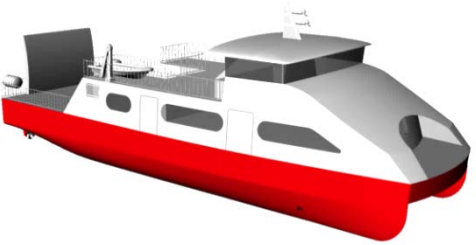


Status of IMO correspondence group and European Regulations

Franz Evegren

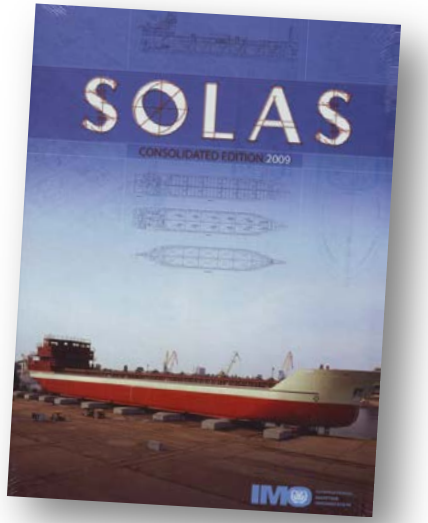
SP Technical Research Institute of Sweden

“Development of guidelines for use of Fibre Reinforced Plastic (FRP) within ship structures”

-Activity within the IMO

MSC 87 *UK* proposed the item and required guidance when FRP replaces steel.

FP 55 *UK* suggested **(1)** to develop guidelines for evaluation of FRP by SOLAS II-2/17 OR **(2)** to incorporate FRP in the regulatory framework.
SWE suggested to develop guidelines for evaluation and testing in a CG.



FP 56 *SWE* suggested to establish a CG and gave input to guidelines.
USA opposed a use of combustible structures.
China favoured guidelines for applying SOLAS II-2/17.

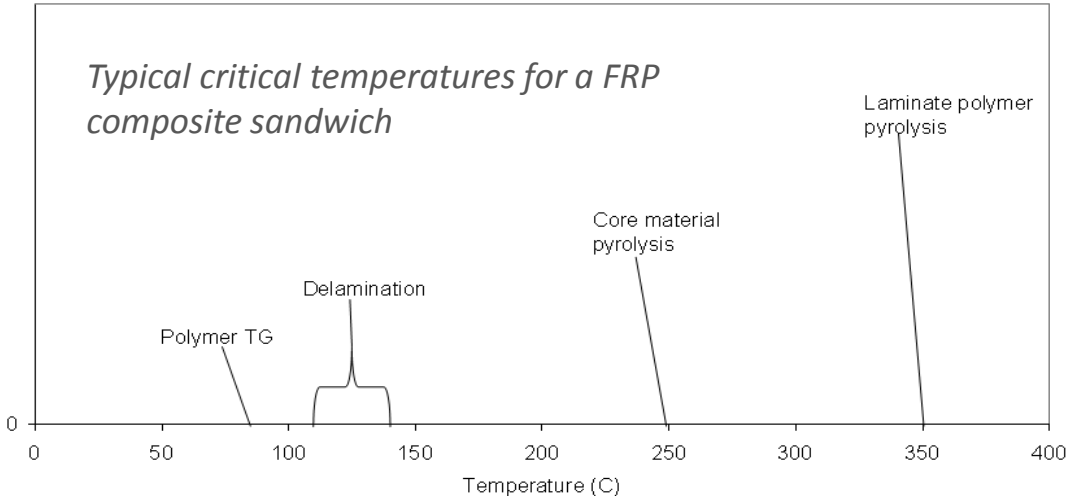
SDC1 CG presented results and draft guidelines.
Not possible to conclude on ToR1, applicability of SOLAS II-2/17.
CG was reinstated and guidelines developed (assuming it applies).

Most CG members are for the possibility to use FRP structures but some consider SOLAS I/5 a more suitable way. Guidelines have been developed.

