THE DEFINITIVE GUIDE TO PAVING SYNTHETICS AND INSTALLATION © 1985 – 2023
Mounque Barazone - Inducted into the Pavement Hall of Fame in 2019

The purpose of this book is to assist the contractor and engineer in understanding the various types of Geosynthetics including Geotextiles (fabrics), Geogrids and Paving Geogrids, Geocomposites, Geomats and the installation procedures. Understanding their specifications, differences and proper installation procedures and various problems that can occur during installation is the key to success.

For the purpose of the book the terms used and referenced 1 – 4 are interchangeable:

1. Geotextile and Fabric
2. Geogrid and Grid
3. Geocomposite and Composite, Grid Composite, Grid with Fabric
4. Hybrid Geomat and Hybrid Mat or Mat

HISTORY:
Mounque "Monk" Barazone

Paving synthetics in asphalt and concrete overlays were first tested in the 1960's with Geotextiles (paving fabric). Regular testing and usage of paving fabric began in the mid 1970's and with paving grids in the mid 1980's. In the 1990's Geocomposites and in the 2000's Hybrid Mats

Paving synthetics are currently used in almost every asphalt application: freeways, highways, city streets, mobile home parks, parking lots, ponds, chip seals, tennis and sport courts, airport runways and taxiways (San Francisco Airport 1981).

I began distributing and installing Geosynthetics in 1980. While working with many Federal, State, City, County, Private Engineers and later foreign agencies I began to discover the differences in the various materials, functions, and applications.

I began the first installation company and also began developing Geosynthetic Installation Equipment that has received 6 United States and Foreign Patents with other Patents Pending and Patents Pending Roll Pullers for unloading vans and containers. New options and machine alterations have been developed and continue to be developed for newer materials. Recently my high melt brushes. I then began learning the procedures and techniques necessary for proper and efficient construction.

Many problems discovered were field related and solved jobsite by jobsite under different application. I also discovered many problems were specifically material related. As I began to broach the subject publicly of the material related problems, I began to be less then appreciated by many manufacturers whose material problems they did not want to be known for sales reasons, market share and proprietary interests. I became an ally to engineers and agencies who needed this information to properly specify materials and installation procedures to derive the desired design life.

This permitted me the opportunity to install many test sections of many different materials and begin to be asked to consult at projects and was often called to locations when field installation problems were occurring. I had the opportunity to help solve the problems. When plan A did not work and they needed a ideas for a plan B or C or D! In many situations I had to redesign on the spot and find a machine or welding shop to make parts or stand in a swamp or hang over a cliff or whatever. Eventually I would get it solved.

This led to my being retained as a consultant and for classes and jobsite training in Europe and South America. The problems there were often a little different (Europe. They made me wear a suit. Blue jeans work better because I actually work at jobsites.

I was now being called an expert on Geosynthetics and installation. LOL (Laughing out Loud) I realized the word expert was created by screw-ups who did not want to be called a “screw up” and needed a better word like “expert” that worked! To me an expert is someone who may not be able to tell you what to do but can tell you what not to do out of their past experience.

In 2019 I was inducted into the Pavement Hall of Fame at the National Pavement Convention.

In the early 1980’s there were no standard specifications for the Geotextiles and no standard installation criteria. It took until the late 1990’s and 2000’s before AASHTO M-288-90 and later AASHTO M288-06 and now AASHTO -M217 became adopted as standards. These are explained further on in the book. There are currently no standard specifications for Geogrids, Paving Grids, Geocomposites and Hybrid Geomats All of these materials are also explained later in the book.

By the mid 1980’s I had developed a course that could be up to 8 hours on all synthetics and was taught as an American Society of Civil Engineers continuing education course, to many agencies and to manufacturers and distributors worldwide. It could be broken into various sections or the full course taught.

As time passed and universities began programs, many using my information, I was excluded from their clubs (LOL) since I did not go to college or have a degree. Academics wanted degrees and professional status for their education. They found it hard to accept someone with lesser education, educating them. Engineers and contractors on the other hand wanted practical experience. Interesting, as to how many of the academics have been inducted into a Hall of Fame!

PHD’s published books and I discovered much of it came from my papers and classes. I was asked by one famous PHD if he could use my extensive article from the July/August 1990 Geotechnical Fabrics Reports (GFR) in his book.

Then I was told by his staff he could not use me as I did not have a degree and the status needed to be in his book. He asked a well know agency engineer who then asked me if he could use much of my paper and articles in his insertion. I was given reference credit.

I have been referenced in papers and articles hundreds of times.

One high level public agency engineer always joked, “When we PHD’s who designed it or field engineers can’t figure out how to install it or solve the installation problems we say “’It’s time to call in Mounque, he did not go to college and no one has educated him on what he can’t do”

This was also true of many of my first patents on the machinery. I had built them by hand and changed the machines dozens of times until the designs worked flawlessly for smooth installation, different fabric problems, grids and construction problems for the fastest production.

When mechanical engineers had to draw my machines for all patents and patents pending they all commented that it was a good thing I had not gone to mechanical engineering school, on paper my machines did not work. That is why no adequate machines were developed before mine, the engineers were trying to design them in an office on paper with no onsite project experience. That was impossible without experiencing actual installations and their problems. These required trial and error, redesign and more redesign of machines and construction techniques developed until the problems were overcome. The machine began to install fabric and later grids and other synthetics almost flawlessly with the least time, most production and lowest field construction costs. Minutes at jobsites add up to a lot of money when your considering the who paving crew and operation.

My learning opportunities from many new installation problems on different applications increased from jobsites worldwide. This permitted me to invent new modifications for my installation equipment and Roll Pullers for unloading trucks and containers, develop custom machinery and most recently a new high melt brush and plastic. This led to patents and patents pending’s and field techniques for installation of not only paving synthetics but many others Geosynthetics. These techniques as well as my patented machines are all used worldwide. (GAC Cub 300T in China)

HISTORY OF THE INDUSTRY AND SALES, MY PERSPECTIVE

In the beginning Manufacturer’s sales staffs wanted the contractors to like using the fabric since they decided on whose they purchased, they were the end users. The sales staffs were more contractor friendly then engineer and correct and installation friendly. Each manufacturer was vying for market share in the new market. Manufactures representatives developed relationships with various contractors with a you scratch my back and I’ll scratch your back relationship. Competitor’s prices were disclosed before bids; last minute price cuts took place leading to a decline in prices that was excluding many manufactures who would not sell below cost to make it up in volume!

This went on until the middle of the 1980’s when a Federal Government Antitrust investigation was launched by the US Justice Department for anticompetitive practices and racketeering. As the government interviewed manufacturers, distributors and contractors the playing field suddenly leveled. Price disclosures and last minute cuts were reduced drastically and price levels rose.

New players were able to enter the market. The investigation ended with no official charges being or action being brought. It concluded that anticompetitive practices existed and were limited to a few companies, but they had failed to prevent the entrance of other companies. The investigation by itself had brought an end to these anticompetitive practices and entry in to the market place was opened.

No one new much at first and everyone was discovering the differences between the fabrics and where to use them, different oils and installation procedures paving, stabilization, drains and what would and would not influence performance, design life and construction time and costs.

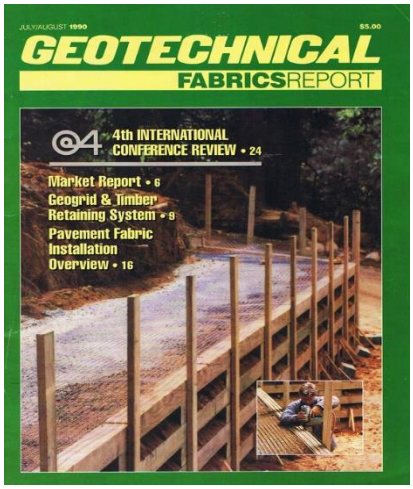
Requiring the contractor to use all the correct installation procedures was not end user friendly. The manufacturer's sales staff often overlooked improper installation to help the contractor install more rapidly and not have his paving production impeded by the Geosynthetics installation. The long-term performance and success of using the materials were secondary to sales no matter what effect it had on the future. Their promotions were based on sales now. They would not be around when the engineers began seeing less than the desired design life. The was another sales person's problem. Many were promoted and became that others sales person's boss. This eventually led to project problems that developed and less design life being realized.

Engineers began questioning the value of incorporating the Geosynthetics. Specifying and sales began to decline. The previous practices were now affecting the current sales and growth. Many agency engineers were also becoming very tired of fighting in the field with contractors to get the Geosynthetics installed correctly. Projects installed with controlled sections that were done with correct stringent procedures showed the value of using the materials. Yet, getting these applied to normal non-stringently controlled projects was difficult when the contractor resisted. It was much more so when the manufacturer's representatives did not back the engineer and enforce the rules or the field engineer looked at the materials as getting in the way of the paving.

An example was the late 1980's and early 1990's Southern California Green Book Committee. It had County Engineers and private engineers. Los Angeles Counties Engineers and materials testing labs engineers had discovered heat shrinkage and delamination problems. They wanted controls and specifications that helped solve the problem. The manufacturers fought them for various propriety reasons. They introduced altered data and test results that disputed the materials lab results. Engineers from Caltrans and Texas DOT came to these meetings and introduced their test data and concerns. The vote of the private engineers over ruled the public engineers by one and the result was a specification which allowed a percent of damage to the fabric to be allowed.

The manufacturer's won their battle. They were busy congratulating each other outside the meeting room while many of the public engineers were furious. They went to their offices and with a few pen strokes wrote project change orders that eliminated millions of yards of paving fabric changing them to rubberized membranes. If they could not have the needed specification and field procedures, they felt were necessary they would not use the product. Los Angeles Counties millions of square yards a year went to nearly none. The manufacturers had won their battle and lost the war.

Geosynthetics magazine published my first version of this book. at that time a much smaller but extensive article in the July/August 1990 issue. It was the longest article they had ever published and one of the most debated.




BY MONIQUE BARAZONE

Paving Fabric Interlayer Membranes and Installation Procedures Over the Past 20 Years

Figure 1: The use of paving fabrics in asphalt concrete overlay systems is far more established than it was 20 years ago.

Paving fabric has been used in asphalt concrete overlay systems since the late 1960s as a waterproofing membrane to retard and/or delay reflective cracking (Figure 1). Most recently, paving fabric has been tried with chip and slurry seals. Performance results of extensive field trials throughout the United States from the late 1970s and 80s have varied from poor to excellent. The majority of failures are either from very early experiments prior to the development of proper installation procedures, or from attempts to reduce transverse (thermal strain) cracking.

As a manufacturer, former installer and patent holder of installation equipment for paving fabrics, the author has collected volumes of research materials and bases his knowledge on field experience. The knowledge contained in this paper is to assist field engineers and other installers, and give perspective on specifications and installation procedures to specifiers of paving fabrics.

Installation of paving fabrics is far more established than it was 20 years ago, because of specification guidelines produced by numerous organizations. But it is by no means a closed science in the respect that everything has been learned and individuals in all levels of the industry agree on all points. Quite the contrary is true. The author has seen specifications for paving fabric installation take some surprising turns in the past year, a trend that will continue.

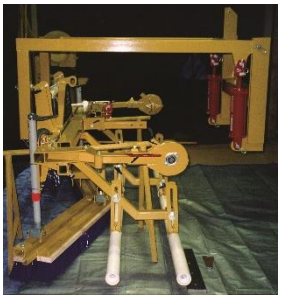
Many states have published volumes of reports with the Federal Highway Administration (FHWA) since 1975, about the installation and performance of pavement fabrics under different climatic conditions. Most of these reports conclude that fabric is an exceptional water proofing (or perhaps more precisely water resistant) membrane, significantly reduces reflective cracking over alligatored pavements, and can reduce the thickness of the asphalt wearing course, depending upon deflection and traffic index calculations. Reports on

JULY/AUGUST 1990

Manufacturers on the advisory committee argued against the article and said my information was incorrect, my opinion and misrepresented. They stated I had altered what was used in the article from the listed reports and from what the many engineers had stated for my own proprietary machine sales interests to try and eliminate the machines behind oil trucks. This was totally untrue and simply stupid, since I built a version of that and it was not to my best interest to show the problem. It was to the best interest of proper engineering.

They were trying to protect their own propriety sales interests for specific contractors whose machines were not built correctly and were installed behind oil trucks that placed the fabric inches from the sprayed oil. Oil spatter burnt the fabric, engineers had no ability to check the spay for problems and as temperatures rose the oil began to shrink and met the fabric. These could not be removed and put on a tractor. Many were in violation of my patents. This damage was noted by Los Angeles County Engineers and other agencies leading to Green Book Confrontation.

I developed this equipment originally. (Oil Truck Mount & Grizzly Canada).
It used a mounting system that attached to the back of the truck my Grizzly 600T pinned into. My machine pinned in and the system could be hydraulically raised and lowered for transportation. It placed fabric 5 feet behind the oil so engineers could check the spray and there was no spatter damage. It allowed for a second delay before the fabric was placed into the oil. My machine was removable from the system so it could be put on a tractor when this shrinkage occurred.



