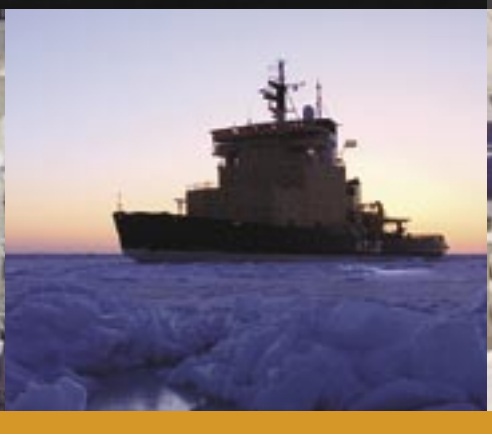
MARINE

Glassfiber Reinforced Epoxy Pipe Systems (GRE)

Version 01

- Ballast water treatment system
- Seawater cooling systems
- Gland & flushing systems
- Firefight systems
- Black & grey water systems
- Condensate lines
- Inert gas effluent
- Sounding & ventilation lines
- Tank cleaning systems
- Potable water systems
- Crude oil washing
- Chlorinated systems
- Scrubber units



FPI

FUTURE PIPE INDUSTRIES

CONTENTS

Glassfiber Reinforced Epoxy (GRE) Pipe Systems Onboard Ships

Exhibiting excellent corrosion resistant properties GRE pipe systems will last for the life of a ship. Meeting Classification Societies' rules and IMO regulations GRE systems are designed specifically for use onboard ships.

In comparison with galvanised and rubber lined steel and CuNiFe, the installation costs of GRE systems are lower as a result of GRE's lightweight nature and ease of handling. Installation and prefabrication training can be provided by FPI either at our facilities or at the customer's site.

Typically steel pipe systems have to be replaced 2-3 times throughout a ship's life; GRE pipe systems will last a ship's lifetime thereby reducing the overall cost of ownership.

Health & Safety of ship crews and shipyard personnel is now rightly afforded the highest priority. When compared to polyester and vinylester pipe systems GRE is significantly less hazardous. GRE pipe systems are also eco-friendly and pose no risk to the environment.

FPI has been a leading manufacturer and supplier of GRE to the marine sector since 1984.

PRODUCTS

To avoid the build-up of static electricity, FPI's Fibermar and Wavistrong systems are available in a conductive version in addition to the standard range. Both systems are available from 25mm (1") up to 1600mm (64").

Diameters of 25mm (1") to 900mm (36") are incorporated in the type approvals. When using larger diameters, special project approval from the Classification Societies can be obtained.

Jointing of the system is achieved by adhesive bonding, rubber sealing (either tensile or non-tensile resistant), lamination, flanges or by using mechanical couplings.

Both Fibermar and Wavistrong pipe systems can be supplied as prefabricated spools. These pipe sections are tailor-made to customers' requirements and have the additional benefits of easier and quicker installation.

Pipes are jointed with standard fittings such as 45/90 degree elbows, T-pieces, eccentric and concentric reducers and heavy duty flanges. Smaller fittings (up to and including DN400) are produced robotically on steel moulds. Fittings larger than DN400 are prefabricated. Prefabrication of fittings means that the number of system joints can be minimised which will, in turn, reduce costs significantly.

When standard fittings (either R=1D or R=1.5D) are unsuitable, tailor-made fittings can be designed and manufactured to meet the specific requirement.

PREFABRICATION

By spooling the pipes and fittings, installation time onboard can be significantly reduced with the bonus that installation costs are also reduced. Typically 70% of the spools for a job are prefabricated in controlled conditions either in FPI facilities, in shipyards or at the workshops of our preferred contractors. A sample of spools will be tested before leaving our workshops to ensure the quality of our product. Additionally, prefabrication reduces the number of bonded joints, and hence reducing the use of chemicals onboard.

APPLICATIONS

GRE can be applied to a wide range of systems, including:

- Ballast (water treatment)
- Seawater cooling
- Gland & flushing (dredgers)
- Firefighting
- Black & grey water
- Condensate lines
- Inert gas effluent
- Sounding & ventilation lines
- Tank cleaning
- Potable water
- Crude oil washing
- Scrubber units

ADVANTAGES

- Long service life due to its non corrosive characteristics
- Lower installation costs due to its light weight (25% of steel)
- Lower operational costs due to no maintenance being required
- Easily repairable
- Conductive variant available if required
- Non hazardous for personnel and the environment
- Support arrangements are the same as steel equivalents

PROJECT MANAGEMENT

FPI specialises in "Turn Key" project management. Complete systems, which will include non GRE items such as bulkhead penetrations, pumps and valves can be provided (although the customer will normally supply items such as pumps and valves). Our teams of highly qualified and experienced supervisors and fitters ensure that installations are successful and correct ensuring the customer's peace of mind.

