

	<b>ARMOR PLATE, INC.</b> <b>P.O. Box 5625</b> <b>Pasadena, TX 77508</b> <b>Phone: (281) 487-2023</b>	<i>Wil-Cor, Inc. - Formulator and Manufacturer of  Armor Plate® Pipe Wrap Systems</i>  <b>INSTALLATION GUIDANCE /  APPLICATION PROCEDURE</b>
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## **Armor Plate® 360 MP (“Multi-Purpose”) Pipe Wrap For External Corrosion and Mechanical Damage**

### **I. General**

Armor Plate® Pipe Wrap (“APPW”) is a composite structural reinforcement pipeline repair system that also prevents future external corrosion. APPW is designed to repair pipelines while in service without depressurizing or lowering the Maximum Allowable Operating Pressure (“MAOP”). APPW is a 3-part system (Resin, Putty and Armor Fiber®) specially designed for repairing straight pipe, elbows, tees, risers, reducers, “**wrinkle bends**”, “**branch connections**” and most any pipe configuration with external corrosion or mechanical damage. Once cured, the AP 360 MP Pipe Wrap has been engineer tested and designed for operating temperatures ranging from -60° F to 195° F (-51° C to 91° C). AP 360 MP Pipe Wrap may be applied in world-wide environments with ambient temperature and/or operating temperature up to 195° F (91° C). The AP 360 MP Kit contains Resin A & B, Putty A & B, Armor Fiber® and all necessary equipment for application in the field. The APPW System is recognized by Department of Transportation (“DOT”) / Pipeline and Hazardous Materials Safety Administration (“PHMSA”), as a permanent repair product and as the model for composite repairs. When a buried pipeline has been exposed and the repair is complete, the area may be backfilled the same day.

Armor Plate® 360 MP Pipe Wrap is user-friendly and is applied by certified installers/applicators.

### **II. Surface Preparation**

Prepare the repair area surface by grit blasting, hand tool cleaning or power tool cleaning. The best surface preparation is grit blasting because it prepares the pipe to a near white metal finish (NACE 2, Swedish Sa 2½ or SSPC SP10) with a 2 to 3 mil anchor pattern. For hand tool and power tool cleaning, remove all loose dirt and debris, rust, and other contaminants that reduce adhesion. A roughened, clean surface is necessary to properly install the AP 360 MP Pipe Wrap. The area prepared for the APPW installation must extend 2 inches (5 centimeters) or more beyond both edges/sides of the anomaly/anomalies. The area to be wrapped should be thoroughly wiped with Acetone, MEK, Xylene or equivalent, if possible.

**NOTE:** It is acceptable to install the AP 360 MP Pipe Wrap over a coating that is non-compressible, such as Fusion Bonded Epoxy (FBE) Coating that is in good condition. However, Armor Plate, Inc. must be contacted if external corrosion or mechanical damage is present to offer additional suggestions on procedure. Surface Preparation options are as follows:

1. Small Repair Areas – use rough grit sandpaper over the entire repair surface area to provide a roughened surface with special attention to the damaged area/areas, wipe clean to remove all dust and contaminants and continue with the APPW Installation as outlined in Sections III and IV of this document.
2. Large Repair Areas – brush or sweep blast the entire repair surface area to provide a roughened surface with special attention to the damaged area/areas, wipe clean to remove all dust and contaminants and continue with the APPW Installation as outlined in Sections III and IV of this document.

### **III. Required Number of Wraps**

- 1.) On external corrosion, the required number of wraps of AP 360 MP Pipe Wrap is determined by using ARMOR

CALC®. ARMOR CALC® is an engineered and tested program that uses the pipe size, nominal pipe wall thickness, pipe grade, corrosion depth and corrosion length. The ARMOR CALC® will then determine how many wraps to apply to bring the pipe back to greater than the MAOP.

2.) The Armor Plate® Pipe Wrap System is designed to repair almost any external corrosion depth or pipe wall loss up to 80 per cent of the nominal wall thickness. For Technical Support, please contact Armor Plate, Inc. at 281-487-2023.

