DIAMONDWRAP® BY CITADEL TECHNOLOGIES

BLACKDIAMOND® BY CITADEL TECHNOLOGIES

DIAMONDWRAP HP BY CITADEL TECHNOLOGIES

RHINOWRAP BY CITADEL TECHNOLOGIES

SLS-SERIES™ BY CITADEL TECHNOLOGIES

GOT IT COVERED.

CUSTOM DESIGNED SOLUTIONS.

Structural Carbon/Epoxy Rehab System for the Prevention and Repair of Leaking or Corroded Piping Systems

CITADEL TECHNOLOGIES

TRIMITZ HIGH PERFORMANCE COATINGS

February, 2011

To Our Valued Customers:

Citadel Technologies has been headquartered in Tulsa, Oklahoma USA since 1993 and is the developer and manufacturer of carbon composite repair systems. Our products include **DIAMONDWRAP®**, **BLACKDIAMOND®**, **DIAMONDWRAP® HP™, RHINOWRAP™** and the **SLS-SERIES™** of primers and coatings. They are the most extensively tested products on the market and have been installed in over 40 countries.

As the best alternative to clamps and replacement, our products of carbon fiber and 100% solid epoxies are used to rehabilitate and restore original strength to damaged, corroded and eroded pipelines and pipe systems. **DIAMONDWRAP®** can also facilitate the repair of leaks, making these systems premier in the market of non-metallic repairs.

Our **SLS-Series™** of coating system provides protection of surfaces for corrosion, erosion and harsh environments.

Citadel Technologies products are compliant with all major composite repair standards, including ASME PCC-2 and ISO-TS 24817. Our commitment to excellence assures that, all systems are continually tested and reviewed using both in-house research and independent labs to insure that we maintain our leadership in the industry.

If you are interested in additional information, please contact our authorized distributor in your area or our office in Tulsa, Oklahoma.

Regards,

Roger H. Walker, PE
President

REGISTERED PROFESSIONAL ENGINEER
ROGER H. WALKER
13028
OKLAHOMA

CUSTOM DESIGNED SOLUTIONS FOR:

Oil and Gas Pipelines	Nuclear and Power Plants
Chemical Plants	Mining
Water/Wastewater Facilities	Pulp and Paper Mills
Refineries	Offshore/Marine Terminals

CONVENIENT AND COST EFFECTIVE

Citadel Technologies´ products save time, labor and equipment costs. In most cases there is no plant downtime. Pipes can be wrapped while the line is in service, requiring no line evacuation, no welding of pipe, no need to cut the pipe, no heavy equipment handling requirements and no volatile compounds (VOC's).

MSDS: Routinely shipped by air freight.

COMPLIANT STANDARDS

- ASME PCC-2-2006 Post Construction Code Repair using Non-metallic Materials
- ASME B31.4 Paragraph 451.6.2
- ASME B31.8 Paragraph 851.42
- ISO-TS 24817 – Composite repairs for pipe work – Qualification and design, installation, testing and inspection
- NRF-030-PEMEX-2006 paragraph 8.4.2.4.6
- NRF-0187-PEMEX-2007 paragraph 8.6.2.5
- API 570
- DOT *

**Note: These standards do not endorse products, but sets forth regulations for non-metallic repairs in CFR Parts 192 and 195*

ADDITIONAL SERVICES

Citadel Technologies engineering team can provide you the following:

- Technical Sessions to provide answers to your questions regarding composites.
- InstallationTraining.
- InspectorTraining.
- Impressive summary of the extensive testing performed.
- Regularly scheduled training and certifications classes.

DESCRIPTION

DIAMONDWRAP® is the premier carbon fiber wrap system used to rehabilitate and restore original operational strength to damaged, corroded and eroded piping systems. **DIAMONDWRAP®** is engineered to provide strength that enables a pipe to be restored to maximum allowable operating pressure (MAOP) without shutting down.The system is comprised of the three components, each thoroughly and independently tested at both the university and international laboratory level. The first component is an epoxy primer, which ensures complete bonding and load transfer between the repair and the substrate. The second component and most unique feature of the **DIAMONDWRAP®** system, is its selection of bi-directional woven carbon-fiber materials, which provides reinforcement in the hoop and axial directions and is the strongest available non-metallic repair on the market. The third part of the binding force in the system is the polymeric epoxy resin, which allows for uniform loading thoroughly the entire wrap. For repairs that require surfaces to be modified (e.g.: heavy pitting or irregular shapes), the high modulus filler can be applied. These components form a composite system that is stronger than steel.The structural system forms a pipe around a pipe, and each successive wrap increases the pressure rating. Minimal creep ensures a long service life.

DIAMONDWRAP® requires an engineering assessment to compile service information such as substrate material, wall loss, operating temperature, pressure ranges and environment exposure. **Citadel Technologies´DIAMONDWRAP® Wizard®** software analyzes this information to determine the number of wraps required for each pipe repair.

Because of its wet lay-up and low profile, **DIAMONDWRAP®** can be installed on tees, elbows, straight runs of pipe, confined spaces and irregular surfaces that require structural reinforcement or leak containment.The adhesive properties of the epoxy allow it to be applied to most substrates.

Features and Characteristics

- Superior alternative to clamps.
- All pipe sizes.
- Straight length, elbows, tees, valves, fittings, vessels.
- Compatible with carbon steel, stainless steel, alloys, PVC, fiberglass and more.
- High pressure – Low profile.
- Carbon fabric wrap (PAN-Polyacrylnitrile).
- High corrosion resistance.
- Long service life.
- NoVOC´s.
- **DIAMONDWRAP®** 100% solids epoxy systems for chemical resistance.
- No hot works. / No welding.
- Engineered solution.
- Supplied as a complete kit.
- Chemically resistant.
- Able to withstand high temperatures.
- High strength.
- Fast curing.
- Extensively tested in labs and in the field.

Make it safely to the next turnaround or longer without an emergency plant shut down!

