



STRONGBACK® PIPE REPAIR METHOD

1. SCOPE

The StrongBack reinforcement system is a self-contained, water-activated wrapping system that can be a permanent, high strength alternative to metal sleeves, welding and other mechanical repairs.

The following document details the properties, applications and installation procedures of the StrongBack products for the purpose of making economical, easy to install, long-term external pipe reinforcement systems.

2. INTRODUCTION

StrongBack systems (tape and epoxy) provide methods of maintenance, protection, repair and reinforcement to tubular structures such as pipes, risers, piles, stacks, etc.

Proper installation assures a calculable hoop strength enhancement. The material's inherent physical characteristics produce a very high post-set strength and also facilitate complete fit-up integrity and conformity between the reinforcing wrap and the pipe.

The StrongBack system's primary component—the tape—is a water-activated, resin-impregnated fiberglass cloth. It is manufactured in various lengths and widths, which affords a choice of solutions for any given installation. Although water activated, the products are not water-soluble and so can be applied as easily underwater as, for example, offshore conditions, as in dry or wet onshore situations.

StrongBack products are non-toxic, easy to apply and are suitable for above ground, buried or underwater applications. They are particularly suited to pipeline applications, for reinforcement, abrasion/impact protection and corrosion prevention. In some instances StrongBack products can be used either alone or in conjunction with other components to repair pipeline leaks.

3. PROPERTIES

The StrongBack pipe reinforcing system provides:

- High Strength
- Good abrasion resistance

- Dielectric protection
- Corrosion prevention
- Chemical resistance
- Sealing properties

The current production version of the StrongBack tape has the following Mechanical Properties:

Tensile Strength (73 F)	ASTM-D-3039:Modified	
61,220 psi		
Flexural Strength (77 F)	ASTM-D-790	53,100 psi
Compression Strength	ASTM-D-695	32,800 psi
Interlaminar Shear (77 F)	ASTM-D-2344	4,500 psi
Glass Transition Temperature	ASTM-E-831	122 C
Shore D Hardness (24 hour cure)	80	
Heat Resistance	500 F	
Max. Installation Temperature	350 F	
Temperature Cycle Test	16 layers cycled from 75 F–450 F with no de-lamination or loss of bond	
Dielectric Strength	Non-conductive when cured (16,000 volts)	

Chemical Immersion Test ASTM-D-543 (30 day immersion period):

Acetone:	Pass
Diesel Fuel:	Pass
Ethyl Alcohol:	Pass
Gasoline:	Pass
Toluene:	Pass
MLK:	Pass
30% HCL:	Pass—slight softening

4. APPLICATIONS

4.1 General

4.1.1 StrongBack systems can be used on a tubular member in virtually any situation where damage has occurred. The resulting weakness or degradation of that member therefore impacts

detrimentally on the structure in which the member is a component. Damage could be in the form of a dent, crack, pitting or loss of wall thickness, etc.

4.1.2 Repairs and reinforcement by StrongBack can be made to hydrocarbon pipelines, steam, or chemical process lines and offshore risers (in sub-sea, splash zone and above high water level areas).

4.1.3 StrongBack applications are not limited to steel pipelines as the products adhere equally as well to all grades of carbon steel tubulars as they do to ductile iron, stainless steel, plastic, GRP and almost every other material type used to manufacture pipe.

4.1.4 A feature of the StrongBack wrap's preset malleability is its' excellent suitability for reinforcing areas not only located along straight tubular sections but also on elbows, S-bends, T-sections, pipe-joints or other oddly-shaped sections.

4.1.5 The StrongBack systems can be used on punctures, leaks and blowouts provided these have been previously sealed.

4.1.6 StrongBack systems should not be used on any pipe defect with < 20% of the minimum design wall thickness remaining.

4.2 Repair System Components

4.2.1 The typical StrongBack installation shall require an initial coating of the proprietary, two-part epoxy, the GS-561 or GS-154. The epoxy coat acts primarily as a load distribution or pressure transfer medium. It is a 100% soluble, wet surface tolerant, Kevlar™ reinforced epoxy material suitable for exposure to a wide range of industrial chemicals at temperature up to 212 Deg.F.continuous service.

4.2.2 The epoxy application is followed by the StrongBack tape which is wrapped into and over the epoxy coat for the required number of layers.

4.2.3 Above ground installations should receive a further coating of the epoxy GS-561, applied over the top layer of tape, to provide it with UV protection.