The editor at the time had me send in every referenced report and publication I used to review it was correctly represented. It was 4 boxes and nearly 80 pounds. He interviewed the engineers at Caltrans, Los Angeles County, Texas Dot and the Asphalt Institute. All of them stated that what was written in my article was exactly what they had provided me, factually correct and unaltered. The article was published in July, 1990 over the manufacturer's objections.

The editor and I agreed to delete all references to my and any other equipment that caused the problems and only reference that equipment had been developed to install fabrics. He did not want any proprietary accusations made. He guaranteed that no letters of criticism of the confirmed facts or my proprietary interests would be published and made sure his staff knew this.

In the November, 1990 Edition while he was on vacation a critical letter was somehow published against what he guaranteed. He was furious and then told me the gloves were off and allowed me a lengthy response (I like it) with no restrictions title Barazone Replies in the January, 1991 edition.

These GFR articles along with many other articles from Pavement Maintenance Magazine, The Asphalt Contractor and The Constructor de Camions in Spanish with the most current edition this book © Copyright 2019 can be found on my website www.pavingfabric.com .

Many manufacturer's representatives and executives warned me to stop telling people the heat shrinkage and other problems because that could affect sales and specifying. Unless I did so they would not recommend my machines or my consulting. I cautioned that their approach of sales first and proper engineering and installation second will eventually reduce sales. Less than expected design life and performance will cause harm to the reputation and displeased engineers will not. Unfortunately, I was not heeded and eventually it caught up to them and sales did begin a decline.

As sales and specifying began to decline the unfortunate sales person at the time, due to no fault of his own but the fault of his predecessors who were now his bosses became the “SACRIFICIAL LAMB”. The new sales person who replaced “the lamb” was charged with fixing the problem. That led to a turnaround in installation attitude. It involved getting the engineers to try using the materials again. It meant they had provide a reason why the performance had not been what was expected. They blamed on improper installation. Many began distributing my information on installation. If the installation procedures were followed correctly and the Geosynthetic installed correctly the engineer and agency would see the value and design life performance the test sections showed.

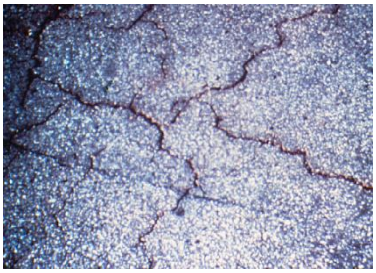
At that time many new sales managers came to me and said they wished their predecessors had listened to me years ago instead of discounting my information. That would have saved many of today’s problems and declining sales they now had overcome.

A number of them began again recommending my machines and Roll Pullers (Roll Pullers in Bolivia, courtesy of Maccaferri). and even bought them. They began using me to do consulting and help with technical field problems. It permitted me to invent new modifications which led to patents and patents pending’s for my installation machinery, Roll Pullers and field techniques for installation of not only paving synthetics but many others.

Of course, for a period this led to installation “field wars”. Contractors who had been allowed to place the material incorrectly were suddenly being told to use all correct procedures. This increased time and costs, and many contractors had not included this time in their bids based on previous experience on projects. (Tractor Bucket Mount, Ohio)

By the mid to late 1990’s installation procedures had become accepted and enforced and the materials values were again becoming evident for fabrics and newer materials that were now being introduced. My articles were being widely circulated and my classes well attended. As the information became better understood it helped develop standardized installation practices.

GOVERNMENT REPORTS



Numerous states have published dozens of reports with the Federal Highway Administration (FHWA) since 1975 (referenced) in regard to the use and performance of paving fabrics under different climatic conditions. Temperatures ranged in excess of 104 degrees F (40 degrees C) and as low as -30 degrees F (-30 degrees C). The majority of reports show significant success while some show failures. In most instances the failures have been traced back to improper installation techniques.

The most extensive studies were by Caltrans, published in 1991 with the Federal Highway Administration. The three reports by Predoehl, studied twenty-four various test and control sections paved over 12 years and concluded: "AC overlays incorporating paving fabric Interlayers (PRF) had less Alligator Cracking than conventional AC overlays that were up to 0.10 foot thicker".
"It is recommended that (PRF) be used to replace approximately .10 foot (3.0 cm) of Dense Graded Asphalt Concrete (DGAC) where additional tensile and flexural stiffness is not required." This results in savings are as much as \$1.13 / Yd^2 (\$0.95 / M^2) over a thicker overlay. "PRF appears to reduce transverse cracking in thinner overlays by 0.20 - 0.40 foot (6cm -12cm) over distressed PCC pavement by approximately one transverse crack/100 feet after 8 years of service."

"In a comparison of performances of twelve different proprietary fabrics in 24 test sections over distressed PCC pavements, there were no significant differences in cracking between any of the fabrics". Button and Epps observations in FHWA-Texas report 261-2 was similar.

Fabric in cold climates has not performed as well as in mild climates. Overall, fabric in cold climates has proven to be effective. Numerous reports have shown marked improvements in test sections in cold climates with temperatures as low as -30 degrees F (-30 degrees C). Donnelly (referenced) reported five years' better performance with an overlay in Colorado on an interstate between Eagle and Dowd. In an FHWA report Wyoming experienced considerably less cracking in the fabric overlay than in the control section with no fabric after one severe winter. Caltrans test sections in the mountains have shown a delay in the cracking of fabric overlays as compared to the non-fabric control sections. Texas reported significant improvements after 3 winters.

Paving Geogrids, Geocomposites and Hybrid Geomats do not have as long a history but there are many reports out now that show grids performance and cost savings. Many manufacturers now have excellent information available on project histories and design guidelines and specifications.

Report # FHWA/MT -01-0299160-1A from the Federal Highway Administration and State of Montana is one of the best on grids. Four design options were employed. One option without grid served as a control and three design options with grid had different materials costs for structural, as asphalt lifts and so on. The design options showed total life cycle costs savings of 10.0%, 14.2% and 17.2%.

Chip seals over fabric began to be used in the late 1980's. There are many reports on their improved performance. Specifications and procedure have been developed for chips seals over fabric. There are dozens of articles and papers on the internet by manufacturers and highway departments. For cost saving it has been shown they may double the life of the chip seal and they improve overall chip retention. They reduced or eliminated the future need for future crack filling. They reduced the effects of thermal expansion and contraction.

Chip Seals require different installation techniques than are used for regular paving. These must be adhered to for the system to work. San Diego County in California has been a leader in the use of chip seals over fabric. They determined that they saved just under $90,000 a year using paving fabric and chip seal versus a regular crack filling and chip seal. The FHWA Resource Center did research on chip seals in 2004. This research produced various reports showing that chip seal sections that incorporated paving fabrics performed much better than chip seal sections without paving fabric.

Most important is that all reports emphasize the two major factors that influence the outcome of the project and its long-term benefits.

- The performance of a Geosynthetics in paving applications depends upon proper installation.
- The proper selection of the Geosynthetic for its intended function

Proper installation also will greatly influence the contractors profit or loss.

1. The contractor's liability for the project is very important
2. AASHTO M288-17 has a provision for the contractor liability

- AASHTO M288-17 / Section 10.2 / Section A6. PAVING FABRIC
- X1.6.3. *Construction:*
- X1.6.3.4.3. **REMOVAL AND REPLACEMENT OF PAVING FABRIC THAT IS DAMAGED WILL BE THE RESPONSIBILITY OF THE CONTRACTOR.**

PROPER TERMINOLOGY

Geosynthetics referrers to all synthetic products used in civil engineering (GEO) applications.

- Geotextiles (Non-woven and woven fabrics)
- Hybrid Geomat (Combination of polymers and fiberglass)
- Geogrids (Grids)
- Geocomposite (Grids with fabrics)
- Impervious membranes (liners)
- Geocells
- Erosion control blankets
- Prefabricated drainage boards and nets.
- Fences (Silt Control – Geotextiles with stakes)
- Safety Fence

Geosynthetics functions include:

- Paving Interlayer Membranes
- Paving Crack Retardation or Prevention
- Reinforcement
- Stabilization
- Filtration
- Separation
- Drainage (Internal Planer Drainage)
- Membranes
- Membrane Cushioning
- Erosion Control

Geogrids, Geocomposites (Grids and Paving Fabric Combination), Geotextiles (Paving Fabric) and Hybrid Geomats (fabrics with a combination of fiber types) are all part of the ever-expanding line of Geosynthetics and are specifically for paving applications.

Paving Geosynthetics have different functions in paving applications. Each type of Geosynthetic will require different installation procedures for proper placement and to obtain the desired design benefit. None of these install similarly.

All of these may be beneficial in both small and large paving synthetics applications:

- Highways and City Streets
- Chip Seals
- Bike and Walking Paths
- Parking lots
- Mobile home parks
- Ponds
- Tennis and Sport Courts and Tracks
- Airport runways & taxiways, asphalt & concrete

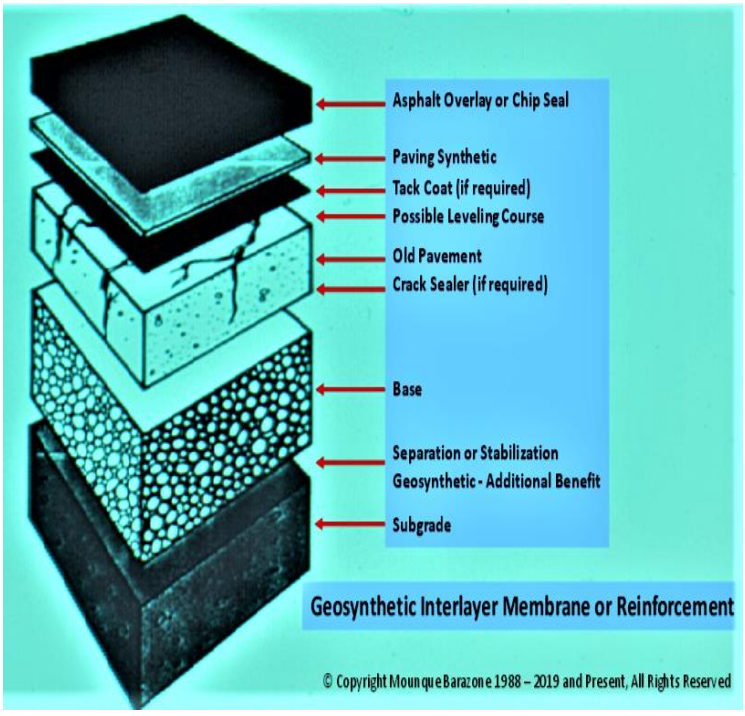
What is important is to determine what function or functions (benefits) that is trying to be obtained nd which Geosynthetic or combination of them will provide the desired outcome.

Any or all these functions can be obtained with the proper selection of the Geosynthetic.

A. A moisture barrier interlayer membrane is for the control of surface water infiltration that breaks down the bearing capacity of the subgrade.
    1. Geotextile Paving Fabric
    2. Hybrid Geomat
B. Preventing Crack Reflection
    1. Alligator Crack Reflection
        a. Geotextile Paving Fabric – Minimal -Medium
        b. Hybrid Geomat – Medium - more
        c. Geogrid Paving - Maximum
        d. Geogrid Composite - Maximum
    2. Medium crack reflection
        a. Hybrid Geomat
        b. Paving Geogrid - Maximum
        c. Geogrid Composite - Maximum
    3. Large crack and joint reflection
        a. Paving Geogrid - Maximum
        b. Geogrid Composite – Maximum
    4. A combination of moisture barrier interlayer membrane and of the medium to large crack reflections.
        a. Hybrid Geomat – Medium
        b. Geogrid Composite – Maximum Large Cracks and Joints

Paving synthetics function as moisture barriers and reflective crack reducers for small reflective alligator cracks to large structural cracks and joints depending on the material selection, these include:

- Geotextiles (paving fabric) functions as an interlayer membrane or moisture barrier and small alligator reflective cracking.
- Paving Grids function as structural alligator, medium and large crack and joint reflective cracking
- Paving Geocomposites – (Grids with fabric) function as both an interlayer membrane structural alligator, medium and large crack and joint reflective cracking
- Hybrid Mats function as a moisture barrier and alligator to medium reflective cracking.



Various names have been given to the use of Geotextile Paving Fabric over the years and now Grids and Mats. The most current terminologies are:

- Fabric Interlayer Membrane
- Moisture Barrier
- Paving Fabric.
- Paving Grid
- Paving Composite
- Paving Mat
- Pavement Reinforcement Fabric (incorrect terminology)

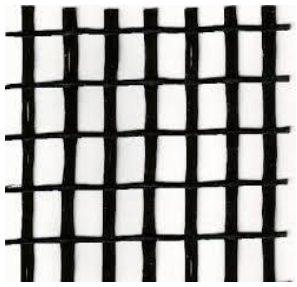
Caltrans' Smith (referenced) showed in laboratory testing that a paving fabric interlayer is not a significant tensile reinforcing element in an AC pavement. Overlays incorporating a paving grid or composite and to a lesser degree hybrid mats can obtain reinforcement. Nonwoven paving fabrics have a high elongation and low modulus. This permits them to have an interior plane to become saturated with oil to create the membrane and remain flexible within the asphalt system.