PROPERTIES

	METRIC SYSTEM	ENGLISH SYSTEM
Layers Normal Range (Typical)	2 to 6 (One Layer = One Ply)	2 to 6 (One Layer = One Ply)
CureTime	Typically 5 Hours @ 25°C	Typically 5 Hours @ 77°F
Total Maximum Recommended OperatingTemperature	82°C Standard	180°F Standard
Chemical Resistance	Excellent (See chemical resistance p. 31)	Excellent
NominalThickness	0.91 mm for 2 Ply BA Fabric to 2.74 mm for 6 Ply BA Fabric	0.036 in for 2 Ply BA Fabric to 0.108 in for 6 Ply BA Fabric
Fabric	PAN (Polyacrylnitrile)	PAN (Polyacrylnitrile)
Carbon Content byVolume	21% to 40%	21% to 40%
Glass Fiber Content byVolume	0%	0%
Lap Sheer (Adhesive) Strength	> 8,618 kPa @ 60°C	> 1,250 PSI @ 140°F
Compressive Strength of Putty	33,129 kPa @ 60°C	8,805 PSI @ 140°F
Hardness	78 to 84 (Shore D)	78 to 84 (Shore D)
Linear Elastic Behavior	1.20% Strain to Failure	1.20% Strain to Failure
Elastic Modulus, Hoop Direction	3.47×10^7 kPa for BA	5.03×10^6 PSI for BA
Elastic Modulus, Axial Direction	3.16×10^7 kPa	4.59×10^6 PSI
Tensile Strength, Hoop Direction	4.44×10^5 kPa	6.44×10^4 PSI
Tensile Strength, Axial Direction	2.72×10^5 kPa	3.94×10^4 PSI
Coefficient ofThermal Expansion, Hoop Direction	2.52×10^{-5}/°C	1.4×10^{-5}/°F
Coefficient ofThermal Expansion, Axial Direction	1.278×10^{-5}/°C	0.71×10^{-5}/°F
Design Stress, Hoop Direction	3.42×10^5 kPa	4.96×10^4 PSI
Design Stress, Axial Direction	2.09×10^5 kPa	3.03×10^4 PSI
Fatigue (cycle without failure - defect dependent)	>100,000 cycles (0-100% MAOP) with up to 80% wall loss	>100,000 cycles (0-100% MAOP) with up to 80% wall loss

(*)Testing as of October 2010 should confirm increasing the maximum temperature of 287°C (550°F)


BEFORE


AFTER

DIAMONDWRAP®

TECH DATA SUMMARY

Citadel Technologies is the industry leader in manufacturing specialty epoxies for use in specialized composite wrap and coating applications. Citadel Technologies' epoxies go unmatched in range, quality, and performance. These specialty epoxies include three different High Temperature systems and an Acid system designed for use with harsh chemicals. Go where no other non-metallic composite wraps can go with these kits available from CitadelTechnologies!

DiamondWrap® High Temperature Ambient™ (HTA) Epoxy System DiamondWrap® High Temperature 701™ (HT701) Epoxy System DiamondWrap® Ultra High Temperature™ (UHT) Epoxy System DiamondWrap® Acid Epoxy System

HIGH TEMPERATURE ENVIRONMENTS

The DiamondWrap® High Temperature kits have been designed to be applied to pipes that operate above 149°C (300°F). Three different high temperature kits are available depending upon the conditions of the pipe and the application: High Temperature Ambient™ (HTA), High Temperature 701™ (HT701), Ultra High Temperature™ (UHT).

DIAMONDWRAP® HIGH TEMPERATURE AMBIENT™ (HTA) EPOXY SYSTEM

This kit is designed to be used on pipes that operate at temperatures up to 149°C (300° F)The HighTemperature Ambient™ kit is formulated to properly cure at temperatures between 82°C-149°C (180°F-300°F) with no additional he at required. It is great for pipes that operate at elevated temperatures, but will be wrapped while the line is out of service.

PROPERTY	METRIC SYSTEM	ENGLISH SYSTEM
GlassTransitionTemperature	171°C	340°F
Maximum Recommended OperatingTemperature	149°C	300°F
Recommended ApplicationTemperature Range	82°C - 149°C	180°F - 300°F
Tensile Strength, Hoop Direction	576,719kPa	83,646 PSI
Tensile Strength, Axial Direction	247,729 kPa	35,930 PSI
Elastic Modulus, Hoop Direction	49.1×10^6 kPa	7.13×10^6PSI
Elastic Modulus, Axial Direction	23.8×10^6 kPa	$3,46 \times 10^6$PSI
NominalThickness	1.016mm(2Ply)-3.43mm(6Ply)	0.04in(2Ply)-0.135in(6Ply)
Carbon Fiber %	35 - 50%	35 - 50%
Glass Fiber %	0%	0%
ResinType	2 Part, 100% Solid Epoxy	2 Part, 100% Solid Epoxy
Lap Shear	>8,273.71 kPa	>1,200 PSI
Hardness @ Full Cure	80 Shore-D	80 Shore-D
Primer Color Code	Gray	Gra

HIGH TEMPERATURE ENVIRONMENTS

The DiamondWrap® High Temperature kits have been designed to be applied to pipes that operate above 149°C (300°F). Three different high temperature kits are available depending upon the conditions of the pipe and the application: High Temperature Ambient™ (HTA), High Temperature 701™ (HT701), Ultra High Temperature™ (UHT).

DIAMONDWRAP® HIGH TEMPERATURE 701™ (HT701) EPOXY SYSTEM

The High Temperature 701™ kit has been designed to be applied on pipes that operate at temperatures up to 177°C (350°F).This kit has been formulated to cure at elevated temperatures, which allows them to be applied to pipes at elevated temperatures without the threat of reduced workability. To properly cure, these kits must be heated to at least 66°C (150°F) after installation unless the pipe is operating above this temperature when the product is applied.

DIAMONDWRAP® HT701 EPOXY DATA

PROPERTY	METRIC SYSTEM	ENGLISH SYSTEM
Glass Transition Temperature	196°C	385°F
Maximum Recommended Operating Temperature	177°C	350°F
Recommended Application Temperature Range	66°C - 150°C	150°F - 300°F
Tensile Strength, Hoop Direction	576,719kPa	83,646 PSI
Tensile Strength, Axial Direction	247,729 kPa	35,930 PSI
Elastic Modulus, Hoop Direction	49.1×10^6 kPa	7.13×10^6PSI
Elastic Modulus, Axial Direction	23.8×10^6 kPa	3.46×10^6PSI
Nominal Thickness	1.016mm(2Ply)-3,43mm(6Ply)	0.04in(2Ply)-0.135in(6Ply)
Carbon Fiber %	35 - 50%	35 - 50%
Glass Fiber %	0%	0%
Resin Type	2 Part, 100% Solid Epoxy	2 Part, 100% Solid Epoxy
Lap Shear	>8,273.71 kPa	>1,200 PSI
Hardness @ Full Cure	80 Shore-D	80 Shore-D
Primer Color Code	Orange/Chocolate	Orange/Chocolate

HIGH TEMPERATURE ENVIRONMENTS

The DiamondWrap® High Temperature kits have been designed to be applied to pipes that operate above 149°C (300°F). Three different high temperature kits are available depending upon the conditions of the pipe and the application: High Temperature Ambient™ (HTA), High Temperature 701™ (HT701), Ultra High Temperature™ (UHT).