4.3 Repair System Design

4.3.1 An estimate of the optimum size and quantity of StrongBack product (tape and epoxy) required to repair any given pipe situation can be obtained by using the Calculation Program, available either at the StrongBack Corporation's web-site or on the mini-compact disc. The effective system solution is entirely dependant on the accuracy of the inputted data.

4.3.2 The number of layers of tape or revolutions required at any point on the line depends on the condition of the pipe and the operational performance parameters required of the pipe, including the maximum design pressure.

4.3.3 Generally, the optimum length roll of StrongBack tape to be used for any given repair should be equal to ten (10) revolutions of the subject pipe. There are no technical restrictions to the number of rolls that can be used, nor numbers of layers that can be applied.

4.3.4 The minimum number of layers, under any situation, should be eight (8) for pipes of < 10" diameter, and ten (10) layers for all pipes > 10" diameter. However, there are no maximum layer limitations for any pipe diameter.

4.3.5 The quantity of epoxy required is based on an average coverage at 30 mils DFT of 50 Sq.Ft./Gal., per coating. Allowances or manual estimations should be made for repairs requiring significant epoxy material to fill voids, build contours, etc.

4.4 Packaging

4.4.1 The StrongBack tape is produced in roll form. The 6" and 10" wide tape is generally rolled onto a 3" diameter core. The 4" (and below) wide tape is rolled onto solid 0.25" cores. Each roll is sealed inside a Mylar pouch, which is filled with dry nitrogen to prevent the product from curing. When a pouch has been opened the tape must then be used. Once opened or perforated the pouch should not be resealed, as the curing process of the resin-impregnated tape will have been activated.

4.4.2 In situations where clearance underneath or around the pipe is restricted, StrongBack can be special ordered, rolled onto smaller diameter or the solid 0.25" dia. core.

4.4.3 Parts A and B of the two-part epoxies, the GS-561 and GS-154, are each supplied in a can of equal size. It is acceptable to replace the lid of a can following removal of some product, provided contamination has not occurred.

4.5 Transportation & Storage

4.5.1 The StrongBack products are classified as non-regulated/non-hazardous, Freight Class NOI – Item 4600, Class 60.

4.5.2 The packaged tape and the epoxies, are not temperature sensitive, hazardous or particularly fragile. However, good transportation, handling and storage/warehouse practices should be maintained. Room temperature storage is preferred but is not essential. Storage in the shade and away from direct sun light is recommended. The Mylar pouches which contain the StrongBack tape should be stored away from rodent activity (if the bag is gnawed and punctured the curing process of the tape will be activated).

4.6 Shelf Life

The minimum warranted shelf life is 1 year from date of dispatch. However, a 3 year shelf life is achievable and subject to good handling and storage practices, up to 5 years is possible.

5 GENERAL INSTALLATION PROCEDURES

The following procedure describes the StrongBack system application for a straight pipe section.

5.1 Personnel Familiarization

5.1.1 In addition to a least one Certified applicator being present, it is recommended that all personnel expected to be involved with the installation of a StrongBack repair system are familiar with the products and the installation instructions.

5.1.2 All personnel expected to handle the product, whether actually applying the StrongBack or in a standby mode, should wear latex or chemical gloves. Protective clothing (such as long sleeve coveralls) and goggles for eye protection are recommended. Refer to the product MSDS.

5.2 Surface Preparation

5.2.1 As with all coating and pipe wraps, product-to-substrate adhesion is enhanced with the more thorough degree of pipe surface preparation. Surface treatment by sand or grit blasting to white metal or to an SA 2.5 profile, followed by a non-hydrocarbon based chemical wash to remove all particulate material is the optimum situation.

5.2.2 At the other end of the scale, thorough wire brushing can be an adequate surface preparation method in some instances. Other methods which generally fit in between blasting and wire brushing are therefore acceptable.

5.2.3 No unduly sharp, pointed or jagged edges should be present within the area of the intended repair.

5.2.3 It is also essential that all particulate, dirt, corrosion deposits and oily matter are removed prior to the StrongBack system installation.

5.2.4 In the instances where further external corrosion control treatment is specified (in addition to the application of the StrongBack), that treatment should be performed prior to the next stage of the StrongBack installation.

5.3 Pressure Transfer Preparation

5.3.1 Once the pipe surface has been cleaned and if significant areas with voids (pits, dents) are evident it will be necessary to fill these void areas (by hand, trowel or brush), with the compatible compressive strength epoxy material the quick setting GS-154 epoxy. This epoxy filler will transfer the load from the bottom of the void areas onto the StrongBack tape wrap. Pin-holes or areas of minor pipe wall loss can be filled using the GS-561 epoxy.

