

# Bondstrand™ Marine Piping Systems





## Performance you trust... from products you know.... Bondstrand

Historically, ship owners have faced the grim reality of continuously replacing most metal piping because of severe corrosion. This results in piping systems costing multiple times the original investment over the life of the vessel since steel and other metal pipe systems are very costly to maintain and replace.

Bondstrand Glassfiber Reinforced Epoxy (GRE) systems are cost-effective, maintenance-free and light weight solutions designed to provide a corrosion-free and erosion-free operation during the service life of the vessel.

### The many advantages of Bondstrand GRE pipe systems

#### Durable and corrosion resistant

Bondstrand GRE piping is highly resistant to corrosion caused by saltwater, chemicals, residues and bacteria. Similarly, it resists external corrosion even in aggressive marine environments.

#### Light weight - easy to install

Bondstrand GRE pipe weighs only a quarter that of steel of pipes and is easy to install without the need of heavy installation equipment.

#### Low installation and operating cost

Installation costs of Bondstrand GRE pipe systems are lower than those for carbon steel, resulting in comparable total installed cost when product costs are factored in. Lower operating costs, due to superior hydraulic performance, reducing energy costs, are realized with Bondstrand. Additionally, should system modifications or repairs be necessary, they can be performed without disrupting the vessel operation as not "hot work" (welding) is required.

#### Wide range of systems

NOV Fiber Glass Systems offers a complete range of pipe systems in a variety of diameters and pressure classes for many different applications. Pipe systems are available in diameters up to 1000 mm (40 inch) and standard lengths up to 12 m (40 ft.).

#### No contamination

Bondstrand GRE does not rust or scale and is resistant to marine fouling. These features also contribute to the cost savings and reduced needs for maintenance.

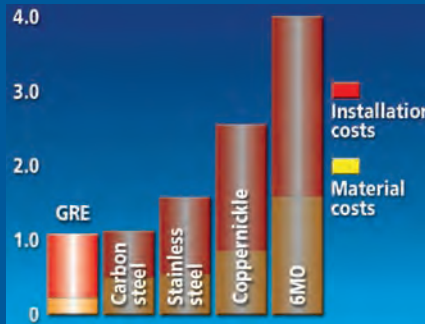
## OUTSTANDING BENEFITS

- Long Service Life
- Low Life-Cycle Cost
- Retrofit Solution
- Easy to Install
- Light Weight
- Corrosion Resistant

### COST COMPARISON WITH CONVENTIONAL STEEL MECHANICAL SYSTEMS

#### TOTAL INSTALLED COST EQUALS TRADITIONAL STEEL PIPING

A comparison of costs clearly shows the typical savings during the service life of the piping system.



## WIDE RANGE OF SOLUTIONS

Bondstrand GRE is available for a wide variety of demanding on-board applications for internal and external pressure as well as conductive requirements.

- Air and equipment cooling circulating water
- Ballast/segregated ballast
- Brine
- Chlorinated systems
- Crude oil washing
- Deck hot air drying (cargo tanks)
- Drainage/sanitary service/sewage
- Eductor systems
- Electrical conduit
- Exhaust piping
- Fire mains and sprinkler systems
- Fresh and salt water systems
- Inert gas effluent
- Main engine cooling
- Petroleum cargo lines (cargo tanks)
- Portable discharge lines
- Scrubbers
- Steam condensate
- Tankcleaning (salt water system)
- Dry deluge systems

## IMO REQUIREMENTS



IMO recognizes the increasing interest to use materials other than steel FOR SHIPS. In 1993, IMO developed guidelines (Res. A.753 [18]) to provide acceptance criteria for plastic materials in piping systems. Bondstrand GRE pipe used for marine and offshore applications are type approved by major certifying bodies.

## PRODUCT OVERVIEW

(External pressure rating according to IMO Regulations)

Series	Characteristics	Joining System	Maximum Operating Temperature		Maximum Operating Pressure		Nominal Pipe Size	
			C	F	bar	psi	mm	in
Bondstrand 2000M*	A standard epoxy system for applications where corrosion resistance and external pressures are of paramount importance.	Quick-Lock™ Taper/Taper	121 121	250 250	17.2 17.2	250 250	25 - 50 200 - 1000	1 - 6 8 - 40
Bondstrand 7000M**	An epoxy system with high strength conductive filaments incorporated in the wall of the pipes to prevent accumulation of static electricity.	Quick-Lock™ Taper/Taper	121 121	250 250	17.2 17.2	250 250	25 - 50 200 - 1000	1 - 6 8 - 40

\* Also available without liner

\*\* Conductive version of Bondstrand 2000M

Note: All systems are available with a fire-protection layer.

# FIRE ENDURANCE

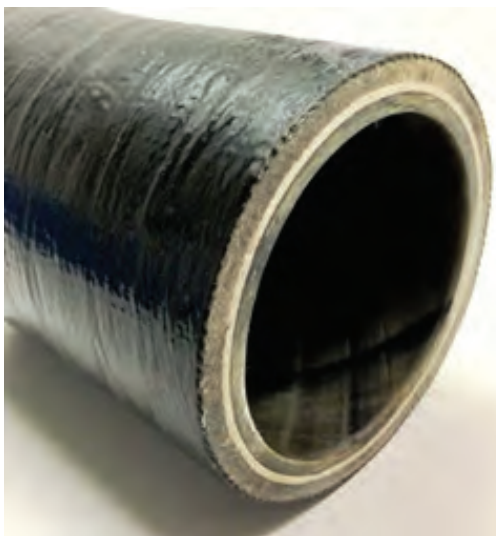


## Epoxy pipe

Under IMO Rules, certain Bondstrand epoxy products can be used for systems (normally water filled) without additional passive fire protection. Fire exposure will cause the outer surface of the pipe to char, but the functionality of the systems remains.