DIAMONDWRAP® ULTRA HIGH TEMPERATURE™ (UHT) EPOXY SYSTEM

This system is pre-impregnated carbon fabric using Citadel Technologies' Ultra-High Temperature™ epoxy system. This epoxy has been formulated to be applied to pipes operating at temperatures up to 288°C (550°F). Curing of this epoxy requires a minimum temperature of 149°C (300°F) either from the piping system itself, or with the addition of an external heatsource.

DIAMONDWRAP® UHT EPOXY DATA

PROPERTY	METRIC SYSTEM	ENGLISH SYSTEM
GlassTransitionTemperature	304°C	580°F
Maximum Recommended OperatingTemperature	288°C	550°F
Recommended ApplicationTemperature Range	149°C - 232°C	300°F - 450°F
Tensile Strength, Hoop Direction	576,719 kPa	83,646 PSI
Tensile Strength, Axial Direction	247,729 kPa	35,930 PSI
Elastic Modulus, Hoop Direction	49.1×10^6 kPa	7.13×10^6PSI
Elastic Modulus, Axial Direction	23.8×10^6 kPa	3.46×10^6PSI
NominalThickness	1.016mm(2Ply)-3.43mm(6Ply)	0.04in(2Ply)-0.135in(6Ply)
Carbon Fiber %	35 - 50%	35 - 50%
Glass Fiber %	0%	0%
ResinType	2 Part, 100% Solid Epoxy	2 Part, 100% Solid Epoxy
Lap Shear	>8,273.71 kPa	>1,200 PSI
Hardness @ Full Cure	80 Shore-D	80 Shore-D
Primer Color Code	Nearly Clear	Nearly Clear

HARSH CHEMICAL ENVIRONMENTS

DIAMONDWRAP® ACID EPOXY SYSTEM

The DiamondWrap® Acid kit has been designed to be applied in areas, and on pipes, that contain harsh chemicals that will cause problems or deterioration in other epoxies. For a partial list of chemicals that are compatible with the DiamondWrap® systems, please reference our Chemical Resistance Chart. If a specific chemical that you work with is not on this list, please contact CitadelTechnologies for additional information and we will determine how the chemical will affect our system.

DIAMONDWRAP® ACID EPOXY DATA

PROPERTY	METRIC SYSTEM	ENGLISH SYSTEM
GlassTransitionTemperature	121°C	250°F
Maximum Recommended OperatingTemperature	83°C	180°F
Recommended ApplicationTemperature Range	27°C - 60°C	80°F - 140°F
Tensile Strength, Hoop Direction	576,719 kPa	83,646 PSI
Tensile Strength, Axial Direction	247,729 kPa	35,930 PSI
Elastic Modulus, Hoop Direction	49.1×10^6 kPa	7.13×10^6PSI
Elastic Modulus, Axial Direction	23.8×10^6 kPa	3.46×10^6PSI
NominalThickness	1.016mm(2Ply)-3,43mm(6Ply)	0.04in(2Ply)-0.135in(6Ply)
Carbon Fiber %	35 - 50%	35 - 50%
Glass Fiber %	0%	0%
ResinType	2 Part, 100% Solid Epoxy	2 Part, 100% Solid Epoxy
Lap Shear	>8,273.71 kPa	>1,200 PSI
Hardness @ Full Cure	80 Shore-D	80 Shore-D
Primer Color Code	Green	Green


BEFORE


DIAMONDWRAP® HTA™
AFTER


DIAMONDWRAP® ACID

DESCRIPTION

BLACKDIAMOND® is the premier carbon fiber wrap system used to rehabilitate and restore original operational strength to damaged, corroded and eroded pipelines. **BLACKDIAMOND®** is engineered to provide strength that enables a pipeline to be restored to maximum allowable operating pressure (MAOP) without shutting down. The system is comprised of the three components, each thoroughly and independently tested at both the university and national laboratory level. The first component is an epoxy primer, which ensures complete bonding and load transfer between the repair and the substrate. The second component and most unique feature of the **BLACKDIAMOND®** system, is its bi-directional woven carbon-fiber material, which provides reinforcement in the hoop and axial directions and is the strongest available non-metallic repair on the market. The third part of the binding force in the system is the polymeric epoxy resin, which allows for uniform loading thoroughly the entire wrap. For repairs that require surfaces to be modified (e.g: heavy pitting), the high modulus filler can be applied. These components form a composite system that is stronger than steel. The structural system forms a pipe around a pipe, and each successive wrap increases the pressure rating. Minimal creep ensures a long service life.

BLACKDIAMOND® requires an engineering assessment to compile information such as substrate material, wall loss, operating temperature and pressure ranges. **Citadel Technologies' BLACKDIAMOND® Wizard®** software analyzes this information to determine the number of wraps required for each pipeline repair.

Because of its wet lay-up and low profile, **BLACKDIAMOND®** can be installed on tees, elbows, straight runs of pipe, confined spaces and irregular surfaces that require structural reinforcement.The adhesive properties of the epoxy allow it to be applied to most substrates.

Features and Characteristics

- Superior alternative to clamps.
- All pipe sizes.
- Straight length, elbows, tees.
- Compatible with carbon steel, stainless steel, alloys, PVC, fiberglass and more.
- High pressure – Low profile.
- Carbon fabric wrap (PAN-Polyacrylnitrile).
- High corrosion resistance.
- Long service life.
- NoVOC´s.
- **BLACKDIAMOND®** 100% solids epoxy systems for chemical resistance.
- No hot works. / No welding.
- Engineered solution.
- Supplied as a complete kit.
- Chemically resistant.
- Able to withstand high temperatures.
- High strength.
- Fast curing.
- Extensively tested in labs and in the field.

NOTE: BLACKDIAMOND® SYSTEM IS DESIGNED FOR INSTALLATION ON TRANSMISSON PIPELINES. BLACKDIAMOND® SYSTEM IS NOT INTENDED FOR USE ON A PIPELINE LEAK REPAIR.
LEAK REPAIR SHOULD BE CONDUCTED USING THE DIAMONDWRAP® LINE OF PRODUCTS.

