











QUAKEWRAP'S PIPELINE AND STORAGE INFRASTRUCTURE SOLUTIONS

www.pipemedic.com www.quakewrap.com

QuakeWrap's Pipeline and Storage Infrastructure Solutions

QuakeWrap specializes in infrastructure rehabilitation with fiber reinforcement polymers (mainly carbon and glass fiber). We provide design, materials, training, and installation for strengthening of pipelines and fluid storage facilities (tanks).

Our pipeline solutions span from external wrapping and internal wrapping of small diameter pipes (less than 30 in. / 76 cm) to internal lining of large diameters pipes with virtually no upper limit. QuakeWrap's FRP pipe liners are made of materials of highest strength in the industry. As such, the design wall thickness is minimal, thereby often times improving the hydraulic capacity of the existing pipe due to lowered roughness coefficient on the interior. Each FRP pipeline rehab solution entails a unique design and fiber orientation depending on the loads and environmental factors associated with the project. Our FRP liners are light weight, hence easy to install



requiring no special equipment for most projects. They are NSF 61 and 372 certified for drinking water applications and corrosion resistant against sulfuric assistant and other abrasive chemicals that may be present in sewers and industrial applications.

QuakeWrap's FRP linings are an ideal solution for rehabilitation of corroded storage tanks used for water and other types of fluid detention. In addition to providing corrosion protection, FRP lining systems will improve the structural integrity of a storage tank, thereby extending or resetting its service life. Our FRP solutions are long-term and for most site conditions, they are designed to last 50+ years.





The Wet Layup Method

Wet layup entails applying resin (epoxy) saturated FRP fabrics as a cured-in-place method. The FRP fabrics can either be applied by the hand layup method or using a packer for small diameter pipes that would not allow person entry.

The wet layup system is one of the most effective ways of strengthening high pressure pipes. In one of the first applications of this technique, QuakeWrap products were used to structurally line a 120-inch (3-m) diameter Prestressed Concrete Cylinder Pipe (PCCP) at the largest nuclear power plant in the USA.



In this technique, sheets of carbon fabric that are typically 2-4 ft (600-1200 mm) wide are saturated with our engineered epoxy resin and applied as sheets in the hoop and longitudinal direction. The ends of these sheets are overlapped to provide a continuous lining, thereby achieving a proper load transfer. Existing pipes can be lined internally or wrapped externally with FRP using this method.



StifPipe®

StifPipe® is an award-winning FRP composite pipe technology that uses a core (3D) fabric along with carbon and glass fiber reinforcement to create an extremely lightweight pipe capable of resisting heavy external loads and internal pressure.

StifPipe® can be pre-manufactured for installation with the sliplining method or can be applied layer by layer with the wet layup method for lining both pressure pipes and gravity flow pipes.

StifPipe® is comprised of a custom-design sandwich structure without the need of excessive layers of carbon fiber. It is a high-strength, lightweight, and corrosion resistant product ideal for water, wastewater, stormwater, oil, gas, and other fluid conveyance systems subject to internal and external loads. StifPipe®'s strength to unit weight ratio is unmatched by any material used in the pipeline industry. It can be used for structural pipeline rehabilitation with trenchless technology (by the wet layup or sliplining method) or new pipe installation. Sliplining with StifPipe® typically does not require any jacking equipment due to its light weight.





USES

- Structural lining of pipelines (no-dig)
- Structural point repair of pipelines (no-dig)
- New pipe installation (open-cut or trenchless)
- Applicable to all types of host pipe materials.

ADVANTAGES

- Made of ultra-high strength FRP layers
- Corrosion resistant (inert to sulfuric acid and other chemicals listed in ASTM D543)
- High dimension ratio (50-100) due to high strength and thinner wall thickness
- Hydraulic capacity is improved for most applications due to smooth surface, thus low Manning's n value, and low thickness
- Easy installation with lightweight materials (e.g., a typical 36- inch StifPipe® weighs 30-35 lbs./ft.)
- Can be made to any shape to fit the host pipe

Manufacture

StifPipe® can be installed with the conventional FRP installation method (wet layup) or can be made on a mandrel and installed by sliplining.

