Fire Safety Requirements for ships

- Fundamental Fire safety Requirements in SOLAS and FTP Code
- Possible input from TRANAFEU to IMO

Fire Safety ISO standards in ISOTC92SC1

- Possible input from TRANSFEU to ISOTC92SC1

Koichi Yoshida
Previous-chairman, IMO Fire Protection Sub-Committee Chairman, ISO/TC92/SC1: Fire safety – Fire initiation and growth
FUNDAMENTAL REQUIREMENTS ON FIRE SAFETY OF SHIPS (SOLAS Convention)

- International Convention of Safety of Life at Sea (SOLAS).
- SOLAS chapter II-2 “Construction - Fire protection, fire detection and fire extinction”
- SOLAS chapter II-2 has been developed and revised at IMO (International Maritime Organization) and its Sub-Committee for Fire Protection (FP) and Maritime Safety Committee (MSC)
- SOLAS chapter II-2 was revised comprehensively in 2000
The fire safety objectives of this chapter are to:

.1 prevent the occurrence of fire and explosion;
.2 reduce the risk to life caused by fire;
.3 reduce the risk of damage caused by fire to the ship, its cargo and the environment;
.4 contain, control and suppress fire and explosion in the compartment of origin; and
.5 provide adequate and readily accessible means of escape for passengers and crew.
FUNDAMENTAL REQUIREMENTS ON FIRE SAFETY OF SHIPS
( SOLAS Convention)

regulation 2 of chapter II-2 of SOLAS

functional requirements
1 division of the ship into main vertical and horizontal zones by thermal and structural boundaries;
2 separation of accommodation spaces from the remainder of the ship by thermal and structural boundaries;
3 restricted use of combustible materials;
4 detection of any fire in the zone of origin;
5 containment and extinction of any fire in the space of origin;
6 protection of means of escape and access for fire fighting;
7 ready availability of fire-extinguishing appliances; and
8 minimization of possibility of ignition of flammable cargo vapour.
Structure of SOLAS Chapter II-2

Part A  General
Regulation 1 Application,
Regulation 2 general principles,
Regulation 3 Definitions

Part B  Prevention of fire and explosion
Reg. 4 Probability of Ignition,
Reg. 5 Fire growth potentials,
Reg. 6 Smoke and toxicity

Part C  Suppression of Fire
Reg. 7, detection and alarm, Reg. 8 Control of smoke spread, Reg. 9 Containment of fire,
Reg. 10 Fire fighting, Reg. 11 Structural integrity

Part D  Escape
Reg. 12 Notification of crew and passengers, Reg. 13 Means of escape

Part E  Operational requirements
Reg. 14 Operational readiness and maintenance, Reg. 15 Instructions, onboard training
and drills, Reg. 16 Operations

Part F  Alternative design and arrangements
Reg. 17 Alternative design and arrangements

Part G  Special requirements
Reg. 18 Helicopter facilities, Reg. 19 Carriage of dangerous goods,
Reg. 20 Protection of vehicle, special category and ro-ro spaces,
Reg. 21 Casualty threshold, safe return to port and safe areas,
Reg. 22 Design criteria for systems to remain operational after a fire casualty,
Reg. 23 Safety centre on passenger ships
FIRE SAFETY REQUIREMENTS FOR MATERIALS USED ON BOARD SHIPS (regulation 5 and 6)

1. **Non-combustibility** for fire protection construction (Decks, Ceilings, Bulkheads, Wall partitions, Doors, Decks, etc.)

2. **Low flame-spread characteristics** for surface finishes including paints, floorings, plastics pipes, cables to be added near future)

3. **Limitation of smoke and toxic gas production** for surface finishes, floorings, plastics pipes, (cables to be added near future)

4. **Ignitability** of curtains, hanging textiles, upholstered furniture and bedding components and films; and

Detailed requirements are specified in International Code of Application of Fire Test Procedures (FTP Code)
Criteria for smoke,
$Dm < 200$ for surface of wall and ceiling
$Dm < 400$ for primary deck covering, plastic pipes and electric cables
$Dm < 500$ for floor covering

Criteria for toxic gases
$CO < 1450$ ppm, $HCl < 600$ ppm, $HF < 600$ ppm, $HBr < 600$ ppm, $NO_2 < 350$ ppm, $HCN < 140$ ppm, $SO_2 < 120$ ppm (200 ppm for floor coverings).

reference: ISO 5659-2 gas measurement using FTIR (ISO/DIS 21489)

IMO needs to further improve FTP Code Part 2 for smoke and Toxicity, and is waiting for any Proposal from TRANSFEU.
| Part 6          | Primary deck coverings test reference: ISO 5658-2 | Criteria: same as floor materials  
Revision: to be merged into Part 5 |
|----------------|---------------------------------------------------|----------------------------------------------------------------------------------|
| Part 7         | Test for vertically supported textiles and films reference: IMO A.652(16) | Criteria: not to ignite by a small flame source (DIN small burner)  
Revision: no change |
| Part 8         | Test for upholstered furniture reference: IMO A.687(17) | Criteria: not to ignite by a specified cigarette and small flame source  
Revision: Specification of cigarette ignition source will be harmonized with Part 9. |
| Part 9         | Test for bedding components reference: IMO A.688(17) | Criteria: not to ignite by a specified cigarette and small flame source  
Revision: no significant change |
IMO and ISO on Fire Protection