UNDERSTANDING GRIDS

Geogrids are used for unstable base reinforcement. Metal grids were used in World War II to make rapid runways and roads. Paving Grids are used for internal asphalt overlay reinforcement and large crack rand joint reflection.

They are very rigid and look like a fence and have openings (apertures) that can vary in size from small to large. They have very low elongation (no stretch) and high modulus which give grids high strength, maximum reinforcement and crack reflection prevention.

Grids are manufactured from a variety of materials including fiberglass, polyethylene and polyester. Each has a slightly different elongation depending on the manufacturer, polymer or glass and apertures and can conform differently to surfaces and especially when paving on a milled surface.



Paving Geogrids come in various widths from 2 feet to 16 feet. The majority are manufactured from 5 to 13 feet wide. Width needs to be taken into consideration when installing. Smaller widths require more installation passes and usually more time to complete the installation. Smaller widths may install driving faster than driving slower with wider widths and may have less wrinkles, depending on the manufacturer, winding process, apertures if coated or uncoated or a Geocomposite.

Paving Geogrids (Photo Courtesy Huesker, Inc. Norfolk regional Airport over a milled surface) must adhere to the pavement, so the paver does not lift them during construction. They can adhere to the asphalt differently depending on the manufacturer.

A. A preinstalled adhesive that does not require a tack coat (oil)
B. With a lite geotextile fabric attached for adhering to a lite tack coat
C. Bitumen Impregnated (oil) that requires less or no tack coat
D. A Geocomposite with a thicker paving fabric that requires a tack

A Grid combined with a Paving Fabric it is called a Geocomposite. They provide both reinforcement and an interlayer membrane. The use the same oil quantities for installing a paving fabric. They have some different installation considerations than a fabric alone.

Installation by hand is easier than a fabric because of its rigid state but is very time consuming and labor intensive in the number of laborers necessary. Machine placement is fastest. It requires different installation techniques than fabric. Any tensioning needs to be to a minimum. If bars for alignment are used, they should roll and not let the grid glide over them, especially if coated with an adhesive or are bitumen impregnated. The material does not stretch (elongate) and a stretching system is detrimental. The grid must unwind freely with little or no impedance.

Grids that have adhesive or are bitumen impregnated may stick together creating tension when unwinding especially the rolls on the bottom of piles or from a van that have been compressed

Each manufacturer has various grids, some with different thicknesses and each has different recommendations and requirements for application and tack coat (oil) and for placement of adjoining rolls for horizontal and longitudinal overlaps. There are no standard ASTM specifications for grids.

Some grids will overlap at joints and some grids will butt up. The same for dealing with cut wrinkles. Thinner grids may overlap while thicker grids may butt up. There may be a difference also when used within a chip seal.

Grids or Geocomposites placement on curves will always be by hand with the cutting of pie shaped wedges. The edges will be based on the manufacturer recommendation either overlapped or butted up. Geocomposites will require overlapping or the membrane will not be continuous.

Binders for grids can be hot tack coat (oils) or rapid set emulsions depending on their manufacturer recommendations. Oils will vary between .06 to .18 gallons per square yard without fabric. Emulsions require a 30% increase in application rate to account for evaporation and the extra installation time. Bitumen (Oil) pre-impregnated grids and composites requires approximately 25% less tack coat (oil) during installation between 0.10 to 0.15 gallon per square yard.

The Gallon per Square Yard for Geocomposites is determined by the fabric weight. A 4.1 ounce ASTM 288-217 paving fabric will use a 0.22 - 0.25 gallon per square yard. The variance is determined if the application is on a new fresh oiled leveling course or an old asphalt. Installation considerations for a Geocomposite are different than if installing a paving fabric alone.

Regarding Paving Grids and Geocomposites, *ask the questions.* specification, equality, increased or decreased tack coat, type of tack coat (oil), roll widths, size and material of the roll's interior cores. All will influence on your production time, costs and ultimately bottom line. Knowing the answers will help you make a correct decision on the selection and planning your installation.

Regarding grids and composites ASK THE QUESTIONS. Specification, equality, Increased or decreased oil or rolls widths. All will have an effect on your production time, costs and ultimately bottom line. Knowing the answers will help you make a correct decision on the grid selection.

UNDERSTANDING GEOTEXTILES

Geotextiles are a Geosynthetic nonwoven and woven fabric (textiles).

Most are manufactured from polypropylene or polyester. More recently some are being manufactured from fiberglass or a hybrid mat combination of fiberglass and another polymer.

Geotextiles are as light as less than an ounce per square yard for landscaping or as heavy as 20 ounces for membrane cushioning and internal plane drainage.

The main functions of Geotextiles are:

- Filtration
- Reinforcement (stabilization)
- Separation
- Liner cushioning
- Silt fencing
- Athletic field protection
- Landscaping
- Paving Membranes with a saturation of an oil.

There are two primary types of Geotextiles woven and nonwoven.

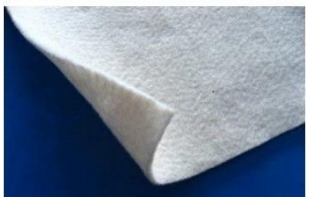
Both of these can broken down into various sub categories which give each fabric individual qualities.

Woven fabrics are higher grab tensile strengths per ounce. They are thin and were found to be ineffective as a paving fabric since they have no interior plane to hold asphalt oil and therefore could not form an impermeable membrane. They also did not perform well as an asphalt reinforcement synthetic to reduce cracking or a trench filtration fabric.

Woven fabric has primarily two manufacturing processes and filaments. Woven slit films (tapes) are flat and have less filtration properties. They are best used in silt retention, separation and stabilization applications for their lower elongation and higher strength.

Woven monofilament fabrics use round thick filaments and have apertures that permit for much better filtration and are best used in erosion control, slope protections or reinforcement where conductivity of water is desired.

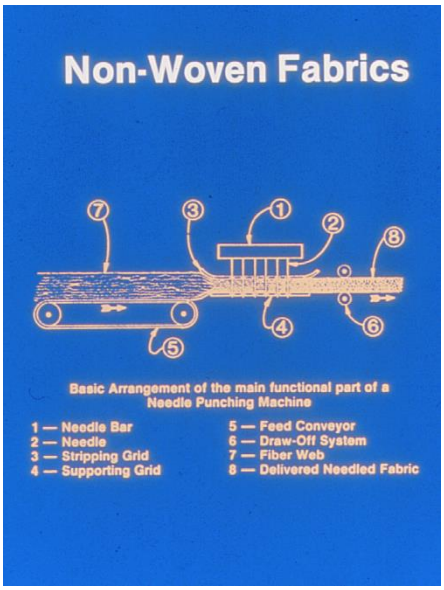
Woven fabrics can be very beneficial in a rehabilitation project when a complete replacement of pavement is needed, and a new base installed prior to paving. They separate the base rock from the subgrade assuring a long-term integrity and can add reinforcement stabilization by assisting in spreading the shear from local to general.



Nonwoven fabrics are primarily used in paving, filtration, drainage, separation and pond cushioning. The nonwoven fabric provides an interior plane (dimensional thickness) so that an oil can cab be absorbed into and saturate the fabric forming a membrane.
Nonwovens use thin filaments of polypropylene or polyester that can be needle-punched from short staple fibers or long continuous filaments.

1. Polypropylene fabric is slightly more absorbent to oil and is less expensive to manufacturer. Its only drawback is that it has a lower shrinkage and melt point. It can be damaged during installation under certain circumstances by very hot oil.

2. Polyester fabric is stronger per ounce with a higher shrinkage and melt point making it more resistant to damage during installation. It is more expensive to manufacturer and raises the cost and thus has not been able to obtain much market share.

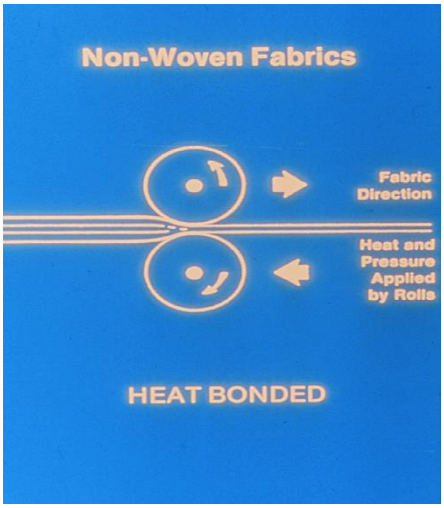


Needle-punched (or entangled) fabrics are formed using two types of filaments. Barbed needles go up and down through the filaments entangling the strands together forming the fabric.
1. Long continuous filaments are spun together (spun process).
2. Short or long staples of filaments 6" to 12" long which are arranged on a carded conveyer system.

Needle-punched (or entangled) fabric is thicker, fuzzy, softer and more pliable making them ideal for the paving application. They install smoother with fewer wrinkles due to their high elongation (stretch). Numerous reports state the fuzzy side placed into the asphalt oil provides reinforcement at the interface. The fuzzy side provides a greater effective surface area of the fabric offering better adhesive and shear strength with less slippage.

Nonwoven fabrics can be manufactured by one of three different processes for paving fabric which have a standard specification and installation procedures under AASHTO 288-17
Of the three types of manufacturing processes listed below only number 1 has the qualities that are desirable for a paving fabric both for performance and installation.

1. Needle-punched and one side heat-bonded (calendared) and the other side fuzzy which is the most desirable and best paving fabric.
2. Needle-punched (non-heat-bonded, calendared)
3. Needle-punched Heat-bonded two sides (calendared)



A heat bonding (calendaring) is a finish that is applied to finish nonwoven needle punched fabric at the end of the manufacturing process. This can be applied to one or both sides of the fabric. This has special benefits to a paving fabric.

One sided heat bonded and one side fuzzy is the most beneficial and desirable paving fabric. It has numerous benefits:

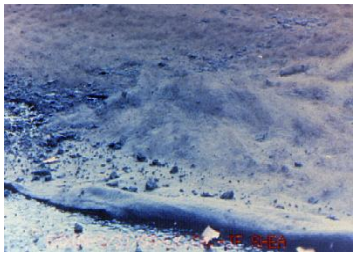
1. Has one fuzzy side that bonds to the oil better at the interface.
2. Reduces oil bleed through.
3. Provides a tough wearing side for construction that does not delaminate under foot traffic, construction vehicles and if necessary public traffic driving on it.

The only installation problem that can occur is that the heat bonded on one side fabric can be placed upside down with the heat-bonded side down and the fuzzy side up. This presents the same delamination problems as non-heat bonded fabrics and additionally can cause fabric slippage from construction vehicles and if traffic drives on it. The heat-bonded side must be placed up to the traffic. The fuzzy side must be placed down to the old pavement.
.

A non-calendared nonwoven needle-punched fabric is primarily for other than paving applications (filtration, separation, liner cushioning). It will install the smoothest and apply around a curve the best because it has higher elongation (stretch). It creates construction problems with no tough wearing side. It almost always delaminates from any vehicle contact and even from oil oily foot traffic. To prevent delamination additional costly and time-consuming procedures are often necessary.

Non-heat-bonded needle-punched fabrics have inherent installation problems. Delimitation is a major problem. FHWA-Texas report 261-2 mentions problems with non-heat-bonded fabrics delaminating and fuzzing up in the wheel paths of traffic and construction vehicles during construction.

These problems when required to be repaired increase costs significantly and slow production. If not removed and replaced the damaged membrane in the wheel paths reduced long term performance. For this reason, it is best to use a calendared on one side that is placed up for traffic with a tough wearing course for foot and vehicle traffic and the other fuzzy side placed down into the oil.

Dual sided calendaring creates a thinner, stiffer fabric. It is harder to install and more likely to slip, can get large wrinkles and bleed more. This can also be true of some Hybrid Geomats.

Dual sided heat-bonded fabrics are very thin and stiff and pose many installation problems because of the dual glazed sides

- They have lower elongation and install with less stretch.
- They have no fuzzy side to form a better bond.
- They can have slippage problems until the oil has set
- It does not form as good an interlayer membrane.

Dual sided calendared fabric and Hybrid Geomats have difficulty being placing smoothly the wrinkles and folds can transverses the full width of the fabric. The thin fabric does not hold oil easily and oil bleed through occurs from foot traffic and vehicle traffic causing hazards to the workers and equipment. 3. The fabric is stiff and has a tendency to slip and curl up when installed by hand.




UNDERSTANDING HYBRID MATS

Hybrid Geomats also referred to as Hybrid Mats are used for all paving applications: There is no AASHTO official specification for them. In some cases when a scrim is used there is a debate as to weather it is a Hybrid Geomat or a Geocomposite.

Hybrid Geomats are a nonwoven combination of polymers using fiberglass and polyester or polypropylene in combination to form a material with less elongation and a higher modulus. They function as moisture barrier & reflective crack prevention for alligator and medium cracks.