PROPERTIES

	METRIC SYSTEM	ENGLISH SYSTEM
Total Layers Normal Range (Typical)	2 to 6 (One Layer = One Ply)	2 to 6 (One Layer = One Ply)
Cure Time	Typically 5 Hours @ 25°C	Typically 5 Hours @ 77°F
Maximum Recommended Operating Temperature	82°C Standard	180°F Standard
Chemical Resistance	Excellent (See chemical resistance p. 31)	Excellent
Nominal Thickness	0.98 mm for 2 Ply to 2.93 mm for 6 Ply	0.039 in for 2 Ply to 0.116 in for 6 Ply
Fabric	PAN (Polyacrylnitrile)	PAN (Polyacrylnitrile)
Carbon Content by Weight	21% to 40%	21% to 40%
Glass Fiber Content by Weight	0%	0%
Lap Sheer (Adhesive) Strength	> 8,618 kPa @ 60°C	> 1,250 PSI @ 140°F
Compressive Strength of Putty	33,129 kPa @ 60°C	8,805 PSI @ 140°F
Hardness	78 to 84 (Shore D)	78 to 84 (Shore D)
Linear Elastic Behavior	1.20% Strain to Failure	1.20% Strain to Failure
Elastic Modulus, Hoop Direction	6.70×10^7 kPa	9.72×10^6 PSI
Elastic Modulus, Axial Direction	1.47×10^7 kPa	2.13×10^6 PSI
Tensile Strength, Hoop Direction	7.55×10^5 kPa	1.09×10^5 PSI
Tensile Strength, Axial Direction	1.88×10^5 kPa	2.73×10^5 PSI
Coefficient of Thermal Expansion, Hoop Direction	2.52×10^{-5}/°C	1.4×10^{-5}/°F
Coefficient of Thermal Expansion, Axial Direction	1.278×10^{-5}/°C	0.71×10^{-5}/°F
Design Stress, Hoop Direction	5.81×10^5 kPa	8.43×10^4 PSI
Design Stress, Axial Direction	1.44×10^5 kPa	2.10×10^4 PSI
Fatigue (cycle without failure - defect dependent)	>100,000 cycles (0 -100% MAOP) with up to 80% wall loss	>100,000 cycles (0 -100% MAOP) with up to 80% wall loss

DESCRIPTION

DIAMONDWRAP® HP™ is the leading carbon fiber wrap system used to rehabilitate and restore original operational strength to dented, gouged, corroded and eroded pipelines. **DIAMONDWRAP® HP™** is engineered to provide strength that enables a pipeline to be restored to maximum allowable operating pressure (MAOP) without shutting down. The system is comprised of the three components, each thoroughly and independently tested at both the university and national laboratory levels.The first component is a solid epoxy primer, which ensures complete bonding and load transfer between the repair and the substrate. The second component and most unique feature of the **DIAMONDWRAP® HP™** system, is its bi-directionally woven carbon-fiber material, which provides reinforcement in the hoop and axial directions and is the strongest available non- metallic repair on the market. The third part of the binding force in the system is the polymeric epoxy resin, which allows for uniform loading thoroughly the entire wrap. For repairs that require surfaces to be modified (e.g: heavy pitting or irregular shapes), the high modulus filler can be applied. These components form a composite system that is stronger than steel. The structural system forms a pipe around a pipe, and each successive wrap increases the pressure rating. Minimal creep ensures the longer service life.

DIAMONDWRAP® HP™ requires an engineering assessment to compile information such as substrate material, wall loss, operating temperature and pressure ranges. **Citadel Technologies' DIAMONDWRAP® HP™Wizard®** software analyzes this information to determine the number of wraps required for each pipeline repair.

Because of its wet lay-up and low profile, **DIAMONDWRAP® HP™** can be installed on tees, elbows, straight runs of pipe, confined spaces and irregular surfaces that require structural reinforcement. The adhesive properties of the epoxy allow it to be applied to most substrates.

Features and Characteristics

- Superior alternative to clamps.
- All pipe sizes.
- Straight length, elbows, tees.
- Compatible with carbon steel, stainless steel, alloys, PVC, fiberglass and more.
- High pressure – Low profile.
- Carbon fabric wrap (PAN-Polyacrylnitrile).
- High corrosion resistance.
- Long service life.
- NoVOC´s.
- **DIAMONDWRAP® HP™** 100% solids epoxy systems for chemical resistance.
- No hot works. / No welding.
- Engineered solution.
- Supplied as a complete kit.
- Chemically resistant.
- Able to withstand high temperatures.
- High strength.
- Fast curing.
- Extensively tested in lab and the field.

NOTE: DIAMONDWRAP® HP™ SYSTEM IS DESIGNED FOR INSTALLATION ON TRANSMISSON PIPELINES. DIAMONDWRAP® HP™ SYSTEM IS NOT INTENDED FOR USE ON A PIPELINE LEAK REPAIR.
LEAK REPAIR SHOULD BE CONDUCTED USING THE DIAMONDWRAP® LINE OF PRODUCTS.

PROPERTIES

	METRIC SYSTEM	ENGLISH SYSTEM
Total Layers Normal Range (Typical)	2 to 7 (One Layer = One Ply)	2 to 7 (One Layer = One Ply)
Cure Time	Typically 5 Hours @ 25°C	Typically 5 Hours @ 77°F
Maximum Recommended Operating Temperature	82°C Standard	180°F Standard Chemical
Resistance	Excellent (See chemical resistance p. 31)	Excellent
Nominal Thickness	1.14 mm or 2 Ply to	0.045 in for 2 Ply to
	4.00 mm for 7 Ply	0.158 in for 7 Ply
Fabric	PAN (Polyacrilnitrile)	PAN (Polyacrilnitrile)
Carbon Content by volume	21% to 40%	21% to 40%
Glass Fiber Content by Weight	0%	0%
Lap Sheer (Adhesive) Strength	> 8,618 kPa @ 60°C	> 1,250 PSI @ 140°F
Compressive Strength of Putty	33,129 kPa @ 60°C	8,805 PSI @ 140°F
Hardness	78 to 84 (Shore D)	78 to 84 (Shore D)
Linear Elastic Behavior	1.20% Strain to Failure	1.20% Strain to Failure
Elastic Modulus, Hoop Direction	4.92×10^7 kPa	7.13×10^6 PSI
Elastic Modulus, Axial Direction	2.39×10^7 kPa	3.46×10^6 PSI
Tensile Strength, Hoop Direction	5.77×10^5 kPa	8.36×10^4 PSI
Tensile Strength, Axial Direction	2.48×10^5 kPa	3.59×10^4 PSI
Coefficient of Thermal Expansion, Hoop Direction	2.52×10^{-5} / °C	1.4×10^{-5} / °F
Coefficient of Thermal Expansion, Axial Direction	1.278×10^{-5} / °C	0.71×10^{-5} / °F
Design Stress, Hoop Direction	4.44×10^5 kPa	6.44×10^4 PSI
Design Stress, Axial Direction	1.90×10^5 kPa	2.76×10^4 PSI
Fatigue (Cycles to failure - defect dependent)	>100,000 cycles (0-100% MAOP) with up to 80% wall loss	>100,000 cycles (0-100% MAOP) with up to 80% wall loss

