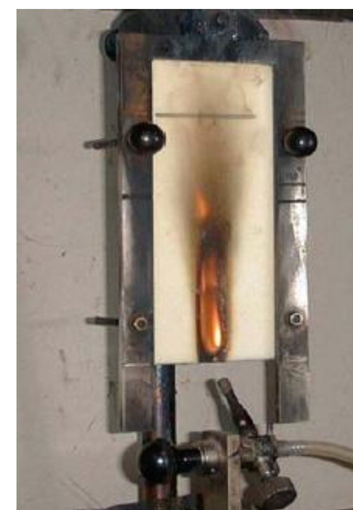
- **Curtains**
  Vertical
  to ISO 6940

- **Ceiling**
  Drip test
  to NF P 92-505



US Safety Standard FMVSS 302 rate of flame spread test for motor vehicle interior components





Fire safety standards for buses in India

India is a Member Country of WP 29 :

World Forum for Harmonization of Vehicle Regulations

(Working Party on General Safety Provisions (United Nations Economic Commission for Europe)

Prevailing standard in India IS 15061:2002 Automotive Vehicles – Flammability Requirements (as amended)

Superseded by UNECE Regs.118 and 107

Bus Body Code AIS 052 refers to above Standards for flammability requirements

A statement of the problem

Flame Retardants Association of India

Bus fire safety is still an issue globally

Experts consider fire safety standards for buses to be less severe than other forms of mass transport

Fire safety standards are often a reaction to accidents and take many years to be agreed and implemented

Meanwhile bus and coach travel needs to be safer

So we need solutions …

Fire safety in buses – practical considerations

Various stages of intervention

- **To prevent a fire starting in the first place**
- To avoid a fire which starts in the engine compartment (or smoke) to spread to the passenger compartment
- **To avoid the fire in the passenger compartment spreading rapidly and to reduce the fire load within the coach**
- To alert the driver as soon as a fire starts
- **To provide sufficient time and access for passengers to escape**
- To provide the driver and passengers a means to extinguish the fire

Each stage of intervention has its own solutions…

Gap analysis and measures to address

- IS 15061 needs updating to incorporate amendments to UNECE 118 & 107
- However, even the UNECE standards may not be robust enough
- **Standards creation / implementation process can be slow and unreliable**
- Therefore, a fire risk assessment could be conducted by OEMs to determine the risks posed by products and components in their coaches
- **Risk assessment should be a systematic process using relevant tools**
- For each identified risk, relevant mitigation measure should be specified
- Mitigation measures can include a process, product or material change or a change in design or layout ; it can also include a detection and suppression system or manual actions such as periodic maintenance
- **Fire prevention should be given priority through the use of less flammable products or materials**
- Critical hazards should be identified through risk assessment – fuel and lubricant lines and layout, thermal and acoustic insulation foams, cabling are just some examples