They install more rigidly then a geotextile and less rigidly then a geogrid. Each manufacturer has different recommendations and requirements for application, tack coat (oil) and for placement. There are no standard ASTM specifications for Hybrids.

They can be harder to place then both a geotextile paving fabric and a paving grid. Hand placement is very hard and even machine placement difficult if the machine is not set up with features for installing grids and hybrid mats.

Often their wrinkles can transverse the entire width of the material. Picture 1 hand placement, picture 2 machine placement.

The same procedures apply to placing a Hybrid Mat as with a Paving Fabric. Depending on the materials elongation they may install better with tensioning and some stretching or may install better with less impedance like a grid. They do not exhibit delamination problems and can handle traffic without damage.

There is an Active Standard ASTM D7239 which was developed by Subcommittee D35.03 but has not been adopted officially. It is called Standard Specification for Hybrid Geosynthetic Paving Mat for Highway Applications. Many manufacturers do not agree with this as it did not take into consideration all manufacturers products.

Hybrid paving mats are typically manufactured of a wet-formed non-woven material consisting of randomly dispersed glass and polyester fibers, bonded together with a resinous binder system. Hybrid mats are in between from fabrics and grids.

They offer a moisture barrier interlayer membrane and but a higher tensile strength and lower elongation than fabric but have a higher elongation than grids. They absorb more energy than a fabric and less energy than a grid. They have a higher performance in reducing reflective cracking than a fabric and less than a grid.

It is believed they have unique properties that give pavement a 360-degree tensile reinforcement. Hybrid mats specifications vary by manufacturer. Each claim proprietary processes that each fell are superior to other manufacturers. No standard exists like a paving fabric. Committees are currently formed at AASHTO and are working on a standard that manufacturers can follow.

UNDERSTANDING GEOTEXTILE SPECIFICATIONS

For the contractor and engineer, it was hard and can be today also difficult to determine which information on fabrics and installation is correct and which is not. Standards needed to be developed. It took many years beginning in 1982 with different groups and later Task Force 25. Finally, AASHTO M-288-90 was implemented and the latest version is M-288-17 for Geotextiles (fabrics).

Prior to AASHTO M-288-90 and currently M288-17 different manufacturers manipulated test results using different reporting methods. Two identical fabrics made by the same manufacturer under different brand names could have specification pages that were totally different and very hard to compare when the published test results were reported differently.

- Minimum Value
- Typical Value
- MARV (Minimum Roll Average Value) AASHTO M-288-06
- Maximum Value

To complicate this, different agencies used different acceptable test results from the above. Many still use Minimum Values rather than MARV. It is important to look at the specification and ASK QUESTIONS of the agency, engineer and fabric supplier before accepting a quote

The most significant in the AASHTO M288-17 specification is 4.1 ounces per square yard and ultimate elongation greater than 50%. Not all agencies or engineers use AASHTO M288-17. Some have their own specifications and a number of states use 4.6 ounce. This will affect the tack coat application. PDOT uses 4.6-ounce fabric.

A 4.1-ounce AASHTO M288-217 paving fabric will use a 0.22 - 0.25 gallon per square yard. The variance is determined if the application is on a new fresh oiled leveling course or an old asphalt. A heavier fabric will require more tack coat.

Individual nonwoven fabric specifications may appear to be nearly identical, yet the different manufacturing processes perform very differently during installation. AASHTO M288-17 uses MARV or minimum average roll value specifications. Many agencies require minimum test results may not accept manufacturer MARV certification and the fabric may pass MARV but fail testing on minimum

I was one of the first distributors and installers of Geosynthetics starting in1980. I sold the company in the late 1980's when my sales were 20 million square yards a year plus. I wanted to concentrate on my machinery and field consulting I enjoyed more and had more fun than selling materials.

I represented numerous manufacturers' products. My main manufacturer produced a nonwoven polypropylene geotextile under their own brand name (Product A). I operated the warehouses for the manufacturer in California storing thousands of rolls of different weight fabrics. They also manufactured fabrics for companies who sold but did not manufacturer. They purchased and private labeled their materials (Product B). These companies often bought from different manufactures. Often you could open three rolls of their material and find three different fabrics all with the same specification but obviously different

California Department of Transportation, CALTRANS required minimum values. Many California cities and counties used their specification. Products A's specification pages listed those minimum vales and not altered Typical or MARV values. Private label Product B listed higher typical averages

THIS REALLY HAPPENED to show how ridicules it can get. I bid a project of a large quantity of drainage fabric. The engineer did not use actual specifications and used Product B or equal. My Product A was Product B which simply had a different label

The engineer did not or did not want to understand or acknowledge the difference in published values between Minimum Caltrans Values and Product B's altered Typical Average values.

Product B's sales staff insisted specifications were not equal and that I needed to provide my Product AA which was 2 ounces more in weight, 25% stronger and more expensive.

My distribution contract prohibited me from relating to anyone that my manufacturer made the fabric for Product B and it was my Product A. The engineer refused to accept my Product A as being equal to their Product B.

Finally, the contractor needed the material and had to buy Product B. Products B's company did not have an inventory. My manufacturer sent my warehouse Product B's private labels and instructed us to remove my Product A labels from the inventory rolls and replace them with the private brand Product B labels and then ship the rolls to the jobsite!

AASHTO M288-17 SPECIFICATION (SEE APPENDIX 1)

AASHTO M288-17 covers six geotextile applications: It was AASHTO M290, them M206 and now M217 and that may have changed again. Subsurface Drainage, Separation, Stabilization, Permanent Erosion Control, Sediment Control and Paving Fabrics. M288-17 is not a design guideline. The version uses metric values and I have added the U.S. standard equivalents to each where needed to make comparison easier. It has five specifications that are used for paving fabric properties.

ASHTO M288-17 uses MARV values defined as Minimum Average Roll Values for testing which is different than minimum or typical values. Not all Agencies use AASHTO M288-17 or MARV values.

The most important thing is for the contractor bidding or purchasing to read and compare the specification that is called for by the agency.Do not assume the agency is using the full specification correctly or in its entirety or that have not altered it in some way. UNDERSTAND WHAT IS THERE AND IF NEEDED ASK QUESTIONS.

THE FIVE SPECIFICATIONS USED FOR PAVING FABRIC PROPERTIES AASHTO M-288-17

Paving Fabric Property Requirements
Refer to Appendix 1 for the full AASHTO M-288-17 Specification

Test Methods	UNITS		Requirements
Grab Strength ASTM D 4632	N		450
Grab Strength *ASTM D 4632*	*lb.*		*101.12*
Ultimate Elongation ASTM D 4632	%		> 50
Mass Per Machine Area ASTM D 5261	gm/m2		140
Mass Per Machine Area *ASTM D 5261*	*oz/yd2*		*4.1*
Asphalt Retention[1] ASTM D 6140	l/m2	*b c*	
Melting Point ASTM D 276	C / F		150 / 302F

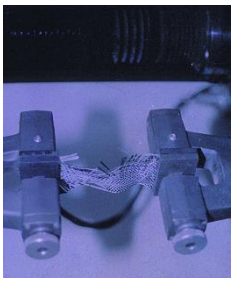
See page 15 for a. b. c.

a. All numeric values represent MARV in the weaker principal direction. (Refer to Section 10.2.)
b. Asphalt required to saturate paving fabric only. Asphalt retention must be provided in manufacturer certification. (Refer to Section 5.) Value does not indicate the asphalt application rate required for construction. Refer to Appendix for discussion of asphalt application rate
c. Product asphalt retention property must meet the MARV value provided by the manufacturer certification. (Refer to Section 5.)

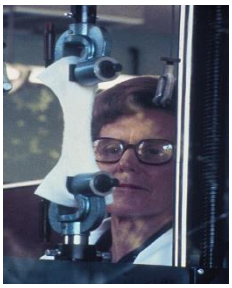
Most important for the contractor to know is your held responsible.

- **AASHTO M288-17 / Section 10.2**
- Section A6. PAVING FABRIC
- X1.6.3. *Construction:*
- X1.6.3.4.3.
- **Removal and replacement of paving fabric that is damaged will be the responsibility of the contractor.**

ASTM TESTS



Grab tensile strength determines the fabric's ultimate strength when pulled between the jaws of a testing machine until it ruptures. Many agencies only care about the strength in the weakest principle direction and many still want conformity to a minimum vale and not MARV.



Elongation uses the same equipment and ASTM test. It determines how fabric stretch. It's measured in percent of change before rupture and has an effect on installation. Woven has a low elongation and high modulus and nonwoven has high elongation and low modulus.

MARV (minimum average roll value) allows for a deviation of two, permitting about 5% of the material to fail testing. A typical average or a MARV value does not mean the fabric will meet the agency specification when tested for minimum values.

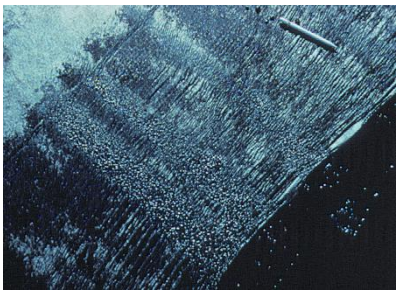
Paving fabric is best with the highest elongation permitted as it stretches more and installs with less wrinkles, it installs faster and installs around curves easier. Less elongation makes a stiffer fabric and is more difficult to install without sophisticated machinery.

Asphalt retention determines how much oil is necessary to saturate the fabric and make a bond.

The quantity of oil (oil) is critical to the final membrane system. Too much oil will bleed through the new asphalt creating hazards to vehicles. Too little will fail to saturate the fabric and form the membrane and not complete the bond. Emulsions will require 30% more application so that after evaporation (breaking0 the residual will be the correct amount of oil.

A typical 4.1ounce, 50 mil fabric (115 grams, 1.270 mm) will absorb 0.20 gal / Yd^2 (0.76 liters / M2). An additional .005 gal / Yd^2 (.0184 liters / M^2) of oil +/- .03 gal / Yd^2 must be included for penetration into the old and new asphalt, unless a freshly oiled leveling course is first installed. Typically, fabric rolls are 360 feet long. Gallons of oil for different widths are. 6'3" – 62 gallons, 10'6" – 100 gallons, 12'6" 125 gallons, 15' 150 gallons, 18' 180 gallons.

The proper quantity of oil also depends on the condition of the old asphalt and if a new leveling course is used or not. AASHTO M-288-06 fabric will absorb .20 gallons Yd^2. Additional oil is needed to create the bond. If the old asphalt is in bad condition that may require .25 / $Yd^{2.}$ If new leveling course with fresh oil is placed first oil may be .22 gal / Yd^2.

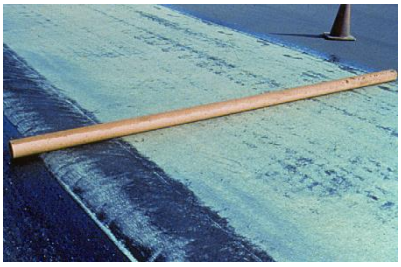


Melt Point is where fabric is fully damaged. This, in my opinion, is incorrectly based on melting when the asphalt is placed onto the fabric and not based on when the fabric is placed into the oil. There is a significant difference between the two. I have argued this point for years, but unfortunately the manufacturers influence always prevails.

Thus, the melt point specification in my opinion is useless and misleading and incorrect. The fabric is insulated when it is saturated with oil protecting it from melting by the hot asphalt. When a permeable non-protected fabric is placed into the hot oil and the oil is too hot it is subject to shrinking first and then melting.

HEAT SHRINKAGE

Heat shrinkage is different from melt point and is a very serious installation consideration. My GFR 1990 article brought the heat shrinkage problem to the engineering communities' attention. It was the reason polypropylene manufacturers objected to my article and began my less than favorable relationship with them for many years. It continues to be a debatable point but is better accepted.



Heat shrinkage occurs when the polypropylene fabric is paced too close to the hot oil or the oil temperature is too high. Polyester does not have this problem. It was first noted when installation machines were mounted on the back oil spreading trucks. Depending on design the fabric often was placed into the oil just inches away from the spray with no time delay. Overlaps shrank as much as 6 inches and separated at the longitudinal joints. Other sections of the fabric melted.

This occurs during the day time when a hot sun has raised the pavement temperature to as much as 200° F. The oil is not cooling as rapidly as it does in the morning or night when the asphalt temperature will be 50° to 80°. It was first noticed with oil truck installations. A second problem for field engineers was they could not see the oil spray to check for improper spray or clogged valves since the oil was covered immediately by the fabric.

My patented machines behind oil trucks had less of this problem since they place the fabric 5 feet behind the oil spray. This allows the engineer the ability to check the oil spray and a second for the oil to cool prior to placement. Regardless, there are times the machine needs to be removed and placed on a tractor or a tractor used so a time delay of 30 seconds to 2 minutes can be implemented.