3.) Dents, gouges, manufactured defects or wrinkle bends are considered to be mechanical damage. Therefore, the “Mechanical Damage” Formula is used to determine how many wraps to apply to bring the pipe back to greater than the MAOP. “Mechanical Damage” Formula: The nominal pipe wall thickness is multiplied by 1.5, then divided by the thickness of the Armor Fiber® (.0625 inches). This formula is not shown on the ARMOR CALC® Program. For “Wrinkle Bend Repairs”, refer to Installation Guidance / Application Procedure for “Armor Plate® 360 MP (“Multi-Purpose”) Pipe Wrap For Wrinkle Bends”. Any sharp edges should be removed and an inspection should be performed to identify cracks. Cracks must be removed before installing AP 360 MP Pipe Wrap.

**\*Note:** AP 360 MP Pipe Wrap is installed with the required number of wraps for each repair area. Two wraps is the minimum number of wraps to apply to assure that the APPW Application is free of pinholes, most commonly referred to as holidays. A typical repair using APPW is normally 5, 6 or 7 wraps. However, if the pipe wall or damage is severe, the number of wraps may be higher based on the pipe data.

#### **IV. Installation**

1.) Measure the circumference of the pipe and add 2 inches (5 centimeters) or more, to provide an overlap of the trailing end over the leading end of the Armor Fiber®. Cut the Armor Fiber® for the required number of wraps, as per the measurement in the circumferential direction. If the “required number of wraps” is more than 4 wraps, add 2 inches (5 centimeters) or more to the cut length of the Armor Fiber® in order to accommodate the increase in the outside diameter. This should be done for each additional 4 wraps.

Example: If the circumference of the pipe is 25 inches (63½ centimeters) around, the Armor Fiber® should be cut 27 inches or more (68½ centimeters or more) long for a 2 inch (5 centimeter) or more overlap at the trailing end on each wrap of Armor Fiber®.

2.) Once the surface of the pipe repair area is ready, it is now time to mix the resin for priming and saturating the Armor Fiber®.

3.) The mixing ratio for the AP 360 MP Pipe Wrap System is 1:1. Mix one Part A to one Part B when mixing the Resin and the Putty.

4.) Mix the AP 360 MP Pipe Wrap Epoxy Resins using one Part A Resin (white) to one Part B Resin (black) with stirring sticks and containers located in the AP 360 MP Pipe Wrap Kit. Mix vigorously for 2 to 3 minutes until the resin color becomes gray. On larger repairs, a drill with a mixing paddle can be used. Mix material until there are no white or black streaks in the Resin, resulting in a final homogenous gray color.

5.) Mix the AP 360 MP Pipe Wrap Epoxy Putty using one Part A Putty (white) to one Part B Putty (black) with stirring sticks and cardboard located in the AP 360 MP Pipe Wrap Kit. Mix until the putty color becomes gray and there are no white or black streaks in the Putty, resulting in a final homogenous gray color.

6.) Apply the Putty to all voids, pitting, mechanical damaged areas and/or irregular surfaces to provide the “load transfer” between the pipe and the AP 360 MP Pipe Wrap repair. Smooth over the Putty, in order to produce a smooth, uniform

and transitional surface.

7.) Using a brush or roller provided, apply a primer coat of the mixed portion of the AP 360 MP Pipe Wrap Resin to the entire pipe surface and over the Putty in the repair area.

8.) With a roller, completely saturate the Armor Fiber® on the rough side (chopped strand) first, then turn the Armor Fiber® over and completely saturate the smooth side, using the mixed AP 360 MP Pipe Wrap Resin.

9.) Once the Armor Fiber® is saturated, with the rough side down and the smooth side exposed, roll the Armor Fiber® onto the 2 inch x 2 inch wide x 15 inch long wooden applicator. The Armor Fiber® is now ready to be applied over the pipe repair area.