Our project management services include:

- Assistance with system design (type of connections, pipe support plan, routing, etc.)
- Isometric, spool and support scheme drawings
- Stress and surge analysis
- Prefabrication of spools
- System installation
- Commissioning
- Project oversight and supervision
- Documentation

TESTING & TRAINING

TESTING

Sample spools are pressure tested in our workshops to 1.5 x design pressure. A charge will be made for spools which require modification to be tested. Certificates of testing are available on request. Commissioning testing is usually undertaken at 1.5 x working pressure. Further details of testing are available on request.

TRAINING

Dedicated trainers provide a 2-3 day installation and prefabrication training programme; this is undertaken either at our Netherlands facility or at the customers' premises. Successful trainees are awarded a certificate which is valid for 3 years; refresher courses are available after 3 years to maintain qualification.

RETROFITS

Despite the fact that steel pipes will corrode, steel has been used in marine applications for many years. During a ship's lifetime, corroded steel pipes will be replaced several times, particularly if the steel has been used in a sea water system. This is both costly and undesirable.

FPI's GRE Wavistrong and Fibermar pipe systems are the ideal replacement for legacy steel systems – GRE's non corrosive characteristics and light weight ensure this. It is simply just "Fit & Forget".

Our network of highly qualified and skilled contractors is able to provide a retrofit service worldwide.

Please contact us if you would like to know more about the retrofit opportunities with GRE. We are always happy to answer questions and provide quotations.

NAVAL MARINE APPLICATIONS

Rigorously and successfully tested for use onboard naval vessels, both Wavistrong & Fibermar are suited to many applications onboard both future and current generations of warships and submarines in service throughout the world.

Our products have been tested and approved to:

- 200g shock test undertaken by QinetiQ
- IMO Level 3 fire test undertaken for type approvals
- Smoke and Toxicity Test undertaken by QinetiQ
- Safety Case compliant with UK MoD DEFSTAN 00-56 & JSP 430

Future Pipe Industries recognises that naval commanders and government departments expect the best from their vessels and with ever increasing pressure to reduce a vessels weight (during build and through life), reduce the cost of maintaining the ship and increase operational availability & effectiveness. Future Pipe products are recognised the world over as a cost effective solution that contributes to making the modern warship less maintenance intensive, more affordable and possessing a more manageable weight distribution.

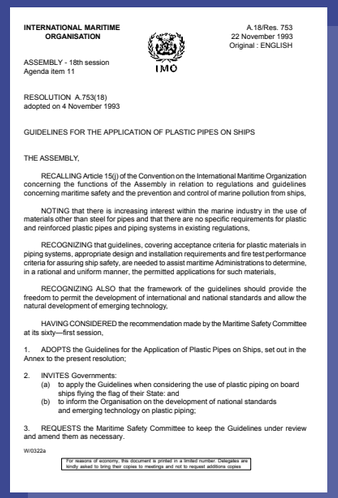
Tangible benefits to both the naval shipyard and the Navy; Fibermar & Wavistrong are typically 60% lighter than CiNiFe, are highly resistant to erosion & bio-fouling, have a service life in excess of 25 years, are more cost effective to procure than CuNiFe, require no maintenance and installation cost and time are also dramatically reduced.

TYPE APPROVALS & OTHER CERTIFICATIONS

FPI is committed to ISO 9001:2008 which ensures the highest standards of quality, reliability and customer service. Wavistrong and Fibermar are type approved by the major Classification Societies. Additionally FPI is the first Dutch company in this industry to obtain the Business Continuity Management certificate (BCM) which provides customers with further confidence that FPI is able to deliver even when faced with a wide range of obstacles and challenges.

IMO RESOLUTION

In 1993 IMO adopted resolution A.753 (18) "guidelines for the use of plastic pipes onboard ships". It stipulates in which systems and spaces GRE is permitted and not permitted. Next to design and installation criteria also requirements for fire are stipulated.



INTERNATIONAL MARITIME ORGANISATION

A.18/Res. 753
22 November 1993
Original : ENGLISH

ASSEMBLY - 18th session
Agenda item 11

IMO

RESOLUTION A.753(18)
adopted on 4 November 1993

GUIDELINES FOR THE APPLICATION OF PLASTIC PIPES ON SHIPS

THE ASSEMBLY,

RECALLING Article 15(j) of the Convention on the International Maritime Organization concerning the functions of the Assembly in relation to regulations and guidelines concerning maritime safety and the prevention and control of marine pollution from ships,

NOTING that there is increasing interest within the marine industry in the use of materials other than steel for pipes and that there are no specific requirements for plastic and reinforced plastic pipes and piping systems in existing regulations,

RECOGNIZING that guidelines, covering acceptance criteria for plastic materials in piping systems, appropriate design and installation requirements and fire test performance criteria for assuring ship safety, are needed to assist maritime Administrations to determine, in a rational and uniform manner, the permitted applications for such materials,

RECOGNIZING ALSO that the framework of the guidelines should provide the freedom to permit the development of international and national standards and allow the natural development of emerging technology,