When Los Angeles County and the other 3 Green Book County engineers experienced these two problems and then conducted shrinkage tests on un saturated fabric they moved to request a specification change in the Green Book to control these problems. The County Engineers were defeated in a 5 -4 vote by the 5 private engineers. The private engineers preferred to accept the manufacturers test results of asphalt on fabric over LA County's test results of uninsulated fabric melting. They adopted an allowable 10% damage to the fabric. The county engineers then issued project change orders removing millions of yards of paving fabric and substituting rubberized membranes. The manufacturers won the specification battle and then lost the sales war.

Caltrans, Texas, Los Angeles County have noted shrinkage of polypropylene fabrics when it is placed in hot oils beginning at 250 Degrees F (121 degrees C). Polyester fabrics are more expensive and harder to heat-bond, but their shrinkage point is around 400 degrees and their melt point is 480 degrees. Currently no one makes a polyester paving fabric because of cost.
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Tractor installations usually do not exhibit the heat shrinkage problem. The placement distance and time can be controlled until fabric is placed into oil or until a heat gun registers 250 degrees or less.

Recyclability of fabric has been proven. Scrimscher of Caltrans found polypropylene fabric to be recyclable during milling research. Cohesion values for hot and cold recycle briquettes exceeded the values of the control mixes. The fabric seemed to provide some tensile reinforcement to the AC mix. The surface abrasion test results showed a significant improvement in the hot recycle briquettes and no detriment in the cold recycle briquettes. Boring of Asphalt Technology found polyester fabric is also recyclable. Further research over the years have confirmed this.

GRID SPECIFICATIONS

There are no standards for paving grids. Grids vary greatly in manufacturing processes, aperture openings and physical properties. Recent efforts by the AASHTO Subcommittee on Materials, Technical Section 4E, to develop a Geocomposite (geogrid with paving geotextile) specification for pavement reinforcement and interlayer membrane combination have started being developed. The expected final specifications will include tensile strength, ultimate elongation and melting point.

Currently fiber types are polyester, polyethylene and fiberglass with various coatings. Grids unlike fabrics have many different manufacturing processes and aperture designs that yield many different field results, each fiber has pluses and minus depending on the desired design results. This makes it much harder to determine equitable specifications that does not proprietarily favor any manufacturer. The debate goes on. It is best on grids to read the specification and ask many questions. Manufacturers have a lots of literature. They have representatives who actually know the products since they are more technical than fabrics.

HYBRID MAT SPECIFICATIONS

There is no AASHTO official specification for Hybrid Geomats. There is an Active Standard ASTM D7239 which was developed by Subcommittee D35.03 but has not been adopted officially. This is one proposed specification: Note: Conditions for tensile strength measurements: Sample width: 50 mm Sample length: 250 mm Gage length:175 mm Crosshead speed: 50 mm/min

PHYSICAL PROPERTIES TABLE

Property Test Method	Units	Typical Value
Mass per machine area, ASTM D5261	g/m2 (oz/yd2)	136 (4.0)
Tensile strength, MD ASTM D50351	N/50 mm (lb/2 in)	> 200 (45)
Tensile Strength, CD ASTM D5035	N/50 mm (lb/2 in)	> 200 (45)
Elongation at maximum load, MD ASTM D5035	percent < 5	
Elongation at maximum load, CD ASTM D5035	percent < 5	
Melting point ASTM D276	C (F)	> 230 (> 446)

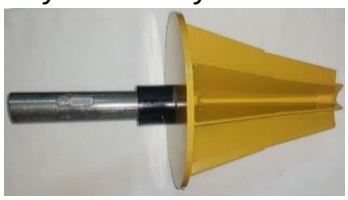
FABRIC STORAGE

Improper fabric storage can cause numerous problems from moisture and UV exposure. The plastic wrappers must be kept hole free. UV rays can damage fibers in just a few weeks. Wet fabric creates steam causing stripping of the asphalt from the fabric due to a poor bond. Wet cardboard cores create two installation problems. Cores break and wet ends shred with tensioning cones.



PLANING AROUND CARDBOARD CORES AND PROBLEMS

It is extremely important for the contractor to know the diameter of the core inside the material they are buying or being offered. There is nothing worse than starting the job and finding out the equipment will not work to install the material. Cardboard cores come in sizes from 3" to 6" and can have a manufacturer deviance of 0.15. depending on cardboard core thickness. That means 2.85 to 6.15. Material coming from Asia have had poor core quality and even plastic cores. Equipment cones cannot bite into plastic. Not all machines will have cones that fit all cores including older machines that were designed for only 4" cores. If you are going to rent or buy a machine or use an installation contractor check the sizes of their machines cones versus the fabric core you buy or will buy.



In 2018 I introduced a new Patent Pending Two Step Cone for my Patented Grizzly 600T installation machines and to upgrade older models cones. The cone is two inches longer and handles cores between 2.25" and 5.25".

A 4 inch core had been standard since the 1970's. Recently many 3 inch cores are appearing. Shipping is costly and a truck load can be increased by as much as 20 to 30 more rolls with 3 inch cores.

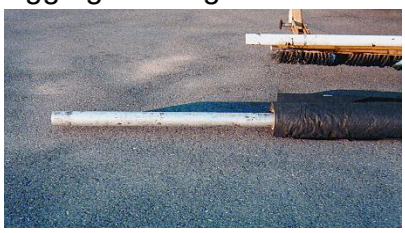
I invented and have produced a Patent Pending Roll Puller RP4 since 1980 that pulls rolls with 3.75 to 4.5 inch cores. In 2018 I introduced a second Patent Pending Roll Puller RP3 for 3 inch cores between 2.75 and 3.25 inches.

There are two basic core problems, broken or crushed cores and sagging rolls. Sagging usually occurs in wider rolls or when the core is not thick enough to support the roll. It is important that the cardboard core be of a thickness to support the roll with a minimum of sagging and breakage. Paving fabric cores need to be thicker than drainage or stabilization cores.

Cores 3/4" or thicker insure core strength so that the core will not break during installation and will sag in the middle. Sagging (smile) will causes wrinkles. The thin core may break during unloading from the truck or during installation as it gets nearer then end of the roll. The roll may dislodge from equipment if the core breaks causing possible injury to labors, damage to the equipment and it and become stuck in the oil.

FIXING CORE PROBLEMS

The simplest way is to obtain a steel or lighter aluminum pipe slightly smaller than roll core diameter. The pipe should be six inches shorter than the roll width so the cones can insert without hitting the pipe. Different width pipes may be needed for multiple roll widths for the project. The pipe reinforces the core preventing breaking and sagging. Having more than one pipe will speed installation.


Rolls can be preloaded speeding roll changeovers. The installation can continue while the other pipe is retrieved afterwards. One end of the pipe can be cut and welded (metal) or Heli arced (aluminum) into an angled shovel type point with the other end a solid cap. The pipe can be easily pushed in and at the broken point pounded through the roll where it is wedged down. The angled nose is able to push against the “V-ed” in core expanding it back to make the roll useable.

INSTALLATION

Installation is critical for the projects successful performance and minimized construction costs for the contractor. Improper installation can cause the project to fail or have problems that the contractor may be liable for the cost of correcting. AASHTO M288-17: X1.6.3.4.3. Removal and replacement of paving fabric that is damaged will be the responsibility of the contractor. Improperly placed fabric results in a poorer membrane and can lead to these contractor problems.

- Asphalt stripping (peeling away of the asphalt from the fabric).
- Cracks from heat damage, wrinkles, and overlaps.
- Fabric shrinkage and damage due to a higher heat exposure
- Delaminating and fuzzing

WARNING SIGNS FOR MOTORISTS

If public traffic is permitted to drive on the fabric warning signs are vitally necessary. It is impossible to 100% idiot proof the job but signs help wake up motorist’s light bulbs! The specifications should include and read:

- 20 MPH MAXIMUM, SLOW BREAKING
- LOOSE GRAVEL (Especially for Chip Seals)
- FRESH OIL (Especially for Chip Seals)

VEHICLE SPEEDS

All Vehicles regardless if they are construction vehicles or public traffic should not exceed 20 MPH (32 kilometers)

- Speeds in excess of 20 MPH can along with breaking can damage or cause separation of the fabric bond
- It can separate overlaps
- Motorists due not always use good judgement and consider the difference in breaking time

NEEDED TOOLS


Certain manual tools and safety items are needed to do the job safely. Laborers need:

- Gloves ● Hats or hardhats
- Insulated sole shoes
- Steel toed shoes
- Safety vests at night
- Air masks to avoid breathing oil fumes
- Long sleeve shirts to avoid sun exposure
- Stiff bristle brushes with handles.
- Aluminum (or steel) pipes in a diameter slightly smaller than the roll core diameter

- A couple aluminum baseball or softball bats (not wood they break)
  Bats can be used as handles inside the roll core to protects laborers backs and from falling down carrying rolls. Most laborers arms are not long enough to reach around the roll and carry it easily
- A generator for operating the saws and for lights at night on the tractor
- An electric chainsaw cuts fabric better than a gasoline powered one. It has a lower RPM and does not generate the heat that melts the end of the fabric together. This is similar to a newspaper where the edges were not cut properly. Other low RPM saws can be used.


Rretractable blade slit knives are essential to trim excess fabric at overlaps and slit wrinkles. Make sure you have lots of blades.

- Slit the wrappers on the fabric.
- Slit the fabric full width after a short pass
- These knives must be retractable and closed when not in use.
- Laborers need to retract them for safety They should never put them in their back pockets open.

Yes, this is common sense. To avoid injuries and workman compensation claims supervisors should issue the instruction in writing if possible, to remind the laborers of common sense.




Additionally, also needed are:

- Pour pot, bucket or truck with sprayer to apply additional oil to the overlaps
- Squeegee
- A few bags of washed sand to absorb excess oil from any double oil spray.
- Square end shovels for broadcasting sand and asphalt on the fabric.
- A spray bottle with diesel or approved distillate for cutting the oiliness on shoes, tractor and truck tires, brushes, tools and other to prevent them from sticking
- A truck to pick up waste wrappers, cores and to carry additional rolls
- Warning Signs

PRIOR TO BEGINNING SYNTHETIC PLACEMENT

PLACE WARNING SIGNS.

Large cracks in excess of 1/8 inch (0.32 cm) should be sealed with hot or cold asphalt mix. Commercial crack filler can also be used. If the filler has a cut back or is emulsified asphalt it must cure completely before the oil is applied.

Cracks should be level with the asphalt and not over filled. Cracks should be cleaned with pressurized air or brooms and filled with a liquid asphalt crack sealant. This will prevent the oil from filling the cracks reducing the oil for saturation.

To save on cleanup of various monuments & drains a piece of fabric or plywood, or cardboard can be cut and placed on the monument prior to spraying the oil. The fabric will absorb most of the oil, reducing cleanup time and saving on labor. If these are standard for the area a thin plywood model can be made that the fabric goes on. Fabric can be removed and replaced regularly.

TEMPERATURE OF ASPHALT AND OIL

The air and pavement temperatures must be at least 50°F (10 °C) and rising for hot oil and at least 60°F (16 °C) and rising for emulsion

Hot oil temperature should be between 290° (143.5 °C) and not exceed 325°F (163 °C) if oil is spread ahead of a tractor installation. It should not exceed the AASHTO M288-06 melt specification of 302°F (150 °C) if is installed by a one system oil truck. Asphalt emulsions tank temperatures should be between 130°F (55 °C) and 160°F (71 °C).

MANUAL AND MECHANIZED METHODS

Manual placement involves hand rolling the fabric and then brushing it in place. All other procedures of trimming overlaps, cutting wrinkles, oiling, clean up are the same.

A total of to 5 to 9 laborers are needed. Two or three laborers will be roll out the fabric to keep it aligned and straight and an additional three at a minimum and best is six laborers to brush the fabric. It is best to brush it from the center outwards like putting up wallpaper. Some of these will also perform other procedures, cleaning up wrappers and cores and slitting and oiling wrinkles. This is a time-consuming slow process and requires the additional labor force. Often the fabric gets off course in rolling it causes large wrinkles. The laborers feet are exposed to the hot oil for long periods and that can be hazardous. Insulated sole steel shoes, goggles and air masks are recommended for their safety.

It is important to order fabric rolled onto the roll so the heat-bonded side will be placed up and the fuzzy side will be placed down. Most fabric is rolled at the factory for machine placement and is not designed for hand placement. Two laborers who will brush afterwards should stand on the fabric ends holding it in place as two other laborers begin rolling the material forward one on each edge. A third laborer in the middle is a benefit to help keep the roll aligned so one side does not get ahead of the other and begin a crooked and wrinkled installation.

Curves will require cutting fabric on diagonals or pie shape and placing these in sections. This will have large overlaps that require additional oiling.

When placing fabric by hand often the oil is cooled and the laborers cannot brush forcefully enough and the fabric is not adhering as well to the oil. The use of a pneumatic or other rubber tire roller to seat the fabric into the oil to increase adherence is necessary. This is similar to the procedure for placing a chip seal on fabric.

MECHANIZED PLACEMENT

My equipment was new in 1980 and was pretty crude at first. A paper towel holder with brushes. It worked better and faster than hand placement. Project by project many realizations became clear on what was needed to install with a minimum or no wrinkles and how to overcome project obstacles.