Draft guidelines for use of FRP structures

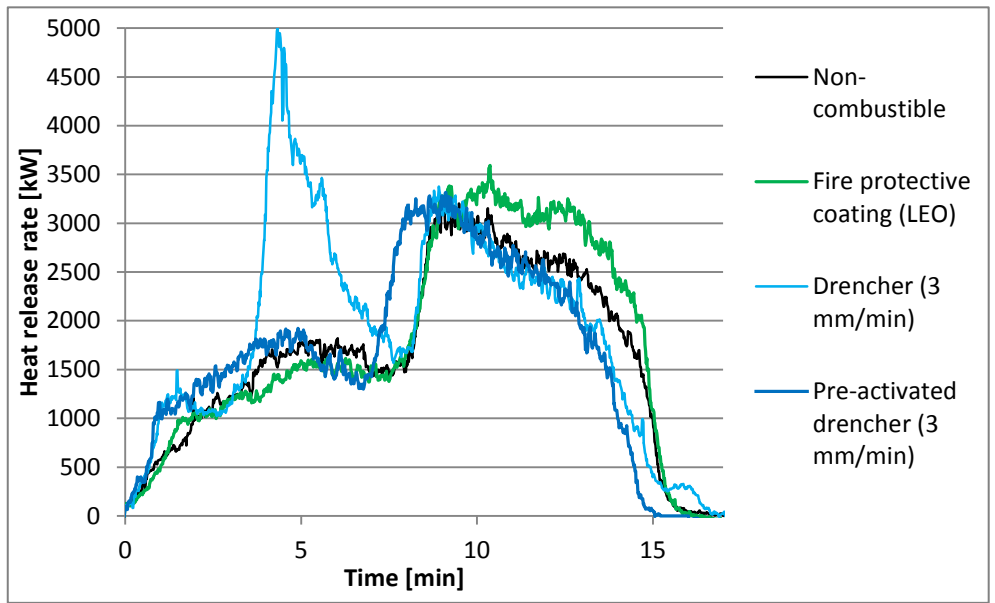
1. General
2. Assessing fire safety of FRP composite structures
3. Important factors to consider with regards to chapter II-2