## Additional fire protection

Depending on the level of fire endurance, enhanced fire protection solutions are available by use of standard products with added passive fire protection.



## 7000M-FP (Fire Protection)

### Fire endurance requirements matrix according to IMO A.753 [18]

- Bondstrand GRE approved systems
- Not applicable
- Not allowed

CARGO (flammable cargoes f.p <60°C)

Cargo lines

Crude oil washing lines

Vent lines

INERT GAS

Water seal effluent lines

Scrubber effluent lines

Main lines

Distribution lines

FLAMMABLE LIQUIDS (f.p. > 60°C)

Cargo lines

Fuel oil

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

Non essential systems

FRESH WATER

Cooling water, essential services

Condensate return

Non essential systems

SANITARY / DRAINS / SCUPPERS

Deck drains (internal)

Sanitary drains (internal)

Scuppers and dischargers (overboard)

SOUNDING / AIR

Water tanks / dry spaces

Oil tanks (f.p. > 60°C)

MISCELLANEOUS

Control air

Service air (non essential)

Brine

Auxiliary low pressure steam ( $\leq 7$  bar)

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 and ducts

Accommodation service and control spaces

Open decks

- 1 Where non-metallic piping is used, remotely controlled valves to be provided at ship's side (valve is to be controlled from outside space).
- 2 Remote closing valves 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 regulation 13F of Annex I of MARPOL 73/78 is required, is to replace .



**Bondstrand conductive piping systems** have been developed to prevent accumulation of potentially dangerous levels of static electrical charges.

Pipe and flanges contain high strength conductive filaments; the fittings include a conductive liner. Combined with a conductive adhesive this provides an integral electrically continuous system.

Grounding saddles can be bonded on the pipe. Integral grounding cables are then bolted to the ship's structure to drain accumulated charges.

## ENGINEERING CAPABILITIES

With manufacturing locations all over the world, FGS has experienced teams of engineers supporting the customer with design, engineering, training, spool making and installation. Services include general calculations such as support span, thrust loads, joint strength, collapse pressure and internal pressure ratings. Assistance in design drawings, stress and hydraulic analyses, drawings from isometrics, support detailing and material takeoffs is offered. We offer supervision and/or survey of installation, special product design for custom made parts, expertise on international specification work to obtain approval authorities, field service, and training to certify installers.

## PREFABRICATION

Bondstrand GRE systems are assembled using industrially manufactured components. Spools can be pre-fabricated at the yard or can be supplied from FGS spooling operation or one of the network partners, limiting the need for adhesive bonded joining on board. If spacing is a constraint, FGS offers custom made spools to meet specific dimensions and our team of piping engineers and fabricators can assist to ensure the custom-made spools are designed and fabricated to meet the design requirements. Pre-fabricated spools will reduce the number of field joints and provide greater reliability because of the high quality joints and testing at our factory. Installers that are trained and certified by FGS according to IMO standards can handle the complete installation.

## RETROFIT

Ships operate in seawater which is one of the most corrosive environments. Corroded steel and metal piping constantly needs to be replaced during the lifetime of the vessel. Often certain pipe is treated as consumables and Bondstrand GRE addresses these problems. Over the years, numerous steel, cupronickel and other piping materials used in engine rooms, ballast systems, inert gas systems and vent lines have been replaced successfully with Bondstrand pipe, the solution that lasts the lifetime of the vessel. FGS is positioned to competitively replace existing piping offering long-term solutions, reduced downtime, no painting required, and improved flow characteristics.



## QUICK-LOCK™

An adhesive-bonded joint with straight spigot and tapered bell. The integral pipe stop in the Quick-Lock bell ensures accurate laying lengths in close tolerance piping.

Available in sizes 25-150 mm (1-6 in).

## TAPER/TAPER

An adhesive-bonded joint with matching tapered male and female ends offering superior joint strength by controlled adhesive thickness.

Available in sizes 2000-1000 mm (8-40 in).

## DOUBLE O-RING

A mechanical joint offering quick assembly between male and female ends. Two "O" rings are employed to provide sealing. Available in sizes 25-900 mm (1-36 in).

## FLANGES

One-piece flanges and Van Stone-type flanges with loose flange rings.

Available in sizes 25-1000 mm (1-40 in).

## DOUBLE O-RING EXPANSION COUPLING

A mechanical coupling provides an excellent seal: This coupling – available with Quick-Lock and Taper connections – is configured with a Key-Lock adaptor and a Double O-Ring adaptor.

### Key-Lock adaptor:

Employed with a nylon locking key and two elastomeric O-rings.

### Double O-Ring adaptor:

Employed with two elastomeric O-rings in Nitrile Butadiene Rubber (NBR) or Ethylene Propylene Rubber (EPDM)

## SALES OFFICES

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## Well Service and Completion Solutions

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