Dozens of design changes reinventing the machines to overcome jobsite problems for fabrics and later new materials. These inventions led to my 6 United States and foreign patents with others currently under patents pending.

- Different mounting options, Tractor, Bucket, Combination of both and oil tuck mounting.
- Multi-Bar Frame for the Grizzly 600T
- Crab Claw Swing Arms
- Short Roll Arm
- Rotating Spindle Roll Holders with cones that have adjustable braking to create tension
- Multi Bar Tensioning System for Fabric
- Multi Bar Roller System for Grids and Hybrid Mats
- Chevron Angled Brushes to accomplish the sweeping action from the center to the outside with 3 angles which can also be straightened for grids and hybrid mats
- High Melt plastic 335 degrees' brushes

By the time 1980 was over my Model 750 mechanically folding with a winching system or hydraulic folding and had a second set of telescoping arms was introduced with all the features developed at that time. .It was my clunker Cadillac model.

My Patented Multi Tensioning Bars, Chevron angled brushes since straight brushes caused fabric wrinkles. I developed my Patented Rotating Spindle Roll Holders to control the roll turning, Crabclaw swing arms to get next to obstacles, my short roll middle arm

In 1986 I realized my machines did not need to fold like oil truck arms and they could just telescope. This brought about the Grizzly 600T a 19.5-foot-wide model which replaced the folding 750. It became my sleek Corvette model which is still my number one machine.

In 1987 I developed my oil truck mounting system with a Grizzly 600T on the back of the truck eliminating the tractor and spreading the oil and installing the fabric installing all in one

In 1988 the Grizzly Cub 300T was introduced as smaller telescoping 15.5-foot width model with all the patents and a smaller version of my corvette model Grizzly 600T. The first Cub 300T went to the City of Great Falls Montana who ordered parts in 2017 for the first time.

After 40 years my machines are still evolving and being reinvented. I added a roller system and a way to convert from angled to straight brushes necessary for Grids and some Hybrid Mats. high melt 335 degree extra fill brushes, two stage cones for more ability to adapt to cardboard core widths from 2.25 inches to 5.25 inches. As new Geosynthetics are introduced like Grids, Composites and Hybrid Mats more changes and inventing is required to keep current with the installation needs.

Tractor Mounts improve operator visibility but are usually for dedicated mounting to a tractor or for larger continuous operation projects.

Bucket mounts save time installing and removing the machine and is great for parking lots where the tractor will be used for other duties. Several professional installers use bucket mounted machines.

Machines can be installed on pickup truck snow plow lifts with adaptation. Quick attach brackets can also be installed with modification.

Machines have been mounted to various equipment. Highway Scrapers (Photo courtesy of Orange County Florida It is not the vehicle but the installing attachment that places the fabric.




Email from Orange County Florida

From: <Nathaniel.Haney@ocfl.net>
Date: Wed, Apr 1, 2015 at 6:19 AM
Subject: RE: Geogrid Applicator Purchase
To: gacco@outlook.com

Monk, We here at Orange County Public Works can't thank you enough. The Grizzly Cub worked fabulous and I wanted to share these two photos with you.

Thank You,
Nathaniel Haney
Contract Administrator
Orange County Public Works Department
4200 S. John Young Parkway
Orlando Florida, 32839
Office-407-836-7957
Fax-407-836-7839
Nathaniel.Haney@ocfl.net

Whatever the machine is mounted on it is important to be able to pull fabric under the brushes.. Some equipment without lifting ability has had the machines mounted to a permanent height and the brush jacks are raised and lowered to pull the material underneath the brushes. This is time consuming and requires as many laborers as there are brush jacks. But it still works.

Four-wheel drive tractors, loaders or pickup trucks should be driven in 2-wheel drive. The heavier duty front end on smaller tractors holds up better under the weight of the installation machine and roll of material. Driving in 4-wheel drive causes wrinkles. The wheels pull the material laterally towards the them. This causes a problem in keeping transverse tension across the Geosynthetic.

FOR NIGHT CONSTRUCTION

Safety procedures first! WARNING SIGNS. Laborers with reflective vests and hard hats, a generator and lights mounted on the tractor.

White or gray fabric for line of sight allows the operator to drive faster and the laborers better visibility for oiling longitudinal and transverse overlaps and increases production over a black fabric on black oil.

Some manufacturers can produce light colored fabric with an adequate lead time. Some produce gray fabric for all day and night use. Others produce black fabric with a higher UV protection. Ask the supplier what is available for night projects before bidding.

Advance planning speeds production.

OIL TRUCK MOUNTED MACHINES

A machine mounted directly on to the back of an oil truck places oil and fabric together in one operation. This can be a sizeable cost savings as it eliminates a tractor, move in and out and the operator. That can be $500 to as much as $1000 a day. But also, it can have construction installation problems from heat shrinkage or melting in the daytime. Placement is the same as with a tractor. A crew of two or three laborers work with the driver. The truck drives faster and stretches fabric more than a tractor.

Many designs exist for oil truck installers. The driver can have control of the hydraulics in the cab or laborers at the end of the truck or dual controls. Some trucks have video for the driver to view. My machines are removable and can be quickly placed on a tractor. Some that permanently mounted may have shrinkage problems with the material at different times.. Some place fabric a few inches from the oil. Some place fabric a distance behind the oil. All this should be considered when purchasing or hiring for installation morning, daytime or night?

You're liable for the outcome. AASHTO M288-06: X1.6.3.4.3. Removal and replacement of paving fabric that is damaged will be the responsibility of the contractor, If the machine cannot be removed from the oil truck a tractor should be available with a machine. This is for when installation with a truck is not possible because. Sometimes tight areas in parking lots, tight on and off ramps and when the oil is too hot in the day and shrinkage or melting is occurring a tractor is needed. GAC machines offer this removable option.

DESIRABLE FEATURES OF INSTALLATION MACHINES

If you are going to build, rent, or buy a machine or use a professional installer look at your project' needs to determine the features to accomplish it. Some designs have total versatility and others are very limited. Fabric, grids and composites all have different installation characteristics. Does it mount on buckets, loader arms, both, an oil truck? How do the arms open? Does it have tensioning cones and bars, stretching and angled and straight brushes systems for fabrics but can convert to a non-stretching roller system for grids, composites and some hybrid mats? Will it install short rolls centered or off centered? Will the arms and brushes place material next to guardrails, curbs, prior asphalt passes, fences or walls without taking out signs and obstacles? The right machine features eliminate problems, cuts labor costs, speeds production and save you thousands of dollars and liability later.

THE FABRIC CREW

A mechanized crew will consist of an oil truck driver and or a tractor operator if a truck mounted is not used. Two or three laborers are needed to load rolls, broom edges, trim overlaps, collect wrappers and cores and cut wrinkles. One of these can also drive the roll and accessory truck.

The truck carries fabric rolls, waste cores and wrappers, pour pots, brooms, squeegees, baseball bats, monument covers, spare slit knife blades, hand sprayers, electric chain saw, generator, spare air masks, gloves, first aid kit, hand tools, and anything else. It is usually backed down behind the laborers on the placed fabric to facilitate use.

It should take 2 to 5 minutes to install a roll with an experienced crew. Most develop a team work routine and understanding of what is necessary very quickly. Roll changes and overlaps will take the most time. The speed of the tractor or oil truck will determine how long the roll takes to install.

WIDTH OF THE GEOSYNTHETIC

The width of the material must be considered for project and road lanes if a highway. Often different sizes other than standard rolls can be ordered in advance to minimalize waste and to speed production. On larger projects this can be a sizeable savings.

Most distributors stock standard 12.5' fabric and whatever is standard for their Grids and Hybrid Mats. Some may stock a small amount of other fabric sizes. Many manufacturers can provide custom fabric widths or color with adequate lead time for truck load quantities. Ask suppliers what their capabilities and lead times are prior to bids. This is less likely for grids or hybrid mats. Sizes from 3 feet to 18 feet for a few manufacturers may be available usually in (.5 foot) increments for overlaps. . Most manufacturers do not produce wider than 15.5 foot.
Woven fabric comes up to 18 feet standard and may be a consideration if purchasing a machine for a contractor who does earth and paving work.

If necessary, fabric rolls can be cut with an electric chain saw or other low RPM saw that cuts without melting the ends of the fabric together. Gasoline chainsaws with high RPM melt the edges.

Grid sizes vary by manufacturer. Most sizes are from 2' to 16’ Many have a (.5) foot factor. Many manufacturers only produce narrower rolls up to 6 feet. Ask what sizes are available before bids. Installing 3 rolls of 5 foot grids takes 3 times as long as one 15-foot roll, additional overlaps and oil. But sometimes shorter rolls can be placed driving faster with less wrinkles.

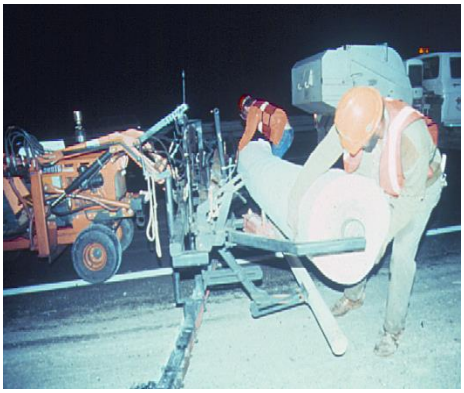
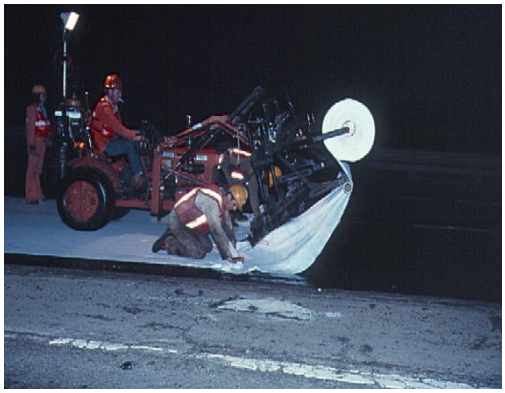
I have a Patented Third Middle Arm for Short rolls that can install 1 foot to 8 foot on the Cub and 10 feet on the Grizzly with rolls centered or off centered. I am in the developmental stage for an optional set up to install two short rolls at one time with an overlap to save on multiple passes and to make the shorter rolls installation time equal to larger rolls. This requires many additional parts and is often diameter and manufacturer specific. I am a while from perfecting this.




STARTING OUT or CHANGING ROLLS

The laborers will cut the wrapper along the roll. Light pressure is all that is needed to avoid slitting the material. The wrapper is removed. The roll is moved into position. This is where a couple baseball bats come in handy to make moving rolls easy and less injury prone.

The machine should be set for the proper width in advance. Check the roll to see if the fabric is cut flush with the core or additional core protrudes an inch or two. This changes the width of the machine set up.
The roll is loaded on to the cone on one side. Make sure the fuzzy side will be down and the heat-bonded side up. The arm is closed with the cone on the other side locking the roll into the cones. The fabric is pulled over tensioning bars and under the brushes then placed into the oil or fabric or under the overlap (shingle in direction of the paving). The two laborers should hold or stand on the fabric corners or ends keeping it in place so it does not slide forward when the tractor or truck begins to move.


The operator of the tractor or truck lowers the machine. If possible at the same time they should slowly move forward to keep the material tight and stretched as the machine makes good contact with the ground. If the operator is skilled, he moves forward the lowering the machine to the ground to avoid wrinkles at the start. Speed should be increased to as fast as possible for the material.



When necessary the laborers can walk along the edges and broom them, trim the overlap, cut the wrinkles and add additional oil. They can then gather up the waste cores, trimmed material, wrappers and move to the side of the road for clean up later or put in a following truck.

INSTALLATION SPEED

Different materials install at different speeds. Fabrics have high elongation (stretch) and should be placed fast as possible to keep the fabric taught and stretched to the maximum. The faster the installation the fewer the wrinkles. Utilize a bar type tensioning system similar to my Patented Multi-Bar Tensioning System. My patented Chevron Angled Brush system works best for fabrics.

Grids, Composites and Hybrid Mats are stiffer materials with less or minimal elongation and require slower installation speeds. Maximum installation speed for these will vary depending on the machine's equipment and options and the materials properties. Wider rolls will installer slower then shorter rolls.

Grids and Geocomposites and some Hybrid Mats require the fabric tension bar or bars to be changed to a roller system, so the material is not impeded at all and rolls freely. These materials have little or no elongation or stretching properties. Less tension is applied to the Rotating Spindle Roll Holder braking cones to keep the material from free-wheeling.

Grids and Composites are better installed with straighter brushes. Hybrid mats will vary depending on their manufacturer and properties. Proper loading on the machine is essential. Grids and some Hybrid Mats will not be able to be placed effectively on curves with a machine and will require hand placement the same as hand placing fabric with cutting pie shaped wedges.

How many rolls to get a head of the paver is a constant problem. A good machine, operator and crew can install a 360-foot roll of fabric with roll changes in 2 to 5 minutes well out pacing the paver. Grids will vary and so will Hybrid Mats.