Appendices



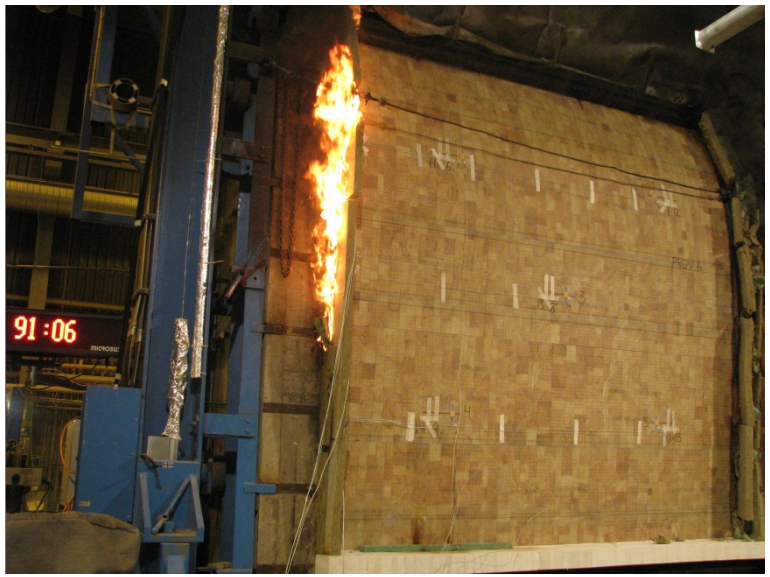
Fire growth potential

Passive and active measures are effective



Structural integrity

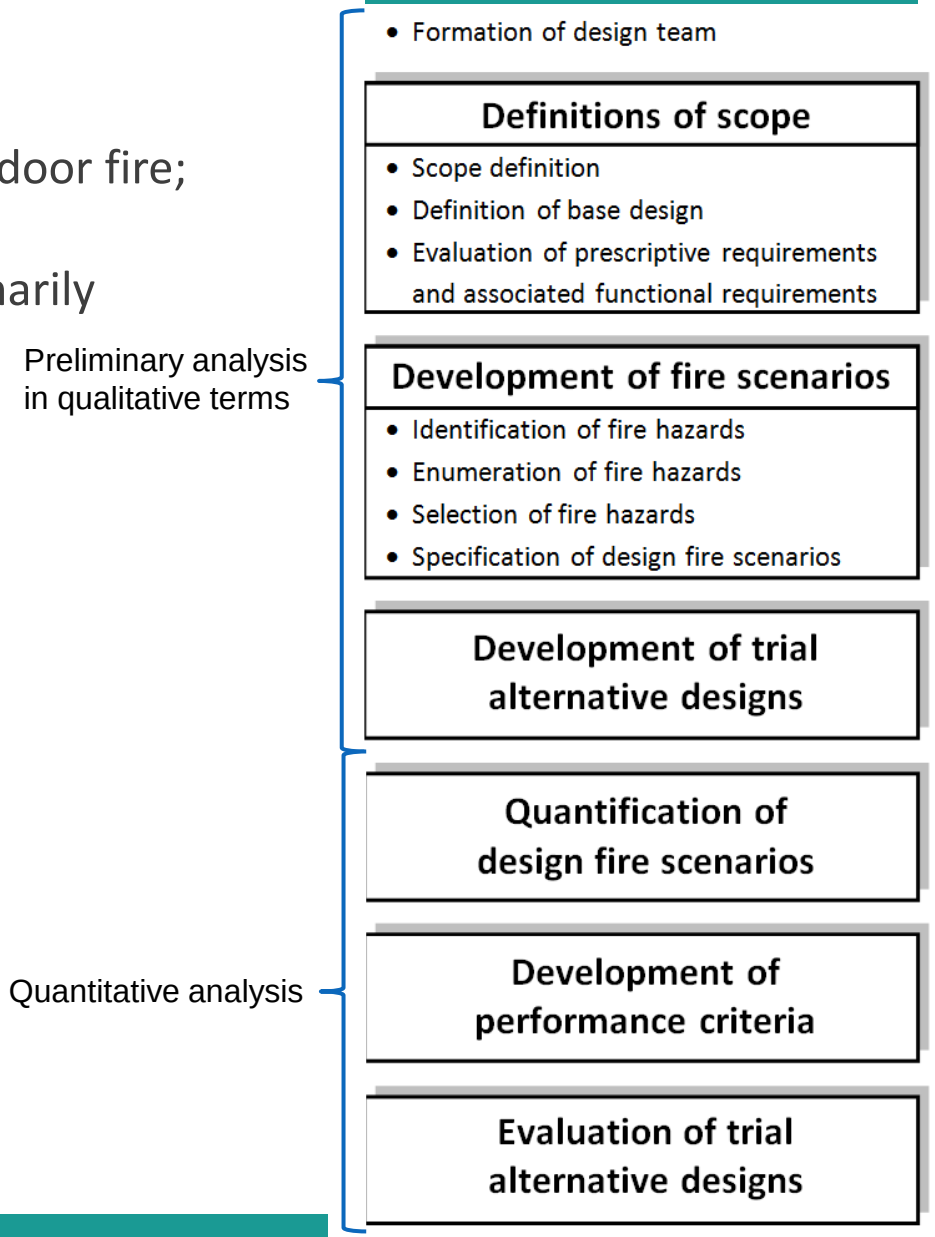
Structural resistance is critical, not insulation capacity
Time to collapse is nearly independent of the loading