(*)Testing as of October 2010 should confirm increasing the maximum temperature of 287°C (550°F)

DESCRIPTION

RHINOWRAP™ is a hybrid carbon fiber and fiberglass composite wrap system used to rehabilitate and restore strength to low pressure, low risk corroded and eroded piping systems. **RHINOWRAP™** is engineered to provide strength that enables a pipe to be restored to normal operating pressure without shutting down.

The system is comprised of the two components, each thoroughly and independently tested at both the university and national laboratory levels.The first component and most unique feature of the **RHINOWRAP™** system, is its hybrid bi- directionally woven carbon/fiberglass material, which provides reinforcement in the hoop and axial directions and is the strongest low risk non-metallic repair on the market.The second part of the binding force in the system is the polymeric epoxy resin, which allows for uniform loading thoroughly the entire wrap.

As a flexible wet lay-up system, **RHINOWRAP™** can be installed on tees, elbows, straight runs of pipe. This flexible system is also easily applied in confined spaces and irregular surfaces that require structural reinforcement or leak containment.The adhesive properties of the epoxy allow it to be applied to most substrates. Each kit is designed to cover a specific square footage amount with 4 options of cloth width.

FEATURES AND CHARACTERISTICS

- Superior alternative to clamps.
- All pipe sizes.
- Straight length, elbows, tees.
- Compatible with carbon steel, stainless steel, alloys, PVC, fiberglass and more.
- Low profile.
- Designed for pressures up to 150 PSI.
- Online training on www.rhinowraponline.com
- Carbon fabric wrap (PAN-Polyacrylnitrile) and Fiberglass.
- High corrosion resistance.
- Long service life.
- **RHINOWRAP™** 100% solids epoxy systems for chemical resistance.
- NoVOC´s.
- No hot works./ No welding.
- Supplied as a complete kit.
- Chemically resistant.
- Fast curing.
- Extensively tested in lab and the field.

NOTE: RHINOWRAP™ SYSTEM IS DESIGNED FOR LOWER RISK:
Low pressure (up to 10 Bar/150PSI) and low temperatures (up to 50°C/122°F).
For questions regarding pressures and temperatures exceeding the above, please contact us.

PROPERTIES	METRIC SYSTEM	ENGLISH SYSTEM
Tensile Strength	164,661 kPa	23,882 PSI
Modulus	12.3 x 10^6 kPa	17.8 x 10^5 PSI
Strength per layer per inch	1.290 kPa/ply/mm	475 PSI/ply/in
Linear elastic behavior	1.64% strain to failure	1.64% strain to failure
CureTime	8 hours @ 25°C	8 hours @ 77°F
Tg, GlassTransitionTemp.	100°C	212°F
Nominal thickness per ply	0.51054 mm	0.0201 in
Carbon fiber content	30 - 50%	30 - 50%
Glass fiber content	50 - 70%	50 - 70%
Lap Shear strength	>6894.76 kPa	>1,000 PSI
Hardness	78 to 84 (Shore D)	78 to 84 (Shore D)

RECOMMENDED KIT PER PIPE SIZE:

Each kit may be used on a wide variety of pipe diameters with easy installation. However, when wrapping around elbows or tees, the following recommendations should be followed to insure proper application.

Pipe Diameter Range		Recommended Kit
Metric System	*English System*	
203.2 mm	< 8 Pol.	RW-2-5
152.4 -355.6 mm	6 – 14 in	RW-4-10
254 - 406.4 mm	10 – 16 in	RW-6-15
355.6 mm	> 14 in	RW-12-20

EXAMPLE APPLICATIONS:

- Using the RW-12-20 kit, you could wrap approximately 3 linear feet on a 24" pipe with 4 layers of material.
- Using the RW-6-15 kit, you could wrap approximately 3.5 linear feet on a 16" pipe with 4 layers of material.
- Using the RW-4-10 kit, you could wrap approximately 5.5 linear feet on a 6" pipe with 4 layers of material.
- Using the RW-2-5 kit, you could wrap approximately 5.5 linear feet on a 3" pipe with 4 layers of material.

Alternatively, if you only needed 2 layers of material for corrosion prevention or external repair with no through-wall defect, you could double these lengths/area coverages.

DESCRIPTION

Citadel Technologies has developed and tested for more than 20 years the **SLS Series™** line of epoxies and coatings for various applications. The epoxy systems can be tailored to its customers' specific needs.

All of your epoxies are easy to apply, are great for long-term durability, and contain no VOC's.

CitadelTechnologies' most popular products are the **SLS-30™**, **SLS-300™**, and **SLS-350™** products:

SLS-30™ is a two component, 100% solids epoxy system. It provides both a structural, cured-in-place lining and a chemical protective barrier in one quick application. It is commonly used in waste collection systems, sewers, lift stations, tanks, vaults and cooling lines.

SLS-300™ is a one step, low cost flexible sealant with excellent bonding properties that can be applied to dam or wet substrates. It is commonly used for manhole rehabilitation, catch based grade rings and joints, but it is also used in a variety of situations where shifts and movements may occur.

SLS-350™ is a two component, 100% solids epoxy system. It provides both a structural, cured-in-place lining and a chemical protective barrier in one quick application. It is commonly used in waste collection systems, sewers, lift stations, tanks, vaults and cooling lines. Slower setting and longer pot life than **SLS-30™**, can be used where spray application is not viable.

SLS-Series™ *is approved by L.A. County, and City of Los Angeles, Kansas City, City of Tulsa and others.*

Product Lines

SLS-30™ Structural Liner.

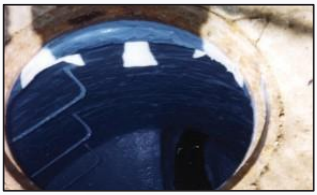
SLS-35™ Super Fast Patching Compound.

SLS-60™ Strong Acid Liner.

SLS-70™ HighTemp Liner.

SLS-300™ Solid Epoxy Coating.

SLS-350™ Solid Epoxy Coating.



