



PowerSleeve®

What is PowerSleeve® ?

PowerSleeve® is a product to make weak things strong: pipe, vessels, tanks or structures. Specifically, this is a field-pregged, field installed, room temperature curing, kit-based, fiber-reinforced polymer (FRP) composite product line.

It is NOT a leak repairing product. Although it is often used after a leak has been stopped by other methods.

The **substrate** (“fabric”) element of the kit is e-grade, premium fiberglass roving, alloyed with Dupont Kevlar^{®1}, in a stitched, non-woven, tri-axial fabric, with no crimping of the fibers. This is radically different, stronger, and more sophisticated than common fiberglassing fabric, and it is not in any way comparable to the fiberglass one might see for general repair applications on cars, boats, home repair, etc.

The standard product has no carbon fiber in it. Carbon is available for certain applications.

The **matrix** (“resin/hardener”) element of the kit is an aerospace-grade, tough polymer system that is custom manufactured to Air Logistics’ specifications.

Matrix systems are rated as to their “neat” (no fiber) physical properties. The **PowerSleeve®** matrix is about as strong and chemically resistant as any suitable system can be. Compared to the standard epoxies used in boats, car parts, bathtubs, etc., (usually called “polyester”) our product is extremely strong. Most of those polyesters also have very serious health & safety problems, none of which apply to our matrix. Our standard 30-minute matrix ships “not regulated” via air and motor freight. Some of our specialty systems ship as Dangerous Goods, so be aware of this possibility when considering freight choices.

What is PowerSleeve® used for?

It is usually meant to be applied at mild ambient temperature around pipe or other vessels that have become weakened for some reason, or which need to be brought up to a higher pressure containment strength.

It is designed to be applied to the outside of pipe and vessels, but can be installed to the inside of large pipe and vessels with different application procedures. This product line is very useful for going over the top of and reinforcing other types of leak repairing patches and structures. It could even be used to reinforce the body wall section of an under-designed leak enclosure.

The **PowerSleeve®** product line can also be adapted to reinforcing concrete piers and structures; flat walls; utility poles, etc., although for some of these types of structural work, Aquawrap[®] may be a better choice..

¹ In some instances, Kevlar[®] is not present in the fabric. Contact customer service for details. Kevlar[®] is a registered trademark of Dupont.



What isn't PowerSleeve® used for?

It's not for stopping or otherwise fixing active leaks. Stop or fix the leak in the conventional way, or with other **F.A.C.S.™** Products, then reinforce that fix with **PowerSleeve®** and reinforce the remainder of the pipe. Some experienced leak seal Technicians can use **PowerSleeve®** to build composite leak seal enclosures, in the field. Contact customer service for more information on this type of application.

The standard kit is not for pipe hotter than 180° F. Special matrix systems are available that can handle normal operating temperatures up to 525° F. Although these systems can handle these temperatures in their cured state, in many cases, they cannot be *applied* on surfaces greater than 225° F.

The standard kit is not well suited for exposure to highly caustic (high pH) products. But there are special systems for some circumstances that can handle almost any industrial chemical.

Strong solvents, strong acids, strong bases, reactive chemicals, ammonia, chlorine & oxidizers are all beyond the capabilities of the standard kit. Special systems are available to handle most applications.

The standard kit's matrix is degraded by exposure to UV light (sunlight) and some other air pollution elements. Therefore, it is mandatory that the installation be painted or otherwise protected, immediately.

PowerSleeve® is somewhat hard to install to the inside of pipe or vessels less than 10-feet in diameter. Consult with our office for details on this type of work.

What are the PowerSleeve® strengths?

Refer to the **PowerSleeve®** Technical Data Sheet for information.

The application must be properly addressed to determine if **PowerSleeve®** is the correct solution.