For most cases, the wet layup will require surface prep and environmental controls. The prefab StifPipe® can be manufactured on or in the vicinity of the project site. Each layer of glass, carbon fiber and 3D core layer is wrapped on a mandrel and let cure for 12 hours at room temperature. The curing process can be accelerated by using heat for both methods.



INSTALLATION

(Basic steps of installation are indicated below. Refer to the technical specification for details.)

WET LAYUP

- Remove sharp protrusions and other irregularities
- Smoothen or abrade the surface as necessary to achieve a surface profile for required bond strength
- Clean the pipe surface of any debris, sediments, dust, tree roots, oil and grease by pressure washing and other means as necessary
- Apply a primer then a tack coat (epoxy) on the surface
- ▶ Apply resin saturated layers of StifPipe® per the design
- > Apply a final, abrasion resistant top-coat and let cure
- Return the rehabilitated pipe to service after 12 hours or less with heated cure.



INSTALLATION

(Basic steps of installation are indicated below. Refer to the technical specification for details.)

SLIPLINING

- Inspect the interior of the pipe, smoothen out any protrusions or joint offsets greater than 3% of the pipe internal diameter.
- It can be installed with a jack, pulled with straps, or alternatively pushed along manually or with a pipe carrier machine using a wheeled assembly (that can fit into the extra space). StifPipe® can safely take over 10,000 psi (70 MPa) of axial (compressive) stress during installation.
- Pump polymeric (epoxy or polyurethane) or cementitious grout into annular space.

STORAGE AND HANDLING

- StifPipe® is a thin-wall and highly flexible pipe. Avoid impact damage from rocks or other sharp objects during unloading and installation.
- Protect pipes stored with wooden studs and wooden/plastic chocks.



- The product should ideally be loaded/unloaded with straps. Avoid any stress concentrations by using chains, etc. Hooks and embedded lugs are not needed or recommended for loading/unloading and installation.
- Avoid dragging StifPipe® over rocks and any sharp objects
- Refer to the technical specification for other details.



StifPipe® Properties

StifPipe® design is specific to each project depending on the internal and external loads. A typical design is comprised of dual layer (with chopped mat for improved impermeability) glass fiber, carbon fiber, and 3D polymeric fabric for improved stiffness.

Property*	Imperial	SI	
Size (ID)	54-in.	1,370 mm	
Thickness	0.56 in.	14 mm	
Weight	50 lb./ft.	74 kg/m	
Pipe Stiffness (ASTM D2412)	43	43	
Modulus of Elasticity (ASTM D2412)	8,124,000 psi	56,000 MPa	
Flexural Strength (ASTM D790)	22,287 psi	154 MPa	
Max Deflection	6%	6%	
Axial Strength (Compressive)	11,000 psi	76 MPa	
Abrasion Wear Index (ASTM D4060)	0.016 oz.	457 mg	
Chemical Resistance	<1% Weight gain in 10% Sulfuric Acid	<1% Weight gain in 10% Sulfuric Acid	

*For a sample 54-in. pipe. Properties vary depending on the size and design loads.