Recommended Service

For industrial and aqueous service where strength and corrosion resistance are most critical.

Recommended Usage

- Waste Collection Systems
- CoolingWater Lines
- Sewers
- SlurryTanks
- Lift Stations
- Vaults
- WasteTreatment Facilities
- Manhole Rehabilitaiton

What is SLS-30™?

SLS-30™ is a two component, 100% solids epoxy system. It has been designed to provide the greatest structural strength and chemical resistance of any product in its class.

Why Use SLS-30?

SLS-30™ provides both a structural, cured in place lining and a chemical protective barrier in one quick application. It can be applied to both old and new bricks, concrete or steel at a thickness of 40 mls. to over 275 mils. Using **Citadel Technologies'** multi-component application system, a two-man crew can line 500 sq. ft. to 1000 sq.ft. per hour at 120 mils greatly reducing standard application costs.

Application

SLS-30™ can be applied at all ambient temperatures ranges; however, care must be taken not to apply over frost or active leaks. It must also benoted that whenapplied to very cold surfaces, set and cure times will begreatly increased. As with any cured in-place system that requires a good bond, the substrate must be free from all dirt, oil, grease, and rust.

Engineering Data

Description	Metric	English
Mix Ratio (Resin/Hardner)	2.5:1*	2.5:1*
CombinedWt. Per Gallon	1.15kg/gal.	9.6lbs/gal.
Pot Life (100g mass)	12 min @ 25°C	12 min @ 77°F
SetTime	3.0hrs @ 2.54 mm @ 25°C	3.0hrs @ 100 mils @ 77°F
Hardness	78-84 (Shore D)	78-84 (Shore D)
Compressive Strength	93,080 kPa	13,500 PSI

Description	Metric	English
Compressive Str. Ult.	151,600 kPa	22,000 PSI
Tensile Strength	59,300 kPa	8,600 PSI
Tensile Elongation, % (resi n)	>3.5	>3.5
Tensile Modulus	3.24×10^6 kPa	4.7×10^5 PSI
Flexural Strength	97,500 kPa	142,00 PSI
Flexural Modulus	3.5×10^6 kPa	5.0×10^5 PSI

** available in 2:1 and 3:1 ratios*

Schedule of Test Methods

Test Performed	Method/Standard Use
Tensile Strength / Elongation	ASTM D638
Flexural Strength	ASTM D790
Hardness, Shore	D ASTM D2260
Solids byVolume (%)	ASTM D2369
Weight per Gallon	ASTM D1475
Flash PointTOC	ASTM D1310
DryTime	ASTM D1650
Chemical Resistance (30 Days)	ASTM D543
Chemical Resistance Flexural Strength (180 Days)	ASTM D790
Compressive Strength	ASTM D695
Freeze-Thaw	UL 76-63
Adhesion	ASTM D3983

COMPOSITE TEST DATA ON SLS-30™ ULTRABUILD EPOXY LINING

Physical Data	Metric System	English System
Pot Life (100 g mass)	11 min 5 sec @ 25 ° C	11 min 5 sec @ 77 ° F
SetTime	2 hrs 47 min @ 2.54 mm @ 25°C	2 hrs 47 min @100 Mils @ 77°F
Hardness	78-84 (Shore D)	78-84 (Shore D)
Compressive Strength	91,650 kPa	13,292 PSI
Tensile Strength	60,000 kPa	8,695 PSI
Tensile Modulus	3.24×10^6 kPa	4.7×10^5 PSI
Flexural Strength	102,700 kPa	14,893 PSI
Flexural Modulus	3.5×10^6 kPa	5.0×10^5 PSI

Chemical Resistance	Percent Weight Gain (112 Days)
Sulfuric Acid, 20%	1.402%
Sodium Hydroxide, 5%	0.91%
Ammonium Hydroxide, 5%	0.995%
Nitric Acid, 1%	1.301%
Ferric Chloride, 1%	1.227%
Sodium Hypochlorite, 1%	1.100%
DistilledWater	1.015%
Toluene	1.205%

Test Information

Rupture Testing

The University ofTulsa and **Citadel Technologies** conducted independent rupture tests per ASME PCC-2 Section 4.1, Appendix III. The results are shown for repairs with a maximum of 6 layers of carbon on the repair, when the pipe was repaired with no internal pressure applied. Both defects were 6 inches long, and the patch defect was 6"x6"in area.

Defect Type	Wall Loss	Failure Pressure			
		No Repair		Repaired	
		ksi	(MPa)	ksi	(MPa)
No Flaw	N/A	6.65	45.85	N/A	N/A
Axi-Symmetrical	50%	4.35	29.99	6.35	43.78
	80%	1.88	12.96	5.12	35.3
Square, Patch-shaped	50%	4.4	30.34	6.25	43.09
	80%	1.88	12.96	5.25	36.2

1Ksi = 1.000 PSI ou 70,30 Kgl/cm2 ou 68,94 Bar

Fatigue Testing

Fatigue tests were performed by the University of Tulsa, on pressure vessels to determine the effectiveness of repairs, made using a carbon/epoxy composite material system. The carbon /epoxy systems is intended to repair externally damaged or corroded steel pipe. Six-inch nominal diameters by five feet long pressure vessels were constructed from A-106. Grade B steel for test purposes. Defects were machined into the outer surface of each pressure vessel to determine limitations of the carbon /epoxy repair system. Unrepaired pipes were cycled to determine a base number of maximum operating cycles. Remaining vessel were wrapped and then cyclically pressurized until a leak in the system was detected. The repaired vessels were compared to un-repaired vessels with equal size defects to determine the effectiveness of the repair. Results indicate there was a substantial increase in the performance of the pipe.

Repair	None	Repaired		
Defect	1.125"x 5.19"	1.25"x 2.75"	1.125"x 5.19"	1.125"x 5.19"
Wall Loss	80%	80%	70%	80%
Cycles	3	Infinite	Infinite	Infinite

CATHODIC DISBONDMENT - ASTM G-896

The University of Tulsa performed cathodic disbondment testing. Cathodic disbondment tests were conducted on A-106, Grade B steel pipes on which carbon- fiber-reinforced polymeric wraps were installed. The composite wraps are part of system used to repair externally damaged or corroded steel pipes. To stimulate a corrosive environment, pipes coated with the composite wraps were submerged in an electrolyte consisting of potable water, sodium chloride, sodium sulfate and sodium carbonate. Holidays or breaks in the composite wrap were produced, exposing electrolyte. Test results indicate the carbon-fiber-reinforced polymeric repair system exhibits no disbondment.