HAVING CONSIDERED the recommendation made by the Maritime Safety Committee at its sixty—first session,

1. ADOPTS the Guidelines for the Application of Plastic Pipes on Ships, set out in the Annex to the present resolution;

2. INVITES Governments:
(a) to apply the Guidelines when considering the use of plastic piping on board ships flying the flag of their State: and
(b) to inform the Organisation on the development of national standards and emerging technology on plastic piping;

3. REQUESTS the Maritime Safety Committee to keep the Guidelines under review and amend them as necessary.

W/0322a

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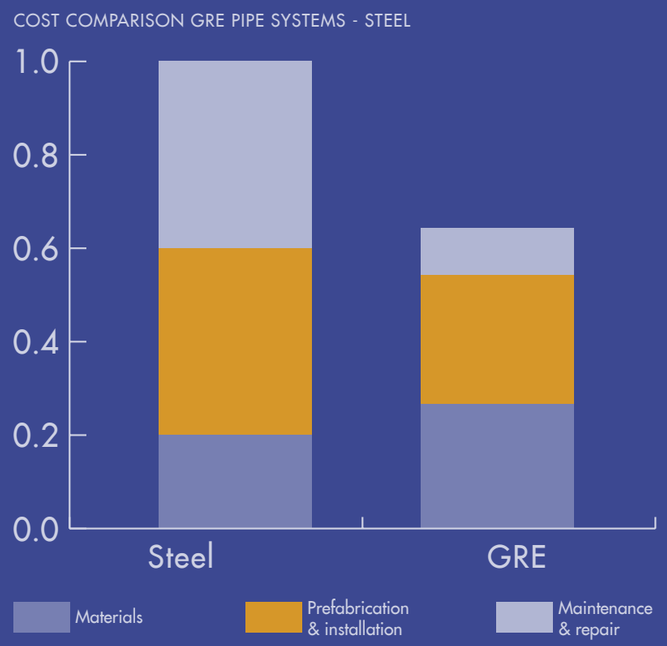
Pipe system locations in accordance with the fire endurance matrix according to IMO A. 753 (18) regulations

PIPING SYSTEM	Machinery spaces of category A.	Other machinery spaces and Pump rooms	Cargo pump rooms	Ro-ro cargo holds	Other dry cargo holds	Cargo tanks	Fuel oil tanks	Ballast water tanks	Cofferdams, void spaces, pipe tunnel & ducts	Accommodation, service and control spaces	Open decks
GRE not applicable / GRE from FPI allowed / GRE not allowed											
Cargo (flammable cargoes f.p. < 60°C											
Cargo lines								9			
Crude oil washing lines								9			
Vent lines								9			
Inert gas											
Water seal effluent lines			1				1	1	1		
Scrubber effluent lines	1	1						1	1		
Main lines											
Distribution lines											
Flammable liquids (f.p. > 60°C)											
Cargo lines						3		9			
Fuel oil						3					
Lubricating											
Hydraulic oil											
Seawater											
Bilge main and branches											
Fire main and water spray											
Foam system											
Sprinkler system											
Ballast											
Cooling water, essential services											
Tank cleaning services fixed machines										3	2
Non essential systems											
Fresh water											
Cooling water, essential services											
Condensate return											
Non essential systems											
Sanitary/Drains/Scuppers											
Deck drains (internal)	4	4		4							
Sanitary drains (internal)											
Scuppers and dischargers (overboard)	1 7	1 7	1 7	1 7	1 7					1 7	
Sounding/Air											
Water tanks/dry spaces						9					
Oil tanks (f.p. > 60°C)						9		9			
Miscellaneous											
Control air	5	5	5	5	5					5	5
Service air (non essential)											
Brine											
Auxiliary low pressure steam (7 bar)			8	8	8					8	8

Notes

1. Where non-metallic piping is used, remotely controlled valves to be proved at ship's side (valve is to be controlled from outside space)
2. Remote closing vales to be provided at the cargo tanks
3. When cargo tanks contain flammable liquids with f.p. > 60°C may replace or
4. For drains serving only the space concerned may replace
5. When controlling functions are not required by statutory requirements or guidelines may replace
6. For pipe between machinery space and deck water seal may replace
7. Scuppers serving open decks in positions 1 and 2, as defined in regulation 13 of the International Convention on Load Lines 1966, should be throughout unless fitted at the upper end with the means of closing capable of being operated from a position above the freeboard deck in order to prevent down flooding
8. For essential services such as fuel oil tank heating and ship's whistle is to replace
9. For tankers where compliance with paragraph 3(f) of regulations 13F of Annex 1 of MARPOL 73/78 is required is to replace

COST COMPARISON GRE PIPE SYSTEMS - STEEL



Although the GRE material cost is higher than steel material, the total installed cost of GRE is similar to steel piping. Moreover, mounting GRE will contribute to lower through life cost.

MARINE NETWORK & CONTACTS

FPI has a marine representative network covering 26 countries in Europe, the Middle East, Far East, Australia, South Africa and the Americas.