10.) With the rough side facing the pipe surface, position the leading end of the saturated Armor Fiber® onto the pipe surface (near the top center of the pipe surface on a horizontal pipeline). Hand tension the Armor Fiber® and wrap the Armor Fiber® around the circumference of the pipe. As you wrap the circumference of the pipe, smooth out the wrap, in the circumferential/hoop direction, using gloved hands to prevent air pockets, voids or wrinkles. You should now have one wrap and one linear foot of pipe covered. The wrap should be straight and even around the pipe. Each additional wrap should always be applied in the same circumferential direction as the previous wrap.

**\*Note:** For buried pipelines and future Smart Pig Runs / In Line Inspection (“ILI”), if a “Marker System” is desired to identify a repair that has been previously completed, the following are some suggestions we offer:

A.) Once the first wrap of Armor Fiber® is in place, install 2 or more wraps of metal banding material about 1 or 2 inches from each inside edge of the installation. Then complete the installation.

B.) Once the Armor Plate® Pipe Wrap installation is complete, install 2 or more wraps of metal banding material about 1 or 2 inches from each outside edge of the installation.

C.) Once the first wrap of Armor Fiber® is in place, install a metal object of choice or magnet (at the 12:00 o’clock position on a horizontal pipeline) about 1 or 2 inches from each inside edge of the installation. Then complete the installation.

D.) Once the installation is complete, install a metal object of choice or magnet (at the 12:00 o’clock position on a horizontal pipeline) about 1 or 2 inches from each outside edge of the AP 360 MP Pipe Wrap installation.

11.) Continue wrapping the pipe until the required number of wraps is obtained. If you are installing more than a one linear foot section, stagger every other wrap/layer by half an inch or more to cover the circumferential seam on the previous layer (Example: After first wrap, move second wrap over by half an inch or more to the right. On third wrap, move over by half an inch to the left. Continue this process until the required number of wraps is obtained). Make sure each wrap in a single layer is adjacent (butted-up and touching) but not overlapping.

**\*Note 1:** When installing multiple continuous wraps for more than a one linear foot area of repair on small diameter pipe, use the same stagger technique per application to cover the circumferential seam on the previous application.

**\*Note 2:** When installing only two wraps, as a corrosion barrier, for more than a one linear foot section, you can deviate from the above procedure by overlapping the edges by half an inch or more instead of staggering. Also, when repairing “Bends” and other configurations, overlapping of the edges is acceptable.

12.) After the “required number of wraps” is installed, mix the AP 360 MP Pipe Wrap Putty. Apply the Putty to each

exposed circumferential seam, to both edges and at the trailing end of the Armor Fiber®. These areas should be covered with approximately one inch (2½ centimeters) in width of Putty to insure the wrap is properly sealed, thus completing the repair. The completed repair will cure and harden in approximately 2 hours at 85° F (29° C). The AP 360 MP Pipe Wrap installation will remain tacky until the cure time has been reached. Once the system has cured, you are now ready to backfill the same or next day, if this repair was on a buried pipeline that has been exposed.

**\*Note:** It is recommended that the Installation Crew or a Crewmember remain on site until there is satisfaction that the progression of the curing is acceptable to where it will not sag at the bottom portion on a horizontal application or slide on a vertical application.

## **V. Materials**

Depending on the number of wraps and the linear feet of the repair, each kit will repair any variation of pipe diameter. The kit sizes are 12.5, 25, 50 or 100 square feet. Each kit contains Resin, Putty, Armor Fiber® and all necessary equipment for application in the field.

Armor Plate® 360 MP Pipe Wrap Resin “A” side (white in color)

Armor Plate® 360 MP Pipe Wrap Resin “B” side (black in color)

Armor Plate® 360 MP Pipe Wrap Putty “A” side (white in color)

Armor Plate® 360 MP Pipe Wrap Putty “B” side (black in color)

Armor Fiber® (The length of the Armor Fiber® is determined by the square footage size of each kit - for example, a 25 square foot kit contains a roll of Armor Fiber® that is 25 foot in length.)