IMO FP Sub-Committee

SOLAS chapter II-2
Fire Protection

Fire Test Procedures Code: FTO Code

ISO standards for
Fire test Procedures and
Fire safety assessment

ISO/TC61/SC4
Plastics/Burning behaviour

ISO/TC92/SC1
Fire safety

Fire Safety Systems Code: FSS Code

ISO standards for
On board
Fire safety system

ISO/TC8/SC1
Ship and marine technology
Possible input from TRANSFEU to IMO
Target products of evaluation

Common products for surface transportation vehicles
• Seating
• Curtain
• Ceiling, Wall and partition surface (floor covering?)
• Table
• Other interior components (e.g., lighting system, luggage shelf)

This does not cover fire safety in sleeping compartment.
Application to surface transportation vehicles

• Data base of fire performance of each component can be developed and used in any application.
• Actual design of vehicles may differ significantly by volume and dimensions. No uniform application of fire performance (either ranking or classification) can be applicable to all vehicles.
• Ships and high-speed water craft shall have sprinkler system and fire detection and alarm system.
• Performance of emergency air/gas exhaust system, if fitted, can be taken into account.
Fire scenario for consideration

- No possibility of self-ignition?
- If power source is accommodated, possibility of initiation by the power source should be considered.
- Smoking is prohibited in enclosure of vehicle
- Ignition by arsonist
  - Size of ignition source
    - Cigarette lighters
    - Papers ignited by lighters and/or alcohol

Need to specify the ignition source for evaluation; possibly

- Seating and table: 75kW burner on the seat and alcohol fire underneath
- Curtain: cigarette lighter
- Wall and ceiling surface (and possibly curtain): 40 kW/m² in 250mm diameter
- Other product: to be decided
Performance criteria

• Product shall not ignite by the ignition source;
  – by the power source accommodated in the product,
  – by arsonist ignition source

or

• Product shall not spread the fire to the neighbor products
  – Limited flame spread within the component
  – Heat release and total heat release rate shall not exceed criteria to be developed

and

• Product shall not give off smoke and gases which result in serious danger in the vehicle
Data necessary for evaluation

• Full scale product fire test would be required.
  – Ignitability test by the ignition source
    If ignited, then;
  – Flame spread, heat release, smoke generation and gas generation by FTIR at
    For surface finish;
    • ISO 5658-4 or ISO 21367;
    For seating, table and other components
    • ISO 9705, ISO 24473 or
    • Furniture calorimeter or smaller scale compartment fire test method may be developed to measure heat release up to 500 kW or 1MW for smaller products such as tables and lighting systems.
    • Measurement resolution should be in order of 1kW.
Evaluation on hazard of smoke and gases

• Evaluation on each design of vehicle shall be done using the test data and designed volume of the vehicle and its compartment;
  – On the assumption of
    • All the smoke and gases are accumulated in the compartment,
    • If emergency exhaust system is installed, the performance of emergency air/gas exhaust system can be taken into account
  – Against FED, FEC, immovability of people in smoke
Possible input from TRANSFEU to IMO

• Bench scale test protocol using ISO5659-2 and continuous FTIR gas measurement for improvement of IMO FTP Code Part 2 (Smoke and gas)

• Fire scenario and design fire for seating and related components as a new approach of fire safety of ships and water-crafts
EC representative to IMO

- EMSA (European Maritime Safety Agency) is the EC representative to IMO.
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TRANSFEU results and proposals can be inputted to IMO through EMSA.
Ignitability
Fire spread
Smoke and gases
Movement of people
Fire safety systems

Fire safety Engineering ISO/TC92 (SC1)
Fire Safety Evaluation System

Establish Safety goal

Simulation Calculation and Evaluation

Defined Test method
Fire test data of components

Design of vehicle
Fire scenario & Design fire

Ignitability
Fire spread
Smoke and gases
Movement of people
Fire safety systems

Approv AL
Possible input from TRANSFEU to ISO/TC92(Fire safety) and its SC1 (Fire initiation and growth)

• NWIP on continuous gas measurement using FTIR during fire tests (e.g., single smoke chamber test, room fire test, open calorimetry, cable fire test)

• NWIP on Fire scenario and design fire for seating and related components in surface vehicles;

• NWIP on smaller furniture calorimeter or smaller scale compartment fire test method to measure heat release up to 500 kW or 1MW with measurement resolution of 1kW
Thank you

Chaired IMO FP from 1994 to 2003
Chairing ISO TC92 SC1 (Fire Safety/Fire Initiation and Growth)
Chairing ISO TC8 SC2 (Marine Environment protection)