As a general rule you want to stay as many rolls a head as there is approved asphalt to pave over.

Also consider paver breakdown and if a spare paver is available. This will keep the contractor from an exposed material problem if the paver or plant breaks down or if the mix goes out of specification. Many agencies require that there be no more than two to three rolls down ahead of the paver in case it breaks down, unless a spare paver is available.

Exposed fabric has four problems. Grids to a lesser degree.

1. Exposed fabric picks up dirt, traps moisture from rain, heavy dew or fog and may project failure from steam and asphalt stripping.
2. Exposed fabric can be damaged by traffic
3. May cause accidents. Traffic control is necessary. Leaving fabric exposed to traffic is never recommended and a liability. Lawsuits over injury and death have occurred when drivers' skid or hydroplane on the wet fabric.
4. It is impossible to idiot proof this problem from drivers.

PLACING FABRIC CORRECT SIDE UP

Fabric is rolled onto the core by the manufacturer two ways, with the heat-bonded side up or down. It is critical to make sure that the heat-bonded side is placed up and the non heat-bonded fuzzy side is down into the oil. Otherwise delamination or fabric slippage can occur. For Geocomposites (grids with Fabrics) the fabric is placed down into the oil and the grid is up.

Hand placement fabric and machine placement fabric often need to be delivered from the manufacturer rolled onto the core in opposite directions. When placing fabric by hand it is important to order the fabric to unroll with the heat-bonded side up of the front of the roll. Otherwise the laborers will have to walk holding the fabric up off the ground (baseball bats work well for this).

Fabric for equipment placement should be rolled onto the core in reverse direction. It should unroll off the back of the roll, then under and over tensioning bars which changes the sides position to heat bonded side up and fuzzy side down and adding more tension. If the fabric comes off the front of the roll less tension is derived, and more wrinkles are likely.

Grids will have an adhesive, Bitumen or fabric and this must be placed down. Hybrid Mats may or may not have a correct side depending on the material.

WRINKLES AND OVERLAPS

Fabrics, composites and mats overlaps should be 2 inches (51 mm) to 6 inches (152 mm) on longitudinal joints and 6 inches (152 mm) at transverse joints. Grids are generally the same but also may vary by manufacturer recommendation or even requiring butting up and no overlap for thicker grids. Wrinkles twice the synthetic thickness should be cut/slit and laid flat. Excess material over two inches should be trimmed. Grids very based on the manufacturer's recommendations. All must be shingled in the direction of the paving. Fabrics, Hybrid Geomats and Geocomposites all require additional oil to be placed by hand spray equipment, a wand off the back of the truck, or by pouring oil on to them. They should be squeegeed smooth and brushed flat. The oil must be sufficient to saturate the two layers. Some feel this oiling can be a hazard to laborers, but it is required by manufacturers specifications and recommendations.

Chip seals longitudinal joints are treated the same as fabric, but their transverse joints are butted up to each other and not overlapped to prevent reflective cracks

NAILING SYNTHETICS

Nailing fabric with case hardened nails and surveying shiners to hold fabric in place at the overlaps is not recommended. This is an old practice that has no benefit, takes time and adds cost. It has been found to cause damage later for milling or if recycling is planned at any time.

OILS AND CONSTRUCTION

Both hot asphalt cements and rapid set emulsions have been used with success with fabrics, mats grids and composites. Many grid and composite manufacturers recommend only hot oil while others recommend hot oil but will accept emulsion. For grids and composites it is important to confirm the manufacturer recommendation and the project specification and only use their recommendations.

On milled surfaces only, hot oil can be used. Never use an emulsion. Emulsions run off into the valleys and cannot obtain the correct oil per square yard application thickness.

There is considerable difference in the construction methods between the hot oil and emulsion. Hot oil temperature should be between 290° (143.5 °C) and not exceed 325°F (163 °C) if oil is spread ahead of a tractor installation. It should not exceed the AASHTO M288-17 melt specification of 302°F (150 °C) if is installed by a one system oil truck. Application is best by distributor truck which is most common, but hand spraying will work.

Hand spraying requires close attention be paid to spraying a uniform oil of the proper gallons per square yard. Multiple spray passes are needed to get the correct gallons per square yard application. Measuring application is difficult. Small metal instruments exist with a rounded point on the end that can indent the oil after it has broken, or hot oil once cooled to check the oil application thickness.

The oil for fabric is not meant to be a binder to stick the fabric to the old asphalt. The oil must saturate the fabric to create an impermeable membrane.

Certain grids use the oil as a binder to adhere the grid to the asphalt and nothing more. Since there is not standard for grids each must be placed by the individual manufacturer recommendations.

Grids with adhesive many not have a tack coat. Grids impregnated with a Bitumen may use less tack coat. Grids with a lite fabric will use less tack coat.

Composites require roughly the same oil rates as fabrics and some manufacturers suggest an increase of +.01 gallons per square yard.

Hybrid Mats usually have the same spread rate as fabric, but it may vary by manufacturer.

The Spray bar height can have an effect. It should be 2 to 3 inches (5 cm to 7.5 cm) higher than the fabric placement.

Oil placement is best by distributor truck. Prior to starting the job, the distributor truck nozzles must be checked for proper spread rate and that they are all functioning correctly. Clogged valves need to be cleared. The correct spay is by double overlapping which gives the most uniform coverage. Valves adjusted improperly, or clogged nozzles will create streaking of the oil or whole strips not oiled at all. These locations will not have total saturate and become membranes and stripping will occur.




A problem with many oil truck mounted units is that they place the fabric into the oil so closely that the engineer cannot see if there were any valve problems and proper spray pattern. This was one concern of the Los Angeles County Engineers as well as others at many agencies.

This resulted in some additional specification for construction for the field engineers. The engineer could at any time require oil to be spread with no fabric placement so they could check the spray for valve problems. Fabric placement on that section had to be done by hand or a tractor.

Excess oil in one area and not enough or no oil for saturation in another causes many problems. Oils spread rate must be uniform with the correct application rate.

- Not enough oil means a poor saturation of the fabric
- Non-bonding likely will occur and asphalt may strip away creating potholes.
- Too much oil bleed through the fabric
- This must be blotted with sand
- If it is not or the problem not recognized oil will eventually bleed through the new asphalt
- This creates hazards for motorists both driving and for the vehicles

Rapid set emulsions will work in the membrane system, but they have numerous disadvantages.

- The emulsion must break completely prior to installation, 15 minutes.
- Cut back must be water and never a distillate.
- All water must evaporate prior to placement slowing installation.
- Moisture creates steam and asphalt stripping can occur later.
- Application rate must be 30% more to achieve the correct residual.
- Crowns, banked curves and steeper grades all have run off problems. with not enough oil in one area and too much in another area.
- Emulsions cannot be used on milled surfaces with fabric or grid-fabric composites.
- Smith, Button and Epps all reported steam from water has been shown to create bubbles in the overlay and eventual separation of the asphalt and fabric.

EXCESS OIL

Excess oil occurs in a number of ways.

- Nozzles are adjusted incorrectly placing too much oil in one pathway
- Overlaps overspray doubles oil thickness on one fabric thickness
- Sand should be hand spread onto the excess oil to blot it up. A truck of sand can be standing by or bagged sand can be spread. The blotted sand & oil should be removed. If not available

NORMAL BLEED THROUGH IS NOT EXCESS OIL

In the morning and at night the ground temperature is cooler and oil l cools rapidly. In the day the suns heat raises the pavement temperature to as much as 200 degrees and oil takes much more time to cool. If the fabric is placed to rapidly some bleed through will occur on every fabric.

Never reduce the amount of oil below the specified levels that will cause failure in the project. If the problem exists hand broadcast asphalt over the fabric to create a bridge for equipment to drive on. Increasing the viscosity of the oil will reduce bleeding, especially in higher temperature areas.

When excessive bleed through is combined with the observing of the beginning fabric shrinkage or melting, then a time delay between the oil spreading and the fabric placement is required to solve all three problems. Some agencies use a temperature gun and 250 degrees as the starting point for placing fabric. An oil truck mounted installer cannot do this. A two-stage installation with the oil spread a head of installing the fabric with a time delay for the tractor to begin placement is required. If the fabric installer is not a model that can be removed from the back of the oil truck and placed onto a tractor, then a separate installation tractor is needed. See Page 16.

MULTIPLE LANES

Paving multiple lanes poses minor installation problems. It is best to leave one lane open to traffic and install the Geosynthetic in one lane and pave it for traffic to drive on prior to installing the Geosynthetic in another lane. Always leave the required specification overlap unpaved to provide for the overlap of the next roll and for the binder to be placed on the existing fabric. Mostly that is 2 inches (51 mm) to 6 inches (152 mm).

The contractor should check the installation equipment to be used if rented or with an installation contractor to make sure the design is such that can place fabric on the overlap and not damage the asphalt paving the adjacent lane It is not recommended to let traffic drive on the fabric, even if heat bonded. It can cause delamination, overlap separation and accidents.



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INSTALLATION ON CURVES

Installing fabrics, Grids, Composites or Hybrid Mats around curves without excessive wrinkles is the most difficult installation task.

With the proper procedures it can be accomplished excellently for high elongation fabrics with a machine and done less well by hand. Grids, Geocomposites and certain Hybrid Mats require hand placement and cannot be installed on curves with a machine.

Never attempt to roll any material around the curve by hand. The wrinkles are so excessive that it may be almost impossible to cut them all without damaging the material and excessive cost of labor to treat all the wrinkles with extra oil.

Hand placement requires cutting smaller crew manageable sections of material on an angle or pie shape and overlapping the sections together matching to the curve with a number of pieces similar to a making a hexagon. All overlaps and wrinkles must be treated correctly with additional oil, brushing and seating.

Depending on the tractor operator's skills and experience there is a special technique that I developed and call HOPPING that works well for fabrics on all size curves and sometimes works for Hybrid Mats on larger curves. It will not work for grids or Geocomposites

The operator does not attempt to drive around the circular curve. They drive multiple straight paths and makes multiple fast adjustments forming angles similar to making the pie shape cuts. This leaves a few long angled large wrinkles to deal with similar to the pie shape hand placement sections. These are then slit and oiled.

Depending on the installation equipment and features other techniques can be used.
If the equipment has cones with tensioning capability like my Patented Rotating Spindle Roll Holder's the inside brake can be tightened to restrict the rolls movement. The outside brake is loosened to allow for more movement and stretch. A limited number of small wrinkles may occur on the inside.

If the equipment has a tensioning bar or bars similar to my Patented Multi-Bar Tensioning System, then adjustments to the bars angles can be made to some degrees to correspond to the curve and alter the angle of the fabric.

If brushes are adjustable from angled to transverse straightening the brushes for tight curves helps. Oil truck installers work well for fabrics and some Hybrid Mats but leave more wrinkles in the curves because the hopping method cannot be used.

Although Grid and Composite manufacturers claim they must be installed by hand a skilled tractor operator may be able to place thinner materials by machine on larger curves. The same for Hybrid Mats. It requires my special HOPPING technique.

MILLED SURFACES

Paving Geosynthetics work well over milled surfaces. Fabrics work excellently. Many Paving Grids, Composites and Hybrid Mats will also work. Refer to each manufacturers recommendation, these vary greatly from one manufacturer to another. Polyester Grids and Composites have a little more elongation and can conform a little better to a milled surface. Fiberglass grids are more fragile, but some manufacturers state they work. The manufacturer recommendations should be followed. It is best to obtain literature or in writing that the materials will conform and work on a milled surface and do not just take some sales person's word for it.

Milling may create micro cracking in the milled pavement. This creates more susceptibility to surface water penetration. Paving fabrics and some composites are ideal to create a membrane for milled surface. Elongation will conform to the milling once asphalt is placed and compacted. Paving fabrics functions of stress relief and interlayer membrane moisture barrier provide superior benefits for the milled surface. Composites provide the membrane and also high strength reinforcement.

Only a hot oil can be used on a milled surface. The application rate needs to be increased by 10% to 15% because of a rougher texture and uneven pavement surface. Never use an emulsion on milled surfaces. They run off in to valleys lengthening the breaking time and the correct uniform application rate cannot be obtained.

Paving fabric has a high elongation of greater than 50% and will stretch and conform to the milling. Most milled surfaces would only use 4% to 22% of the fabric's elongation. Paving fabric is strong enough to resist tears, puncture and burst on milled surfaces. Properties vary by manufacturer but from research all fabric exceed these specifications.

TEAR: 4500 pounds (20.017kN)
PUNCTURE: 6000 pounds' puncture (26.68935 kN)
BURTS STRENGTH: 195 PSI (1344.4776721678304 kPa)

Construction on milling requires a little extra attention. The surface must be clean and dry. All dust and cuttings left on the pavement surface need to be removed by brooming or air blowing or both. Different agencies and manufacturers suggest different asphalt thicknesses depending on the roadway loads. It is generally agreed that a minimum of 1.25 inches of compacted asphalt should be placed at the thinnest location. Usually gutters or curb areas if milled or if feathered to them.