GALVANIC CORROSION

Galvanic Corrosion tests were performed by the University of Tulsa using composite panels joined in conjunction with dissimilar metals.The test results showed no corrosion attributed to Galvanic Corrosion.

CREEP TESTING - ASTM D2990

Room temperature, coupon testing was performed at the University of Tulsa. Specimens were tested using an in-situ creepture fixture. The test was done at 77% (UTS), and the results were recorded for a 1350-hour test period. The creep testing supports the fact that carbon-fiber composites are resistant to creep and creep rupture under ambient conditions.The level of creep in the tests was small enough to extrapolate that the material would not fail at 77% (UTS) load during its lifetime.

Test Information

Chemical Resistance

Chemical Resistance for StanGarG Epoxies 30 Days Exposed	
Water	No effect
Sulfuric Acid,20%	No effect
Sodium Hydroxide,50%	No effect
Ammonium Hydroxide,5%	No effect
Nitric Acid,1%	No effect
Sodium Hypochlorite(Bleach)	No effect
Ferric Chloride,1%	No effect
Detergent Solution	No effect
Gasoline	No effect
Tolune	No effect

Citadel Technologies' standard epoxy is designed for operating temperatures up to 82°C (180°F). This system is blended to withstand a wide range of chemicals including: caustic, 20% sulfuric acid, 20% hydrochloric acid, water, brine, detergents, toluene, gasoline, and other weak acids and solvents. It is not intended for concentrated Strong Acids, Organic Acids, Strong Solvents (MEK, Acetone, Alcohol). For these stronger chemical concentrations, please consult **Citadel Technologies** and consider the use of **Citadel Technologies'** Acid epoxy system.

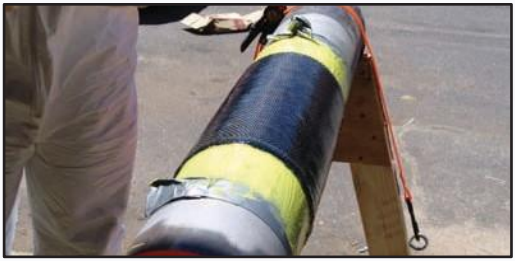
DENTS

Tests involving dents and gouges were performed both by the University ofTulsa and by Stress Engineering. The results of this test program, along with supporting data from other studies on these repair systems, confirm the validity of this repair system for repair of dents and pipes with gouges. The reinforcement provided by the carbon fiber/epoxy composite repair system provides a significant increase to the fatigue life of un-repaired mechanically damaged pipes.

COMPOSITE REPAIRS MADE UNDER LOAD

Testing was conducted on **CitadelTechnologies'**carbon composite products bywrapping defective pipe while under internal pressure loading. Test pipes with flaws varying form 20% to 75% wall loss were wrapped while the pipe was operating at MAOP. The pipes were then cycled between 50 PSI and MAOP. After inspection indicated that there was no de-lamination, the pipes were pressured to rupture. No differences were noted to those pipes that were wrapped at zero pressure. This testing shows that defects may be repaired without reducing the pipeline pressure prior to wrapping.

If you would like more detailed information regarding these, or other, test programs, please contact Citadel Technologies and request a copy of the Citadel Technologies Product Guide.



APPENDIX

CITADEL TECHNOLOGIES CARBON FIBER COMPOSITE WRAP PRODUCT GUIDE

	CITADEL TECHNOLOGIES PRODUCTS
	DIAMONDWRAP®
Transmission	Under certain conditions
Facilities "In Plant" Lines	Preferred
External Corrosion	Yes
Internal Corrosion	Per Design
	(Length of repair life determined by rate of internal
Thru Wall Defect	Up to 1" hole *(larger w/ plug)*
Dents	Yes
Wrinkle Bends	Yes
Weld	Yes
Bending	Yes
Axial Loads	Yes
Pipe Material	*Bonds well to most metals and plastics with the exception of polypropylene and polyethylene*
Pipe Size	No limit
Straight Pipe	No limits in continuous length
Elbow	Yes
Tee	Yes
Valve Heads	Yes
Other configurations	Yes
Maximum Recommended Operating Temperature	82°C (180°F) Standard 171°C (340°F) HT701 149°C (300°F) HTA 288°C (550°F) UHT (*)
Pressure	No limit
Chemical Compatibility	Excellent
	For strong acids and solvents consult Citadel Technologies
Standar	ASME PCC-2, 4.1

(*) Testing as of October 2010 should confirm increasing the maximum temperature of 287°C (550°F)

BLACKDIAMOND®	DIAMONDWRAP®HP™
Preferred	Preferred
Under certain conditions	Under certain conditions
Yes	Yes
Per Design	No
(Length of repair life determined by rate of internal corrosion)	
No Yes	No
Yes	Yes
Yes	Yes
Yes	Yes
	Yes
Yes	Yes

Bonds well to most metals and plastics with the exception of polypropylene and polyethylene

No limit	No limit
No limits in continuous length	No limits in continuous length
Yes	Yes
Yes	Yes
Yes	Yes
Yes	Yes
82°C (180°F) Standard	82°C (180°F) Standard 171°C (340°F) HT701 149°C (300°F) HTA 288°C (550°F) UHT (*)
No limit	No limit
Excellent	Excellent

For strong acids and solvents consult Citadel Technologies

ASME PCC-2, 4.1	ASME PCC-2, 4.1

PRODUCT CARE

STORAGE AND SHELF LIFE

Citadel Technologies´ epoxies products have a minimum shelf life of more than two (2) years when stored in a dry place at room temperature and sealed in the original unopened container.

BlackDiamond® System stored over 5 years has been tested with no measurable change in characteristics.

OPTIMUM HANDLING CHARACTERISTICS

Typically stabilizing the resin system temperature between 20°C and 30°C (68°F -86°F) is recommended. This provides of the best viscosities and pot life of ease of installation. Note that some environmental and operating conditions and temperatures can change this recommendation. Our engineering staff will provide you with any recommended changes.

The epoxy systems are 100% solids. Each system is manufactured for specific applications for installation on systems where hydrocarbons and high operating temperatures are a critical factor.