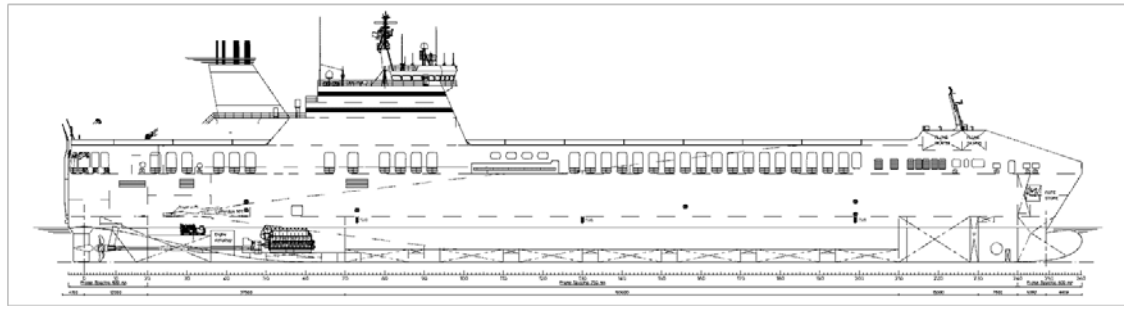
Regulation 17 example

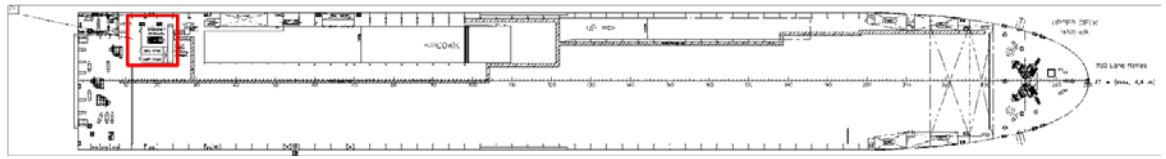
General principles

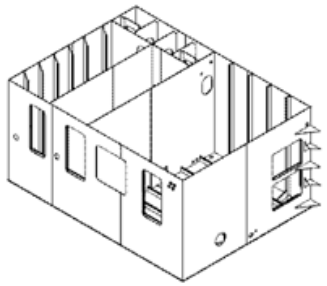
1. protect internal structures against exposure to an indoor fire;
2. protect against fires exposing external surfaces; and
3. document performance of fire protection using primarily established test procedures.

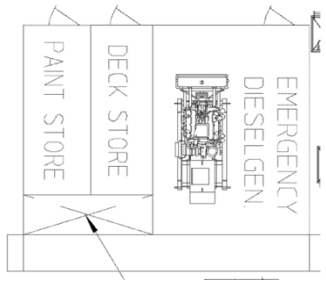


Regulation 17 example – Emergency Generator superstructure





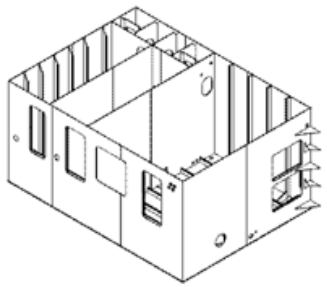




- FRP composite sandwich panel structures
- Internally protected with thermal insulation to achieve 60 minutes of fire integrity according to the FTP Code, Part 11

Regulation 17 example – Regulation investigation

- Combustible structures => deviations to regulations 9 and 11
- Reg. 9: A-class divisions with 0-60 minutes fire insulation capability
- Reg. 11: Deckhouses made in steel or equivalent material
- Purpose statements: Unprotected external surfaces…



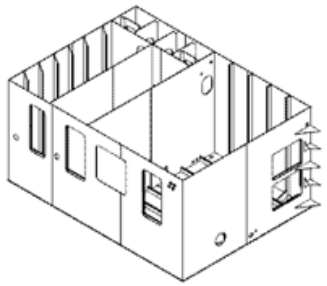
Affected functional requirements may be identified as:

- Restrict ignitability of combustible materials;
- Restrict the amount of combustible materials;
- Restrict the fire growth potential of combustible materials;
- Limit the quantity of smoke and toxic products released from combustible materials during fire;
- Boundaries shall provide thermal insulation and integrity with due regard to the fire risk of adjacent spaces;
- Materials used in the ships' structure shall ensure that the structural integrity is not degraded due to fire;
- …

Regulation 17 example – Development of fire scenarios

Deterministic approach gives two design fire scenarios:

- Flashover fire in the emergency generator space; and
- Significant exterior hydrocarbon fire.