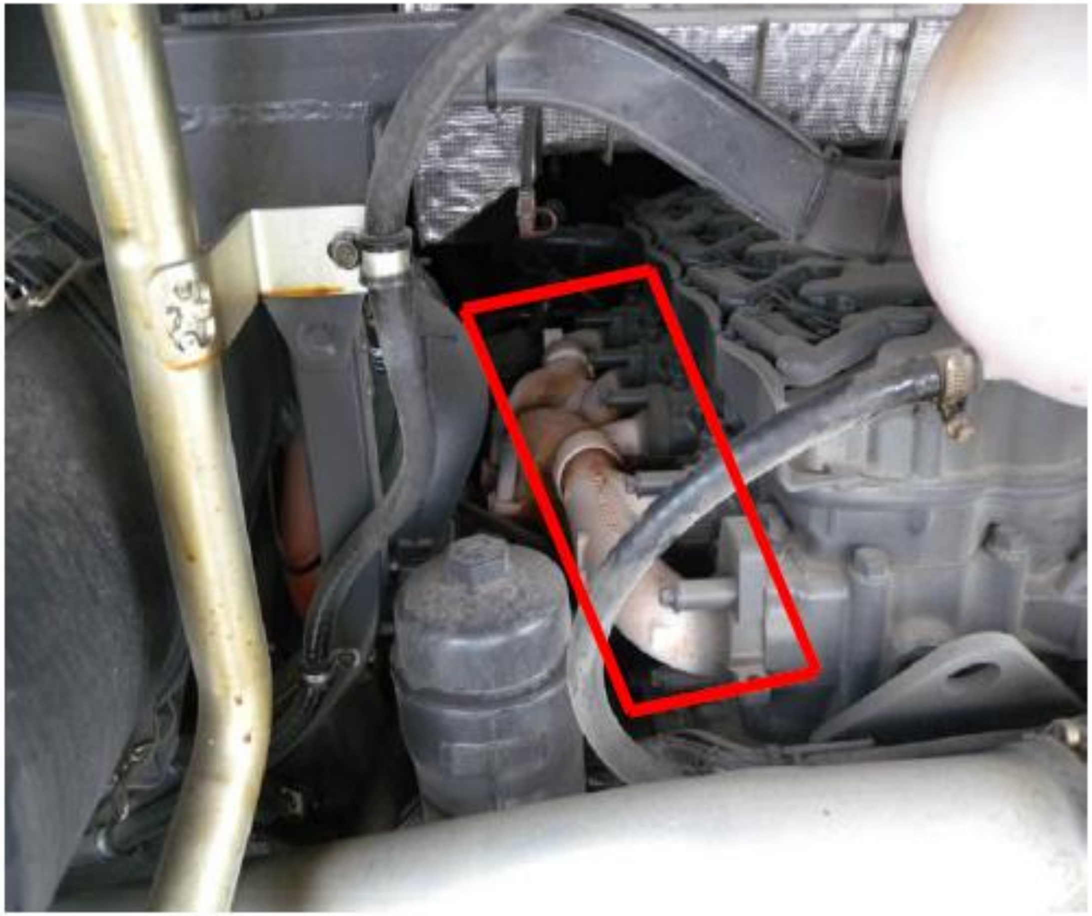
Risk Assessment for bus interiors

Hazard identification and Risk Assessment

Flame Retardants Association of India

Potential fire hazards

- Engine compartment and exhaust system temperatures
- Proximity of manifold / turbo to fuel injection system
- Flammable liquids and pressurised fuel and oil lines – diesel, engine oil, hydraulic oil, coolant - leaks
- Margin between flash points and surface temps is lower than normal, increasing risk of ignition and fire spread
- Auxiliary heater hazards
- Use of acoustic insulation foams for noise attenuation
- Ignition sources – generator, starter motor, hot manifold, turbocharger, unsecured wiring, short circuits, slipping belts…
- Internal materials – seating foams, curtains, other plastics



Typical thermoplastics used in coach construction

China bus fire safety standards

(reference : Changchun FAW draft proposals)

BUS seating materials

- Thermoplastics & Textile material : LOI >= 26
- PU foam: Minimum B grade according to GB 8410 (similar to FMVSS 302, burning rate < 50mm/min)

- Reference:
  - Current standard for normal BUS is burning rate < 100mm/min
  - School BUS is burning rate < 70mm/min and LOI >22
- Other components and materials:
  - Ceiling & floor board LOI >32, UL 94 V-1
  - Chair plastics LOI >30, UL 94 V-1
  - Overhead luggage frame, dash board, door material LOI >26, UL 94 V-1
  - Curtain LOI > 30

Why use flame retarded plastics ?

- **Benefits of flame retarded products in reducing injuries and the loss of life and property are well documented.**
  - Escape times can be as much as 15X greater
  - 75% less heat release
  - 2/3 less carbon monoxide equivalents

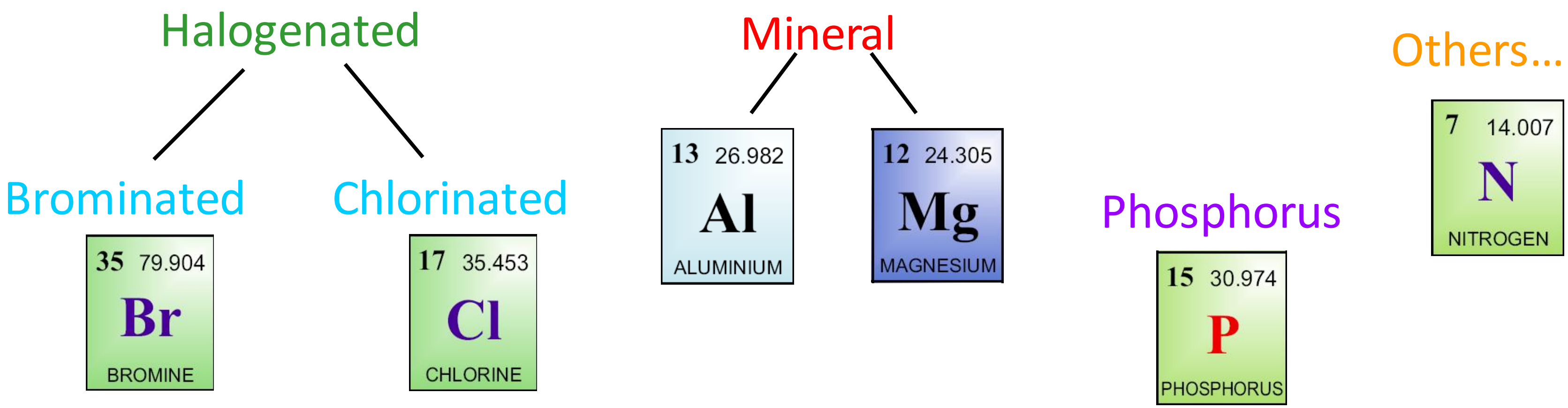
(Study by US National Bureau of Standards)