- Is there any strength left in the vessel being **PowerSleeve®**-ed, which is to be taken into account when calculating the repaired strength?
- Is any of the strength of the **PowerSleeve®** going to be eaten up by torsion (twisting), beam bending, chemical attack or other physical stress?
- What is the pipe/vessel preparation going to be? Sandblast? Chemical clean? None?

What is done with these standard kits is much like what the pipe industry does with "standard wall" (steel is always 0.375" >10" nominal); not what they do with "schedule 40" (much heavier than "standard" >10" nominal). Our standard kit is 4 lamina (layers) of tri-axial substrate, incorporating, therefore, 12 plies of variously oriented fiber bundles. So no matter what diameter you apply a standard kit onto, it is normally always going to be "**PowerSleeve®**" "Standard Wall."

But our "standard wall" is not steel pipe's "standard wall." The ultimate load carrying capacity of a properly installed single wrap of **PowerSleeve®** is over 1,000 pounds of load (NOT psi), per inch of width. Engineers can use this number to calculate how many wraps are required.

With the proper information, the correct amount of required layers can be determined through calculations. We have a composite reinforcement calculator to assist you, and is available upon request.

Another definition of the word "strengths" refers to a product's marketing strengths. Here are some:

- Is installed in the field, without interrupting the pipe/vessel operation.
- Has a life expectancy of at least 20 years, under normal operating conditions. Some reliable industry testing suggests composite repairs may last 50 years or more, if well protected.
- Very high strength to cost ratio.
- Very high strength to weight ratio. Major repairs won't generally require special support.
- Protects the original pipe/vessel from further external degradation.
- Is environmentally friendly – no hazardous waste.
- Works over the top of & around irregularities and complicated piping configurations.



What are PowerSleeve® limitations?

You can't apply **PowerSleeve®** in the rain or other inclement weather, unprotected.

The standard matrix system is temperature sensitive while it is curing. The air and pipe temperature must be in the 60° F – 110° F range to allow proper installation. Colder temperatures prolonged and can sometimes inhibit curing. Warmer temperatures cause the system to cure too quickly, which may result in improper installation. Special systems have different application ranges. Refer to the specific matrix data sheet for more information.

The standard kit is limited to 180°F top end working temperature. Special systems can handle service temperatures to 525° F, but may have application restrictions at the higher temperatures.

It's an unfamiliar concept to many customers and they don't have first hand "installed jobs" experience.

For buried service, there needs to be conventional pipe wrapping put over the **PowerSleeve®**, or there needs to be special paint applied, to resist possible immersion in ground water.

For buried service there needs to be a strict procedure to insure against back-fill rocks and debris impacting the repair. Although **PowerSleeve®** is very tough, a fairly small, pointed rock, dropping a fairly short distance could start a micro-fracture that would dramatically weaken the overall structure. "Rock shield" is available in many forms and should be applied where "fines" are not the backfill of choice.

What are the "red flags" to be careful of?

See the section, above, "What isn't it used for"; and ...

Always consider the ambient weather and working conditions. Severe exposures during installation can radically impact the finished product's strengths.

Totally rotted away pipe or surfaces that are so bad that they cannot be cleaned cannot possibly be bonded-to fully. Therefore, if the bond is to dirt or rust, the leak-containment capability (leaking out the end) of the **PowerSleeve®** is only equal to the strength of the dirt's or rust's bonding to the parent vessel wall.

"Emergency" situations where the customer has a vessel about to come flying apart. Composite systems all take at least 24 hours to develop any decent strength, and most of them, ours included, take 7 days at 77°F to reach *full* design or "laboratory" properties. Lower temperatures can add days, weeks or months to this time. Therefore, if they're expecting **PowerSleeve®** to keep their vessel "glued together" a couple of hours after we're off the jobsite, back away from the job.

Applications where mechanical abrasion or other rubbing might occur (crossing pipe racks, etc.) are fine, but need to be equipped with armoring or emp loy other special components.