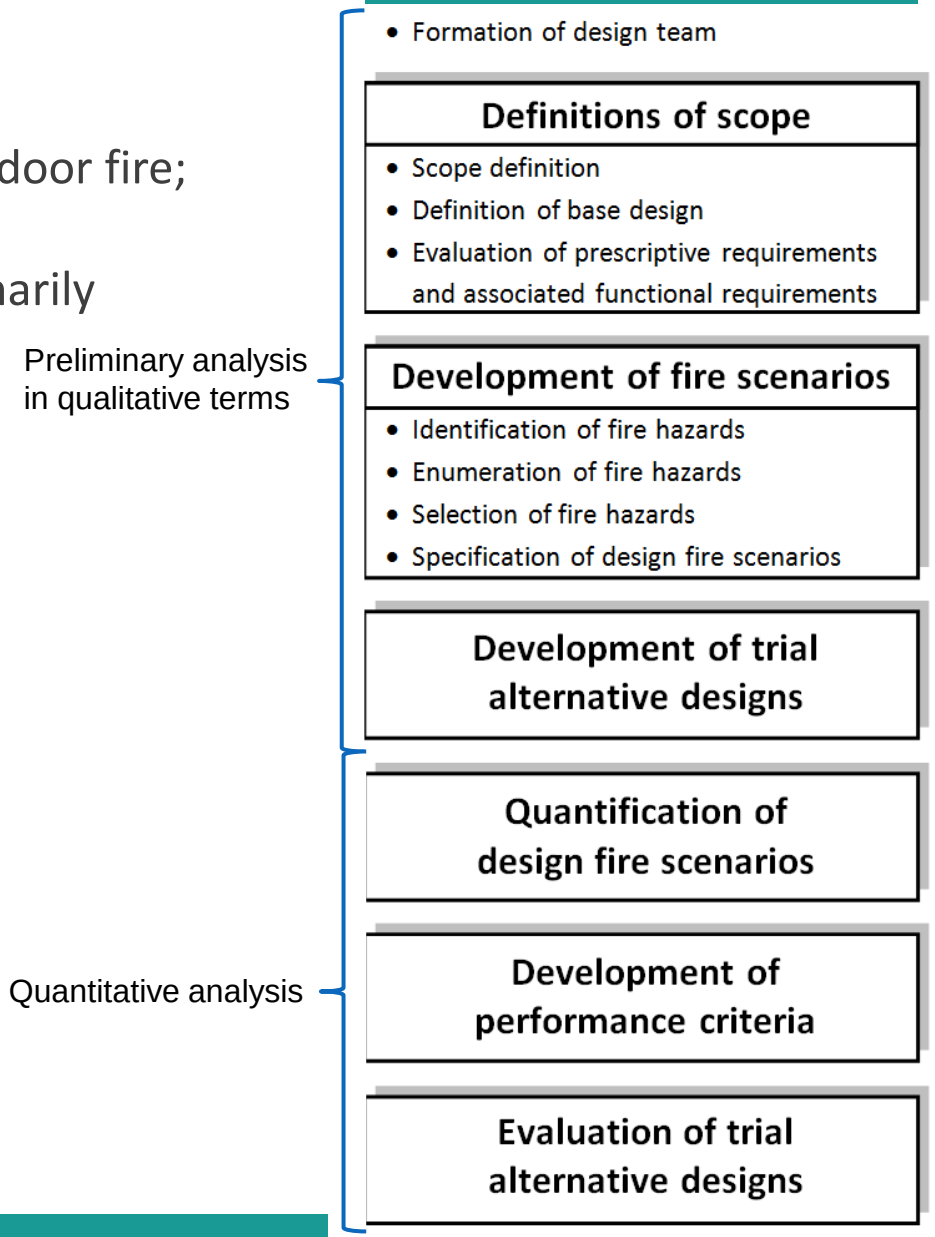
Trial alternative designs are formed by adding any combination of the risk control measures:

a. Provision of stiffeners at the inside of the exterior bulkheads (to provide structural integrity along with the unexposed laminate in case of an external fire).
b. Use of double sandwich panels (triple skin sandwich panels), where only half are necessary to carry the design load (to structural integrity along with the unexposed laminate in case of an external fire).
c. Provision of a drencher system covering the external surfaces.
d. Redundant supply unit for the drencher system.
e. Provision of low flame-spread characteristics on external surfaces.
f. Automatic surveillance of closure of doors.
g. …

Regulation 17 example

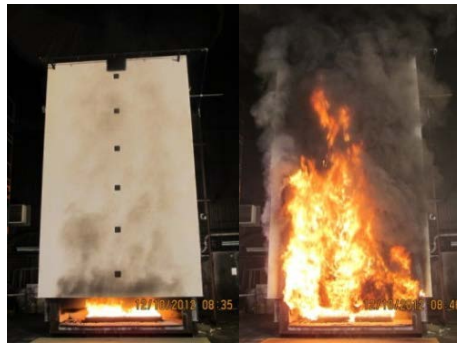
General principles

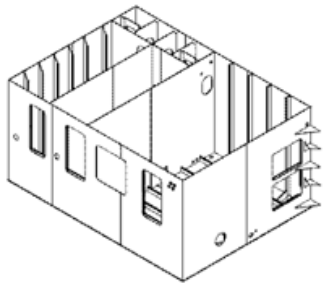
1. protect internal structures against exposure to an indoor fire;
2. protect against fires exposing external surfaces; and
3. document performance of fire protection using primarily established test procedures.

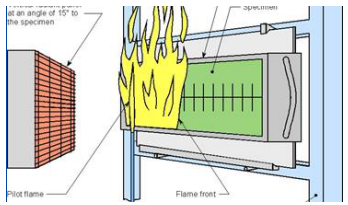


Regulation 17 example – Development of fire scenarios

FTP Code fire testing of fire integrity, fire growth and smoke production
Experimental fire testing => *RCM e* or preactivation of *RCM c* prevents ignition







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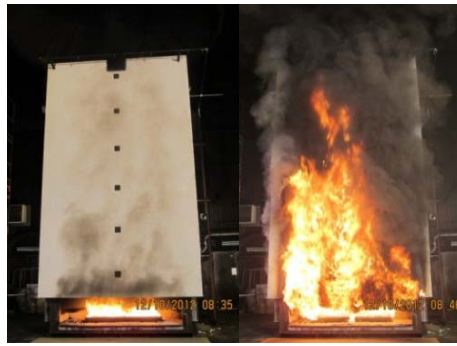
c. Provision of a drencher system covering the external surfaces.
d. Redundant supply unit for the drencher system.
e. Provision of low flame-spread characteristics on external surfaces.
f. Automatic surveillance of closure of doors.
g. …

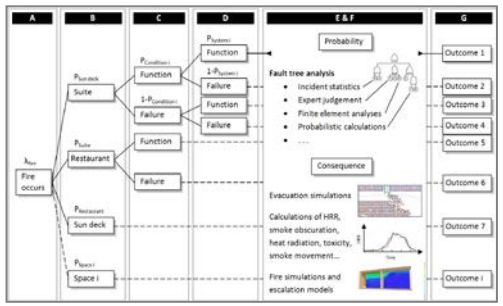
Suggested final risk control option

Conclusions from R&D (2005-2014)

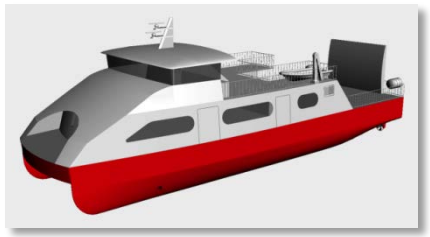
- Experience from solutions certified according to the HSC Code exist
- Introduced fire hazards are effectively managed by suitable safety measures
- Non-standardized fire testing may be necessary