Fire safety action

- If ignition occurs: auto extinguishes
- Slows down combustion
- Gives enough time for people to intervene
- Maintains a viable atmosphere for longer

Flame Retardants Association of India

Overview of flame retardants



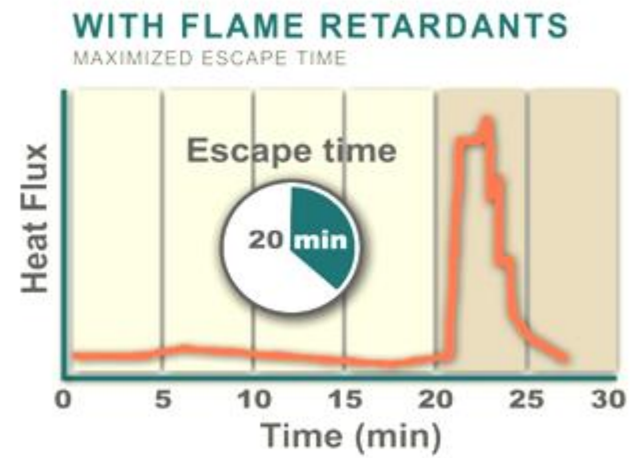
- Based on a variety of elements and chemical compositions
- Several commercial flame retardants in each of these classes
- Flame retardants are not all the same and have differing physical, chemical and toxicological properties, even within the same chemistry
- Therefore, each flame retardant should be treated on its own merits and not considered as a cluster when making a selection ; “Non hal” requirements have little basis in science…

Benefits of flame retardants

Fire safety action

- Avoiding ignition
- If ignition occurs: auto extinguishing
- Slowing down the combustion process
- Give enough time for people to escape
- Facilitating fire-fighters intervention
- Maintain a viable atmosphere for a longer period
- Several examples of the life saving benefits of flame retardants

  UK Furniture Regulations : >1000 lives
- areyousittingcomfortably



Conclusions

- Losses due to coach fires are of concern in India and globally
- International standards making process is time consuming
- Need for bus & coach OEMs to systematically assess their specific risks
- Bespoke Fire Risk Assessments should supplement standards
- Seating, thermal and acoustic foams, wire and cables key target areas
- These products can be produced with cost effective flame retarded grades
- Fire prevention must take equal priority as detection and suppression
- Flame retardants are part of the solution to fire prevention

Study on bus fire safety by Imperial College London (under Professor Guillermo Rein)

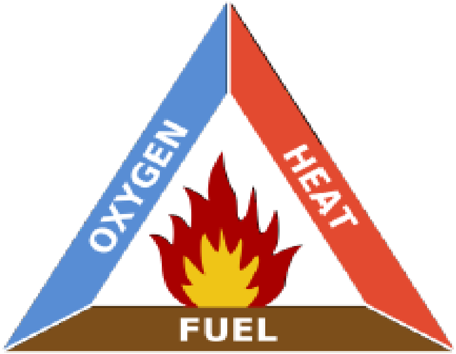
Flame Retardants Association of India

Rationale of N-LAYERS

- Safety in residential and industrial buildings is made of a series of layers

  Prevention ‖ Fuel control ‖ Passive systems ‖ Detection ‖ Suppression ‖ Evacuation ‖ Structural Resilience

- All layers have a role in fire safety, but **not all layers are equally important**, effective or costly.
- We think that the most effective, but often forgotten, is **prevention**
- Prevention consists on aiming at not having a fire in the first place (disrupt fire triangle).
- The most effective prevention consists on making objects less flammable, and less prone to ignition and flame spread
- By fuel manipulation, design of materials and the removal of ignition sources, etc.



Thank You

Flame Retardants
Association of India