Work where the existing piping is being eroded, worn or abraded away by the internal product (like catalyst and slurry piping). For **PowerSleeve®** to handle this type of service (resistant to abrasive erosion), an abrasive resistant coating must be applied first.

What are the variations on the basic product?

Medium and high heat matrix, by special order and pricing.

Systems to handle a small variety of acid mixtures. Hydrofluoric is one of the worst acids for composites, because it can damage the glass fibers. Contact with HF acid must be avoided.

Currently there are six different fabrics that we work with. Custom fabrics and hybrids are available, but test data may be limited.

Kits with special numbers of substrate layers are available by special order and pricing.



How is PowerSleeve® priced?

We have a published list price, showing a list price for the Kit only. Installation labor, etc., is extra. Custom configurations may be priced differently. Contact customer service for assistance.

Factory discounts may be increased for large orders. Contact customer service for details.

How is it installed?

Refer to “**PowerSleeve**® Installation Instructions.” Deviating from this procedure will probably cause an installation to be weaker than it should be or perhaps even fail. The most common error or omission for **PowerSleeve**® installations is failure to sandblast or otherwise properly clean the pipe.

The question of “how clean do I have to get the pipe?” comes up very often. The best response is, “what do you really want the **PowerSleeve**® to do?” The structural strength imparted by the **PowerSleeve**® is generally not affected by poor pipe surface preparation (within reason). But, most customers are looking for the **PowerSleeve**® to bridge from an area of good pipe, to another area of good pipe, bonding to those good areas, and taking over the duties of the weakened or damaged pipe between the two good areas. If that is what they are looking to do, then the preparation at the “good pipe” bonding sites is critical. Some type of abrasive blasting is mandatory in those cases if success is expected. But, the abrasive blast does not have to be sand blasting. There are many types of blast media that are friendlier and simpler than sand. Popular now is a “baking soda” blast; and some contractors are promoting a cryogenic blast system that leaves zero blast-media residue.

Dents, ridges, craters, etc., in the vessel/pipe walls have to be brought to “smooth & level” with a high compressive strength filler material. This is to provide load transfer between the pipe and the composite. Our BP-10 system is an excellent choice for this purpose.

If the **PowerSleeve**® is expected to contain the product within the pipeline at some point, then extra precautions need to met during installation. Cleaning of the pipe surface is the most important part for this type of installation.

What are some of the cost cutting factors?

High volume of kits. Larger factory discounts may be given for large orders.



How do we compare to other composite products?

ARGUMENTS FOR PRODUCT A, AGAINST **PowerSleeve®**

Product A	PowerSleeve®
Exotic, non-crimped, multi-axis substrate.	Same
No handling chemicals in the field.	a). Not true. You have to mix their adhesive; and b). PowerSleeve® is set up so that there is no measuring, and mixing is done with factory-provided tools.
Factory cured, so there are no environmental affects to the structural properties.	Our substrate is pre-cut & sealed and our matrix is a high technology room cure system that yields factory-cure properties, in the field.
Goes on faster.	Possibly, but not by much, for an experienced PowerSleeve® crew. In some cases, PowerSleeve® will go on much faster.

ARGUMENTS FOR **PowerSleeve®**, AGAINST PRODUCT A

PowerSleeve®	Product A
We can accommodate huge diameter deviations, offsets, elbows (& all fittings), branches, tapers and non-round shapes .	Unable to handle such variations. And, the kits are very size specific. Any little deviation once you get out on the jobsite, and problems can develop. Elbows and tees are impossible to completely cover.
We can very easily provide custom tailored matrix to handle most temperature and chemical exposure.	Difficult for Product A. And, their matrix is relatively a low technology system.
Field modifications take only scissors and a razor knife.	Field modifications, other than length of the sleeve sections, are very difficult. These modifications require power saws, power drills, etc.
We can easily bump up strengths, at selective spots or on selective axis, with field placement of extra composite	Possible, but this would take extreme planning and sales people or a customer that really understood composite engineering.
Our shipping & handling is easier. The kits generally ship in a neat container that is the size of a large briefcase – everything included. Total weight per foot shipped is about the same.	Their product ships in semi-rigid cylinders, the diameter of the pipe to be repaired X 4-foot long. The adhesive and accessories ship in a separate box.