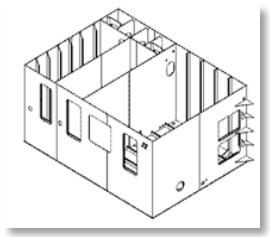
- Conservative safety measures simplify the assessment
- Optimization or large scope require a complex assessment
- MSC/Circ.1002 provides some guidance



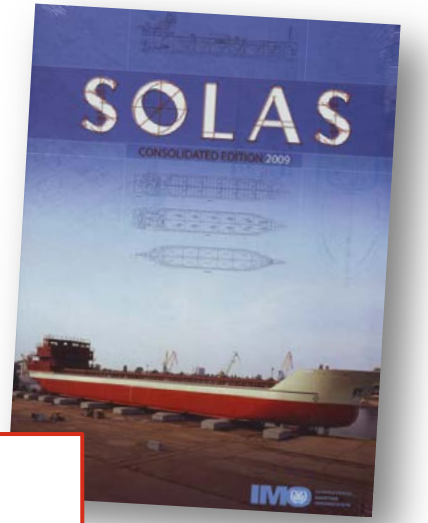


- Approved examples are necessary to release the industry
- Evaluation of FRP composite structures must be harmonized and known by Administrations





International regulations



SOLAS (Safety Of Life At Sea) chapter II-2

Regulation 4	Probability of ignition
Regulation 5	Fire growth potential
Regulation 6	Smoke generation potential and toxicity
Regulation 9	Containment of fire
Regulation 10	Fire fighting
Regulation 11	Structural integrity
Regulation 13	Means of escape

...

Regulation 17
Alternative solutions for fire safety are allowed if they can be shown to be at least as safe as a prescriptive design

SOLAS chapter I
Regulation 5 Equivalents

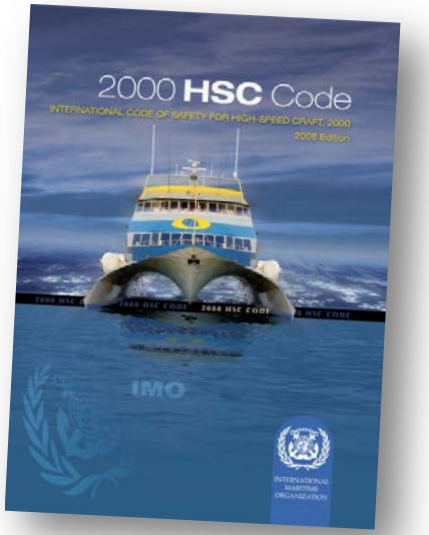
Reg. 9 prescribes main vertical and horizontal zones of A-class divisions
= steel or other equivalent material
= a non-combustible material which, by itself or down to insulation provided, has structur
the end of the standa

Reg. 11 prescribes the hull, superstructures, structural bulkheads, decks and deckhouses to be constructed of steel or other equivalent material.

International regulations

High Speed Craft (HSC) Code

Chapter 7 Fire safety



7.2 Definitions

7.2.1 *Fire-resisting divisions* are those divisions formed by bulkheads and decks which comply with the following:

- **.1** They shall be constructed of non-combustible or fire-restricting materials which by insulation or inherent fire-resisting properties satisfy the requirements of 7.2.1.2 to 7.2.1.6.
- **.2** They shall be suitably stiffened.
- **.3** They shall be so constructed as to be capable of preventing the passage of smoke and flame up to the end of the appropriate fire

OK with FRD in combustible material

International regulations

Naval Ship Code (NSC)
Goal-Based Standard (GBS), current version Edition 4 (dec 2012)

Fire Safety Chapter VI, based on SOLAS, HSC Code and DNV Naval

Ship Types:

- Ship Type A: >240 persons or >36 pax;
- Ship Type B: 60-239 persons and <36 pax;
- Ship Type C: <60 persons and <12 pax.