5.3.2 Mix adequate quantities of the two-part epoxy, # GS-154, in

equal volumes according to the label instructions.

5.3.3 Permanent protrusions from the pipe external surface within the repair area, such as plug heads or patches, should be embedded in mounds of the epoxy, preferably the quick curing GS-154 type, which has to be built-up, around and over those obstacles, to produce a smooth, contoured surface.

5.4 Primary Epoxy Coating

5.4.1 The procedure described in 5.3 can be omitted if the necessity for the StrongBack reinforcement is due to internal wall loss and the external surface has not suffered from any significant pitting activity nor has any protrusions.

5.4.2 With the voids filled and protrusions embedded, an initial 20 mils. thick coating of the GS-561 epoxy should be applied completely around the pipe circumference and for the predetermined length of the repair. This layer of epoxy acts as an undercoat and limits flash rusting.

5.4.3 Both the epoxy types require equal portions of the Parts A and B be thoroughly mixed. The two Parts of the GS-154 are colored black and white and when satisfactorily mixed should become a consistent grey color. Likewise, Parts A and B of the GS-561 are yellow and blue, which must become a consistent green when mixed.

5.5 Personnel Preparedness

5.5.1 Installation personnel should be situated either side of the pipe or in a manner that will facilitate the application of StrongBack – one wrapper and one sprayer for small diameter lines (< 10" O.D.), or for larger diameter lines, one wrapper either side of the pipe plus one sprayer.

5.5.2 Water should be available in sufficient quantities and a manner that facilitates frequent and generous application to the tape as it is unrolled off the core. A simple two gallon sprayer, with refills, is generally adequate.

5.6 Wrapping Options and Technique

5.6.1 The intention is to manually wrap the StrongBack tape around the tubular and along the required length until the previously determined number of layers have been achieved.

5.6.2 In some instances simultaneous multiple application with a tape machine may be required. The tapes' 3" dia. core can be accommodated by a tape machine. For these situations, separate installation instructions can be provided by the Strongback Corporation.

5.6.3 The StrongBack tape can be applied on a spiral bias or circumferentially over itself (layer on top of layer). When applied on a spiral bias and where practical an overlap not to exceed fifty

percent (50%) is recommended. Subsequent rolls should all be applied in the same directional bias as the prior rolls.

5.6.4 In those instances where the StrongBack is applied directly over itself and more than ten (10) layers are required, it is necessary to let the product set up (for 10–15 minutes) between each ten to fifteen (10–15) layers of build.

5.6.5 When the tape is being applied, water should be continuously sprayed over the entire length of the StrongBack repair. In all situations where 10–15 layers are to be applied, additional dosage of water should be applied during to each layer as it is applied.

5.6.6 It is very important to make sure that the StrongBack tape lays flat and that no voids or airspaces exist. The tape should, therefore, be constantly smoothed from the center of the tape outwards to the sides. Where two or more installation personnel are being used, those who are not holding the product should be checking that the tape has been laid correctly. If it is not, they should smooth out the wrap or take remedial action. Within a minute or two of the initial application it is permissible to wind the tape back onto the roll and then rewrap the pipe to obtain a better lay with the subsequent layers. It is also permissible to cut the product to obtain a better lay. However, in this instance it is necessary to overlap the tape ends on the restart.

5.6.7 In many installations, several rolls of Strongback tape are required to provide the length of repair with the calculated numbers of layers. In these instances, when a roll of tape has been totally applied, the starting end of the new roll of tape should be laid to overlap the end of the previous tape by ½"–1". Loose ends should be avoided.

5.6.8 When the required layers of StrongBack have been applied, it is then necessary to continue to smooth the product in the direction of the wrap, for approximately 15 minutes, or until the product becomes tacky to the touch.

5.6.9 Three (3) layers of plastic stretch wrap or pallet wrap should be wrapped around the repair when the StrongBack tape becomes tacky to the touch. This step helps to create a smoother surface finish, which can be visually or aesthetically important for above ground repairs. A number of small perforations should be carefully made into the plastic wrap only, to provide escape outlets for the gases and moisture released during the subsequent curing process. Loose material at each end of the repair (tape and plastic wrap) can be trimmed off with a pen-knife at this time to further improve the appearance.

5.7 Underwater Repairs

5.7.1 Underwater repairs should follow the same procedure as indicated above, with the exception of the water spray. It is necessary that the end of the final StrongBack tape is held down so

that wave or current action does not interfere with the final set. The stretch wrap or pallet wrap can also be used for this purpose.