ENGINEERING ASSESSMENT

CITADEL TECHNOLOGIES / TRIMITZ	**ENGINEERING ASSESSMENT**	FOR-ENG-001 Date: September 15, 2010 Version: 4 Page: 1 of 6

(*) c.N. #:

Exclusive use for Citadel Technologies

Assessment submitted by: _____ **Date:** _____

GENERAL INFORMATION

I. Owner/Operator: _____

Plant Contact: _____

Address: _____

City: _____ State: _____ Zip Code: _____

Phone #: _____ Fax: _____

Email: _____

Owner/Operator Verification of Submittal

_____ _____

Signature Date

II. contractor/ Installer: _____

Contractor Field Contact (Name) _____

Field Office Address: _____

City: _____ State: _____ Zip Code: _____

Phone #: _____ Fax: _____

Email: _____

(*) A Case Number will be assigned to this assessment. Please refer to this Case Number on any purchase order or other communication related to this assessment.

CITADEL TECHNOLOGIES / TRIMITZ	ENGINEERING ASSESSMENT	FOR-ENG-001 Date: September 15, 2010 Version: 4 Page: 2 of 6

III. Plant Information

☐ Crude Oil ☐ Refinery ☐ Gas Processing ☐ Water

☐ Chemical ☐ DOT Pipeline

☐ Other Type of service line: _____

IV. Situation Analysis

Description of Existing Condition:

☐ Not Leaking ☐ Seam Leak ☐ Crack

☐ Pinhole Leak ☐ Internal Corrosion ☐ External Corrosion

1. Pipe Specification

Diameter _____ Length of flaw _____

Repair Length _____ Type of Steel _____

Grade _____ Schedule _____

2. Component

☐ Pipe ☐ Tee

☐ Elbow ☐ Tank Other _____

3. Temperature

Low _____ ˚F Max _____ ˚F Constant _____ ˚F Cycling _____ ˚F

4. Line Pressure

Low _____ PSI Operating _____ PSI High ** _____ PSI

**** MAoP**: is the maximum allowable operating pressure as defined in ASME B31G or API 579 or other calculation method.

5. Line Chemistry

Type of chemical _____ Concentration _____ %

6. Measured wall thickness

	Inches	Date
Current		
Previous		

7. Max. un-supported span length _____

8. Pipe coating type _____

9. Details of the defect area
attach drawings, photos, and/or inspection reports for each area identified.

Defect	Location	Distance from weld	Size (Length, Width)	Depth of defect	Type of Flaw M,C, E (1)	Type of existent repair

(1) M - Mechanical **C** – Corrosion **E** – Erosion

CITADEL TECHNOLOGIES / TRIMITZ	ENGINEERING ASSESSMENT	FOR-ENG-001
		Date: September 15, 2010
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Sketch of repair area:

Additional Information: _____

V. Risk

1. ☐ Plant Shutdown ☐ Production Loss ☐ Environmental

2. Emergency Repair ☐ Yes ☐ No

3. Wrap Line while in Service ☐ Yes ☐ No

4. Line pressure can be lowered during maintenance to _____ PSI

5. Line temperature can be lowered or raised during maintenance to

Low _____ °F Max _____ °F

6. Surface Preparation available? _____

7. Location of the repair :

☐ Above ground ☐ Below ground ☐ Transition

8. Type of Repair:

a. How much of the pipe runs horizontally? _____ Ft.

b. How much of the pipe runs vertically? _____ Ft.

9. Minimum available space for the repair:

Above _____ Below _____ Around _____

10. Conditions at the time of repair

Pipe temperature _____ °F

Ambient temperature _____ °F

11. What is anticipated service life of the repair system? ☐ Months ☐ Years

CITADEL TECHNOLOGIES / TRIMITZ	ENGINEERING ASSESSMENT	FOR-ENG-001 Date: September 15, 2010 Version: 4 Page: 6 of 6

12. Wrap Schedule: Start day: _____

End: _____

13. Time allowed to complete work and return line to service _____

14. Services to be provided by the Owner/Operator _____

****

Please EMAIL or FAX information to 1-918-584-2221

This assessment is valid for 30 days. After 30 days an update should be submitted to verify that no changes have occured that could adversely affect conditions and design.

This assessment is the only valid document for providing the engineering conditions of any defect. Special information can be attached; however, it has to be referenced in the assessment.

Citadel Technologies conforms to ASME PCC-2, Article 4.1 which states that all composit e wraps shall be installed by trained and certified technicians.

SAMPLE DIAMOND WRAP® WIZARD© CALCULATION

DIAMONDWRAP BY CITADEL TECHNOLOGIES

TRIMITZ HIGH PERFORMANCE COATINGS

6430 S. 39th W. Ave Tulsa, Oklahoma 74132
Phone: 918.584.2220 Fax: 918.584.2221

#XXXXX
3/5/2009

Each kit will supply

Owner contact	**Diamond Wrap® Contact**
XXX Refinery	Maintenance Contracting
Joe Engineer	Joe Wrap
123 Refinery Dr.	XYZ Fixit Rd.
Houston, TX	Houston, TX
Joe.engineer@xxxrefinery.com	wrapman@MCont.com
Phone: 555-555-2181	Phone: 555-555-1812
Fax:	Fax:

From Engineering Assessment

Material Type - Carbon Steel ASTM A106 Gr. B
Minimum Yield Strength - 35000 psi
Pipe Diameter - 12 in
Operating Pressure - 150 psi
Design Pressure - 225 psi
Operating Temperature - 100 F
Design Temperature - 180 F
Current Wall Thickness - 0 in
Application - Plants
External Defects - Corrosion.
Internal Defects - Corrosion.

Wrap calculations have taken into consideration all information provided on the engineering report and are subject to Citadel Technologies' terms and conditions.

$$t_{repair} = \frac{1}{\varepsilon_c E_c}\left(\frac{PD}{2} - st_s\right) =$$ 0.064 (Using Design Conditions)
0.051 (Using Operating Conditions)

Design repair thickness (t_repair) = 0.027 in
Tensile modulus for the composite laminate in the circumferential direction (Ec):
Operating: 3784491 psi
Design : 3736230 psi
External Pipe Diameter(D) = 12.75 in
Internal Pressure(P) = 150 psi (Operating) , 225 psi (Design)
SMYS (Specified Minimum Yield Strength) (s) = 35000 psi
Minimum remaining wall thickness of the pipe (ts) = 0 in
Allowable circumferential strain ( ) = 0.50% (operating) and 0.60% (design)
Ply or layer thickness of the composite repair material (t_layer) = 0.018 in

= 4 wraps of BA cloth

Kit = Standard

Material Specifications:

(3) DW-1204 Kits

Phone/Fax.+62-021-22950836 |Office:Jln Mandor Aren no.45
RT05/07Ciketing Udik-Bantargebang-Bekasi|
www.trimitz.com |marketing@trimitz.com |