Regulation 1.8
"For ships not constructed from steel or having significant parts not constructed from steel, e.g. ships using aluminium or composite construction, the application of the code is limited to Type C ships with no more than 60 persons on board. For ships with greater number of persons onboard, a fire safety analysis is to be undertaken in accordance with Chapter 1 Regulation 5."

European regulations

Directive 2009/45/EC on safety rules and standards for passenger ships
Applies to passenger ships (>12 pax, >24 m LOA) on domestic voyages

Annex 1, Chapter II-2, part A, reg.1.3 -> SOLAS II-2/17

.3 The fire safety objectives set out in paragraph .1 shall be achieved by ensuring compliance with the prescriptive requirements specified in this chapter or by alternative design and arrangements which comply with Part F of the revised Chapter II-2 of the 1974 SOLAS Convention, as amended, which applies to ships constructed on or after 1 January 2003. A ship shall be considered to meet the functional requirements set out in paragraph .2 and to achieve the fire safety objectives set out in paragraph .1 when either:

.1 the ship's designs and arrangements, as a whole, complies with the relevant prescriptive requirements in this chapter;

.2 the ship's designs and arrangements, as a whole, have been reviewed and approved in accordance with Part F of the revised Chapter II-2 of the 1974 SOLAS Convention, as amended, which applies to ships constructed on or after 1 January 2003;

European regulations

Directive 2009/45/EC on safety rules and standards for passenger ships
Applies to passenger ships (>12 pax, >24 m LOA) on domestic voyages

Annex 1, Chapter II-2, part A, reg.1.3 -> SOLAS II-2/17

Article 3: Directive does not apply to ships built in materials other than steel or equivalent

the requirements of this Directive, before they may be engaged on domestic voyages in that Member State.

2. This Directive does not apply to:

(a) passenger ships which are:

(i) ships of war and troopships;

(ii) ships not propelled by mechanical means;

(iii) vessels constructed in material other than steel or equivalent and not covered by the standards concerning High Speed Craft (Resolution MSC 36 (63)) or Dynamically Supported Craft (Resolution A.373 (X));

(iv) wooden ships of primitive build;

(v) original, and individual replicas of, historical passenger ships designed before 1965, built predominantly with

European regulations

Directive 2006/87/EC laying down technical requirements for inland waterway vessels and repealing

- Passenger ships (>12 pax)
- Other vessels >20 m (or having a volume over 100 m^3)
- Tugs and pusher craft (of any length)
- Floating equipment

Excluding ferries, naval vessels and sea-going vessels which
(i) operate or are based on tidal waters; or
(ii) operate temporarily on inland waterways, provided that
they carry either SOLAS, EU passenger ship or recreational certificate.

European regulations

Directive 2006/87/EC laying down technical requirements for inland waterway vessels and repealing

Article 3.02 Strength and stability §2

thicknesses, of not more than 10 % reduction from calculated values, are acceptable locally for small areas.

2. Where a material other than steel is used for the construction of the hull, it shall be proved by calculation that the hull strength (longitudinal, lateral and local strength) equals at least the strength that would result from the use of steel under the assumption of minimum thickness in accordance with paragraph1. If a certificate of class or a declaration issued by a recognised classification society is presented, a proof by calculation may be dispensed with.

3. The stability of vessels shall correspond to their intended use.

Article 3.04 Engine and boiler rooms, bunkers §3

3. Engine room, boiler room and bunker bulkheads, ceilings and doors shall be made of steel or another equivalent non-combustible material.

Article 15.11 Fire protection

Non-combustible material in:

- Bulkheads
- Linings
- Ceilings
- Draught stops
- Insulation material
- Stairways

DAMEN
Water Bus

Approved

- Fire Control and Safety plan
- Fire Zone Division plan
- Insulation Plan

SP your Science Partner

Summary of openings for FRP composite in regulations

SOLAS: if achieving sufficient safety
HSC Code: Yes
NSC: To a degree depending on the ship type
EU pass: No (new rules earliest 2015-2016)
IWW: New possibilities

Thank you for your attention!

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