5.7.2 In those instances or locations that do not permit the use of stretch wrap, other methods can be employed. In these situations, the Strongback Corp. should be contacted for advice.

5.8 Post Installation

5.8.1 The plastic wrap can be removed after 30–60 minutes, or left in place when the repair is to be buried or backfilled.

5.8.2 Following removal of the plastic wrap it is suggested that a 20–30 mils thick coating of GS-561 epoxy is applied over the entire exposed tape surface.

5.8.3 Under most conditions the StrongBack system will be hard and durable after approximately one hour, although the full cure is reached within about 24 hours.

5.8.4 For repair/installations on buried lines, the backfilling and pressurization of the lines can commence without damage to the wrap one and two hours respectively after completing the application procedure.

5.9 Above Ground Repairs

5.9.1 Following removal of the plastic wrap a 20–30 mils thick coating of GS-561 epoxy must be applied over the entire exposed tape surface.

5.9.2 The StrongBack repair system can be completely overpainted, if required for any reason, after the topcoat of GS-561 has cured.

5.10 High Temperature Applications

In some applications, including high ambient or surface temperatures, it is possible to install the StrongBack tape without applying water, as to do so would extend the cure time. Applications without water should not be made without prior consultation with the StrongBack Corporation.

6. GENERAL INSTALLATION PROCEDURES – ODD SHAPED STRUCTURES

A significant feature of the Strongback repair system is the ability to completely fit and conform to the shape of pipes and tubular structures. Material can be wrapped over itself circumferentially or wrapped in a crossing helical pattern for curves and odd shapes, for example tees, nipples and elbows. The material can also be cut to fit special applications, or twisted into rope for transition areas or changes in pipe diameter.

The following describes a general procedure that allows installa-

tion of a StrongBack reinforcement system over the critical welds of nipples and at the interface nipple and pipe. The procedure and methodology are representative of the approach and system design that can be employed for all other similar situations.

6.1 Personnel Familiarization

Refer to Para. 5.1

6.2 Surface Preparation

A. For insulated pipe with corrosion-under-installation present

1. Remove insulation from the full circumference 8" above and 8" below the nipple.
2. Abrasive blast pipe and nipple to minimum "commercial" standard (SA-2.0; SSPC-SP-6).
3. Wash down with fresh water to remove all residual dirt.

B. For painted non- insulated pipe

1. Wire brush or disc clean to remove chalking or dust.
2. Wipe with a solvent rag (MEK, Xylene or lacquer thinner), to remove residual dust.

6.3 Application Method

6.3.1 Mix adequate quantities of the StrongBack two-part epoxy, # GS-561, in equal volumes according to the label instructions.

6.3.2 Before flash rusting occurs, quickly apply the epoxy to all surfaces for encapsulation using appropriate tools, such as spreaders or stiff brushes. Apply to the main (larger) pipe for an area approximately 6" above and 6" below the nipple

6.3.3 Cut the 2" wide fiberglass tape into a number of strips, approximately 36" and 8" long.

6.3.4 Impregnate each strip with just the sufficient amount of # GG-561 to wet the fibers without a significant excess. Note: Too much epoxy will make the installation difficult and sloppy.

6.3.5 Tightly wrap the 36" strips of wetted tape around the smaller diameter inner portion of the nipple until the diameter has been built up to the same level as that of the outer shoulders.

6.3.6 Lay the 8" wetted strips along the length of the nipple and alongside of each other, ensuring that the base weld is fully covered. The ends of the strips will have to splay out to lay evenly on the larger diameter pipe.

6.3.7 Bind the strips with light string to firmly lock them into place.

6.3.8 Tightly spiral wrap with the 36' wetted strips around the nipple, once again ensuring that the base weld is fully covered.

6.3.9 Lay 8" wetted strips against the nipple to pipe weld, which will ensure adequate thickness of laminate has been applied in this area.

6.3.10 Starting 6" above the nipple, tightly spiral wrap dry fiberglass tape into the still uncured # GS-561, that was applied per step 6.3.2. Lay the tape firmly against the nipple weld. If necessary, cut slits in the tape to allow it to lay flat against the weld and without wrinkling.

6.3.11 Finish by applying a coating of # GS-561 to the entire installation to ensure perfect sealing.

6.3.12 Allow to cure until firm (approx. 4 hrs at 60 Deg.F.) and keep dust-free before reinstallation of the insulation.