Nominal	External Pressure (psi/kPa)						
Diameter	10/69	30/207	50/345	70/483	90/621	110/758	
(in./mm)* Minimum Wall Thickness (in./mm)							
18/460	0.33/8	0.33/8	0.33/8	0.33/8	0.33/8	0.33/8	
24/610	0.3/8	0.33/8	0.33/8	0.33/8	0.36/9	0.39/10	
30/760	0.5/13	0.5/13	0.52/13	0.52/13	0.6/15	0.9/23	
36/910	0.50/13	0.5/13	0.52/13	0.6/15	0.65/17	0.9/23	
48/1220	0.5/13	0.5/13	0.9/23	0.9/23	0.9/23	0.9/23	
54/1370	0.54/14	0.6/15	0.9/23	0.9/23	0.9/23	1.0/25	
60/1520	0.6/15	0.65/17	0.9/23	0.9/23	0.9/23	1.0/25	
66/1680	0.7/18	0.9/23	0.9/23	0.9/23	1.0/25	1.3/33	
72/1830	0.7/18	0.9/23	0.9/23	1.0/25	1.1/28	1.3/33	
78/1980	0.9/23	0.9/23	0.9/23	1.0/25	1.3/33	1.3/33	
84/2130	0.9/23	0.9/23	1.0/25	1.1/28	1.3/33	1.3/33	
96/2440	1.0/25	1.0/25	1.1/28	1.3/33	1.3/33	1.3/33	
120/3050	1.2/31	1.2/31	1.3/33	1.3/33	1.4/36	1.5/38	
144/3660	1.3/33	1.3/33	1.3/33	1.4/36	1.5/38	1.6/41	
168/4270	1.30/33	1.30/33	1.34/34	1.57/40	1.73/44	1.89/48	
192/4880	1.34/34	1.34/34	1.57/40	1.81/46	2.12/54	2.20/56	

RING STIFFNESS

With its composite system of carbon/glass fiber, and proprietary 3D fabric, StifPipe® is designed to take high external loads at minimal thickness and weight. StifPipe® mechanical properties are specific to each project and design. The Pipe Stiffness (PS value per ASTM D2412) is typically within the range of 50 to 100.



JOINTS



StifPipe® pipe segments are connected in two ways:

- Butt-joined pipe segments are connected with cured-in-place FRP strips or
- Pipe segments are made with bell and spigot ends, and the spigot with a custom-design gasket is pushed into the bell.

SuperLaminate[™]

SuperLaminate[™] is a .composite pipe point repair system suitable for smaller pressure and gravity pipes. It can be used on pipes that convey any type of fluid and can be applied internally and externally. It is a high-strength, lightweight, and corrosion resistant product ideal for water, hot (process) water, oil, gas, and other fluid conveyance systems subject to internal and external loads. It is an easy to install system with a minimal number of composite layers due to its unique fiber orientation, high strength, and light weight.

USES

- No-dig pipe repair system.
- Typically applied to pressure pipes.
- Applicable to all types of pipe materials.
- Precured laminate option is available to span any gaps on the existing pipe.





ADVANTAGES

- Made of ultra-high strength glass and carbon fiber reinforced polymer (CFRP/GFRP) layers.
- Can be designed to any pressure.
- Corrosion resistant.
- ▶ Type A (non-leaking) and Type B (leaking) pipe repairs per ASME PCC2 / Part 4.
- Can be applied without interruption to service.
- Can be installed without excavation (no-dig) into buried pipes using an inflatable packer.
- Can accommodate essentially any shape of host pipe.
- A typical installation is completed in less than 4 hours.

INSTALLATION (INTERNAL)

- Stop any leaks by chemical grout injection.
- ▶ Saturate the SuperLaminate[™] fabric layers with high strength epoxy.
- Wrap the inflatable packer with saturated FRP fabric. Tie thin ropes to hold the FRP fabric in place.
- ▶ Deploy the packer with SuperLaminate[™].
- ▶ Inflate the packer to 15-20 psi internal pressure at the location of repair.
- ▶ Let the system cure in inflated position for eight hours or less if heat cured.
- Deflate the packer and pull it out of the pipe.
- Return the repaired pipe back to service.

INSTALLATION (EXTERNAL)

- Stop any leaks by using a hydrophobic sealant (Type B repairs).
- Remove any sharp protrusions and other irregularities.
- Clean the pipe surface of any debris, sediments, dust, tree roots, oil and grease.
- Smoothen or abrade the surface as necessary to achieve a surface profile for required bond strength.
- Apply a primer then a tack coat (epoxy) on the surface.
- ▶ Apply resin saturated layers of SuperLaminate[™] per the design.
- Apply a final UV resistant top-coat (as necessary).

Please visit our Youtube channel for videos on our products and case studies: https://www.youtube.com/@QuakeWrapInc