The Armor Fiber® is 12 inches (304.8 mm) in width and .0625 inches (1.6 mm) in thickness.

**\*Note:** See the respective Material Safety Data Sheets for additional information on the above materials.

## **VI. Characteristics**

- 1.) The AP 360 MP Pipe Wrap System is user-friendly.
- 2.) The mix ratio is 1:1 (equal amounts) for the AP 360 MP Pipe Wrap Resin and Putty.
- 3.) The AP 360 MP Pipe Wrap may be applied in world-wide environments with ambient temperature and operating temperatures up to 195° F (91° C). Warm temperatures may require tenting to provide shade for mixing and application. Cool temperatures, below 60° F (16° C), may require external heat for mixing and application.
- 4.) The AP 360 MP Pipe Wrap may be properly applied on damp pipe or condensating pipe, with limitations. For Technical Support, please contact Armor Plate, Inc. at 281-487-2023.
- 5.) Once cured, the AP 360 MP Pipe Wrap has been tested and designed for operating temperatures ranging from -60° F to 195° F (-51° C to 91° C).
- 6.) Once the AP 360 MP Pipe Wrap is properly installed and cured, it restores the strength above the Maximum Operating Pressure (MOP) of the pipeline.
- 7.) The AP 360 MP Pipe Wrap contains ultraviolet (UV) inhibitors. An additional layer of paint or coating may be applied for additional protection.

8.) The AP 360 MP Pipe Wrap can usually be applied by two field crewmembers. On larger repairs a crew of four field crewmembers is required. They can usually apply between 75 and 125 square feet of material per hour, depending on the severity of weather conditions and/or access to the repair area.

9.) Estimating Coverage: One gallon of AP 360 MP Pipe Wrap Resin will saturate approximately 25 square feet of Armor Fiber®.

## **VII. Curing**

1.) If the ambient temperature is below 55° F (13° C), we recommend warming the Resin and Putty to above 60° F (16° C). This will insure the Resin and Putty will mix easier and apply faster. Once the Resin or Putty has been mixed, it will set up at 60° F (16° C) or higher.

2.) The AP 360 MP Pipe Wrap will cure with outside temperature and pipe temperature above 60° F (16° C).

3.) The application of heat reduces the cure time of the AP 360 MP Pipe Wrap. External heat (i.e. – heat lamps, quartz lights, Tioga Heaters / ducts, etc.) applied at temperatures below 70° F (21° C) makes the system apply easier and cure.

4.) One quart mass of mixed AP 360 MP Pipe Wrap Resin and Putty will have a pot life/working time of approximately 45 minutes at 75° F (24° C).

## **VIII. Storage and Handling**

1.) The AP 360 MP Pipe Wrap components must be kept dry. The Epoxy Resin, Epoxy Putty and Armor Fiber® must be stored in a dry area, or covered in order for the application equipment and Armor Fiber® to perform properly.

2.) The Armor Fiber® must be completely dry at the time of mixing to achieve proper saturation.

3.) Shelf Life of the AP 360 MP Pipe Wrap Resin and Putty – minimum two (2) years in sealed containers.

## **IX. Cautions and Warnings**

1.) AP 360 MP Pipe Wrap is a safe system, but we recommend usage of the safety equipment: rubber gloves, Tyvek suit, proper eye wear, etc.

2.) Use AP 360 MP Pipe Wrap in well-ventilated areas and avoid directly breathing fumes while mixing and saturating the Armor Fiber®.

3.) Avoid skin contact if possible. Gloves and safety glasses are recommended.

4.) Use soap and water to thoroughly clean contaminated areas of the body.

5.) In case of eye contact, thoroughly flush the eye with water and seek immediate medical attention.

The Armor Plate® Pipe Wrap System saves time, money and labor costs. The APPW System is safe, user-friendly and may be applied in less than one hour, depending on the size of the repair. We appreciate your business. If you have any questions, please visit our website:

**[WWW.ARMORPLATEINC.COM](http://WWW.ARMORPLATEINC.COM)** OR call us at **(281) 487-2023**

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