ARGUMENTS FOR PRODUCT B, AGAINST **PowerSleeve®**

Product B	PowerSleeve®
Uni-directional, extreme hoop-strength product.	Yes ... and that means that <u>they provide almost zero axial, bending and torsional strength.</u> PowerSleeve® has a tri-directional (tri-axial) design with substantial strength properties in bending and torsion. Uni-directional fabrics are available when required.
It's pultruded.	Exactly. And pultrusion severely limits the type of substrate and matrix that can be used, thereby limiting this product to mostly mild or buried applications. The pultrusion process actually limits the degree of product fiber and matrix sophistication and strength that can be achieved.
It is qualified by DOT for pipe line rehabilitation.	PowerSleeve® also qualifies to the DOT rule.
Factory cured, so there are no environmental affects to the structural properties.	Our substrate is pre-cut & sealed and our matrix is a high technology room cure system that yields factory-cure properties, in the field.
No handling chemicals in the field.	a). Not true. You have to mix their adhesive; and b). PowerSleeve® is set up so that there is no measuring, and mixing is done with factory-provided tools. No big deal.
It's a continuous wrap around the pipe, without seams or start/stops.	Yes, but study after study has shown that overlapped composite joints are very close to the same strength. Not a real argument.
It's "heat treated" in the factory.	Their manufacturing process requires heat or "heat treating" for a couple of reasons. We can achieve the same strengths and properties without the heat.
Fully cured and ready to backfill in just minutes.	Their system that glues the layers of the wrap together in the field does cure much faster than our matrix.

ARGUMENTS FOR **PowerSleeve®** AGAINST PRODUCT B

PowerSleeve®	Product B
Our PowerSleeve® is meant to provide structural repair and reinforcement to anything containing pressure or needing structural help.	For all practical purposes, they are limited to fixing flaws, dents or other minor defects in very small areas of piping. If you need to cover more than 1-foot, you start having problems. Tees & obstructions are difficult.
We're better for above grade installations because we can tailor our components to radical industrial exposures; and we provide bending and torsional reinforcement, along with hoop strength.	Not too good for many industrial exposures and provides nothing but hoop strength.
Field modifications take only scissors and a razor knife.	No modifications or changes in shape, length or fit are permitted.
We can fit anything from tiny pipe to storage tanks, and any shape from round to square, flat or convoluted.	Limited to pipe sizes from about 4", up to medium-large. Object to be repaired must be very close to round.
Our product is meant to "go the distance"; including joint overlaps, staggered layer phases and the usual large area composite methods.	When covering more than 1-foot, linear, of pipe, getting joint overlap between the kits is impossible.
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PowerSleeve®	Product B
We can accommodate huge diameter deviations, offsets, elbows (& all fittings), branches, tapers and non-round shapes, all out of the same kit.	Cannot handle complete coverage of any elbows, tees, etc., nor any branches, flanges, tapers, offsets, etc.
Up through 20" pipe, we can get under a pipe with only 6" clearance (less if we really had to). For larger sizes, the clearance goes up, but certainly not higher than 1-foot of clearance.	Often requires serious excavation, relative to the pipe size.
We can supply 3", 6", 12", 18" and 24" widths off the shelf.	Some special small widths, but generally, 1-foot wide is the only choice.

PowerSleeve® is an excellent choice for rehabilitating weakened structures. With proper training and application, using this type of repair can add years of life to structural components, saving a lot of money in the long run.

If there is ever a time where an installation is of a concern, please contact our office. We are here to support your installations so they go as smooth as possible, with minimal difficulty.