If the milling has penetrated under the pavement into the base or sub base in limited areas a repair is needed with hot asphalt prior to placing the fabric. If milling reaches base rock or holes or has deeper grooves it is not a good candidate for using paving fabric. The paving fabric and oil do not conform well to near vertical grooves or the rough surface. An asphalt leveling course needs to be placed and then a paving fabric can be used.

Some manufacturers recommend rubber tire rolling their fabric or composite on milled surfaces.

Once the paving fabric, grid or composite is placed normal procedures for construction are used.

Additional general milling information is available in The AASHTO guide for Design of Pavement Structures III-135 5.7.6 for milling.

FABRIC ROLL PROBLEMS FROM THE MANUFACTURER.

Wrinkles can be rolled in to the fabric at the manufacturer. This occurs when the fabric was not placed on the roll at the factory or re-winder correctly. By hand it is almost impossible to remove the wrinkles. By machine it is possible to remove a good percentage of these pre-rolled wrinkles if the machine has adjustable tensioning and stretching mechanisms.

The Geosynthetic is attached to the cardboard core of the roll with glue or staples. This makes it easier to wind the roll at the manufacturer and can make for a tighter more compact roll. At the jobsite it can cause problems or be dangerous. The end of the material does not easily come off the roll. It can cause the tractor or truck to come to an abrupt stop or jerk at the end.

It may break the core causing it to dislodge from the installer into the oil or become lodged in the installer or be run over. It may have to be cut from the core, pulled out of the oil and poses a danger to the laborers, operators as well as slows production.

Grids with adhesive or bitumen may stick together and not unroll easily creating a resistance.

The fabric width is not consistent with scallops on the edges. It appears as if operator was weaving in and out. This causes overlap and oil problems. To obtain a correct overlap at the narrowest part the overlap the fabric will be excessive at the widest part of the scalloped material. The double spray of oil will not have a double thickness of fabric. This can leave excess oil cause bleed through the new asphalt and get on vechiles on a hot day.

This problem occurs when the fabric edges were not slit square during the manufacturer and slitting process. The material is made wider than the end product in the wrapper. This allows the edges to be trimmed by slitters (knives) in the manufacturing line before the fabric is rolled on to the core.

Factory slitting is done for two reasons. To square the edges and to trim thinner material from the edge to an inner area that is consistent in thickness. This assures that the fabric meets the meets engineering specification. When a slitter becomes out of place it may wobble back and forth or float during the slitting. This causes the edges to be inconsistent scalloping in and out. It can vary the width of the fabric by as much as a foot and make one or both edges inconsistent.

To fix this problem first immediately notify the manufacturer or distributor. Explain the problem and make them understand you know what the problem is. See if they will send a representative to the jobsite. It is best to send this defective fabric back to the source and have it replaced. Time may not permit this if in the middle of a job. Check rolls to see if it a few rolls or the whole shipment. Document this and then document it again, take many photos, get engineer's reports. You will need this to get any type of restitution from the manufacturer.

If purchased from the manufacturer direct see how long it takes to replace it. if bought from a local distributor see what they have in inventory of standard width 12.5-foot fabric and sometimes they may have different widths. See how much of an exchange can be performed immediately. This may give enough time for the manufacturer to dispatch new fabric from the factory. If it came from the manufacturer see if they have a nearby distributor who may be able to provide some rolls from their inventory to keep the project going until new truckloads can arrive.

Cutting the fabric is an option to keep the project going. This takes time but efficiently done will reduce the delay.

Save all wasted material for your documentation as it may require additional material to complete the project. Use an electric chain saw or other low RPM saw. High RPM gasoline saws will melt the fabric ends together. Measure the scallop maximum and cut it to make useable rolls for the combinations of the roadway width needed. Try for a minimum 2-3 inches past the widest scallop point. This will accomplish the squaring of the edge and eliminating the scallop.

Reconfigure the roll widths to use one cut off wider roll and one cut off short roll to get the right width and overlap for the project. Your decision on roll widths may change depending if this is a hand installation or a machine installation. It may involve cutting the roll off further than a few inches to get a correct width that will work with a short roll. One to 3 feet is harder to install by hand and 3 to 6 feet is much easier. If the machine is equipped with short roll or off set features the width will be dependent on the machines capabilities.

Example. The project calls for 12.5 feet rolls with a 2 – 4-inch overlap. Cut off 2 feet leaving approximately 10 feet 6 inches. There will be a little loss to the saw cuts. Then cut one roll into 5 short rolls after cutting off the bad edge at a foot (if possible depending on the scallop width. That leaves 11.5 feet and then cut that into 5 rolls of 2 feet 3 inches. This gives a 2 to 4-inch overlap on the 10.6 inch roll and results in the same project width. It allows for some discretion on the overlap. If two lanes or more wide. The short roll will then have a 10 foot 6-inch roll placed on it and require an overlap. The additional 6 inches and 3 inches allows for this with discretion.

ASPHALT CONSTRUCTION

Asphalt Construction temperature should not be less than 250 degrees F and not exceed 302 degrees F (or 150 degrees C) as specified in AASHTO M288-06. This temperature will not hurt the fabric once it has been placed in the oil as the oil acts as an insulator for the fabric.

The thickness of the asphalt must not be less than 1 1/2 inches (3.81 cm) after compaction if installed under ideal climatic conditions, 70 degrees F (21 degrees C) or above. For temperatures between 50 and 70 degrees F (10 - 21 degrees C) overlay thickness should not be less than 2 inches.

Some manufacturers claim that only 1 inch of asphalt is necessary and there have been many successful 1-inch fabric overlays done in ideal situations but also failures. Grid composites require a minimum 1.5 inch at the thinnest location if feathering towards the curb.

Overlays should not be attempted with temperatures less than 50 degrees F (10 degrees C). The heat from the overlay draws the oil up through the fabric making a bond. If enough residual heat after compaction is not present to continue the drawing of the oil up through the fabric, then the bonding process is disrupted. This results in slippage, stripping and eventual overlay failure.

PLACING THE ASPHALT

Paving on fabric is the same as any paving. Some precautions are necessary. Equipment and pavers must move in the direction the fabric is shingled. Turning of vehicles should be slow. Asphalt can be placed by semi-truck and trailer with a belly dump leaving rows for the paver to pick up and place. A truck end dumping into the paver as they move forward. Compacting should be immediately to concentrate the heat and create pressure that adds to the oil saturating through the fabric.

COMPACTING THE ASPHALT

Compacting the asphalt immediately after placement concentrates the heat and supplies pressure to start the process of the oil saturating the fabric fully and making a bond.

This is very important when using a thinner overlay as they cool more rapidly.

The heat is what helps draws the oil up through the fabric for saturation.

Various size rollers large and small are used and size has no bearing other than availability and project size.

Larger rollers may compact faster and require less passes but may not be able to get as close to burbs.

Hand compacting the gutters can be beneficial.

When the overlay thickness is feathered (tapered) toward the edges or gutters it must be a minimum of 1 inch for fabric or mats and 1.5 inches after

CHIP SEALS ON FABRIC

Usually grids are treated the same but each grid is dependent upon its manufacturers recommendations.

Chip seals on fabric have been successfully performed for 25 years. Chip Seals require different installation techniques than asphalt paving on fabric.

There is no weight or heat from asphalt compaction to draw the oil up through the fabric. Rubber tire rolling is necessary to complete total saturation and seat the fabric into the oil. Usually the roller is a pneumatic rubber tire roller. But other can be used.

Sanding with sieve size % passing 3/8" -100 # 4 - 90 -100 # 200 0-5 is needed after fabric placement. Sanding is necessary to prevent roller and other tires and laborer's shoes from sticking to fabric and oil. Sanding is at 4 to 6 pounds per $yd^{2.}$ A PNEUMATIC RUBBER TIRE ROLLER equipped with a spray system to apply a parting agent to the tires may eliminate sanding.

Both hot tack coats and emulsions can be used. A debate exists if the emulsion problems exist for chip seals and require the time to break before placing the fabric. There is no hot asphalt temperate to concentrate for heat to create the saturation process which is the reason for rolling the fabric to obtain saturation. There is no heat to create steam that causes stripping. It is debated if waiting for breaking is necessary. The water will evaporate without harming the fabric or project. This is promoted primarily by installers with oil truck mounted units.

Oil selection is important. Local availability of oil resources should be considered. Preferred oil is AR (aged residue), AC (asphalt cement) or PG (performance grade un cut AC). This speeds production. Annual year-round ambient temperatures need to be taken into account when selecting the oil. Do not solely consider temperature at construction time.

The oil selected must be able to harden and yet not become brittle in cold temperatures and still be able to soften but not liquefy in hot temperatures.

WARNING SIGNS must to be used for chip seals. The agency should require them but regardless they must be used and read: Loose gravel and oil if traffic is allowed to drive on the new roadway immediately.

Oil or emulsion spreading is the same as with any fabric project for the fabric. The width of the application should not be greater than the width of the aggregate spreader except when additional passes are required.

The oil or emulsion should be four inches beyond the aggregate spread at a fifty percent application rate. For the chipping process the oil or emulsion should not be all owed to break, chill, setup, harden, or otherwise impair the aggregate retention before the aggregate has been properly applied and rolled.

Placing the fabric has one difference when it comes to overlaps.

- Longitudinal overlaps are 2 inches (51 mm) to 6 inches (152 mm), the same as pavement overlays.
- Make sure the joint overlap receives a second oil coverage
- DIFFERENCE: Horizontal Transverse joints DO NOT GET AN OVERLAP
- These joints are butted up to each other
- A double fabric layer can create bumps in the chip seal

Sand the fabric.

- If the rubber tire roller does not have a spray system
- Pneumatic rubber tire rollers equipped with spray system to apply a parting agent to the tires may eliminate sanding
- The sand must be evenly spread at 4 – 6 pounds $yd^{2.}$
- Use a vehicle mounted sand spreader for a uniform spread
- If a vehicle mounted available any means of spreading the sand is adequate
- The sand remains in place until the chip seal is done

Seat the fabric into the oil with a roller. A pneumatic rubber tire roller is best but other rubber tire rollers will work to seat the fabric into the oil.

- Require numerous passes, 3 or more may be necessary
- When the pavement surface texture is visible on the fabric top it is then satisfactorily saturated
- The sand will change color from brown to a dark gray, almost black.

Place the chip seal using normal construction procedures. Apply oil (asphalt binder) on top of the fabric. Some specifications recommend increasing the oil rate by .01 $yd^{2.}$ Place a layer of aggregate chips into the oil on the fabric Roll the chips to embed the aggregate into the binder on the fabric. If a double chip layer, then proceed with the new oil again and chipping procedure.




INSTALLING

GEOGRIDS AND GEOCOMPOSITES

All previous sections should be considered as they all apply to installing Grids and Composites. Particular attention to these sections should be reviewed.

There is no standard for Geogrids and Geocomposite specifications similar to AASHTO M 288 for fabrics.

Even fill placement and overlap recommendations will vary by manufacturer. As mentioned in previous sections.

This means that installation procedure for Geogrids will vary based on each manufacture's recommendations, type of grid fibers, the aperture openings, the axial, (biaxial, triaxial) and so on.

Grid sizes vary by manufacturer. Most sizes are from 2' to 16' Many have a (.5) foot factor. Many manufacturers only produce narrower rolls up to 6 feet. Ask what sizes are available before bids. Installing 3 rolls of 5 foot grids takes 3 times as long as one 15-foot roll, additional overlaps and oil.

Paving Geotextiles (Paving Fabrics) have a high elongation (stretch) and tensioning and stretching is required to place the fabric smoothly wrinkle free.

Geogrids and Geocomposites have little or no elongation and high modulus. They require installing with as little tension as possible and no impedance to their unrolling. This requires changes in procedure and use of the equipment.

READ THE SPECIFICATIONS and ASK QUESTIONS. The contractor is ultimately responsible for installation and what is in his bid.

Geogrids are placed directly on the prepared surfaces. Usually major objects such as rocks, tree and bush stumps are removed. Hollows and depressions must be filed. The normal vegetation and topsoil covering the site do not need removal. But as always grading and leveling the site is best. (Photo courtesy Huesker Inc)

Paving Geogrids are used on asphalt for structural asphalt repairs. These do not have fabrics. Geocomposites (grids with fabric) can be placed directly onto the older asphalt or leveling course after oil placement.

Attempts to tension the material for stretch will have the opposite effect causing wrinkles and folds.

When mechanical installation equipment is used, which is 98% of the time, it will likely have some version of my Patented Rotating Spindle Roll Holders which have an internal braking mechanism and cones. It is recommended the tension on the braking be minimal and solely to prevent the material from free rolling when stopping.

This regular types of tensioning and brushing systems do not work well for Geogrids and Geocomposites that do not stretch. It will cause the material to drag across the bars with an impedance to free rolling and does not sweep from the middle outward. This will cause wrinkles and folds. For grids and composites the brushes should be straight and not angled.

A version of my Patent Pending Multi Bar Roller System eliminates the Geogrid or Geocomposite drag across the bar or bars and will keep the material aligned, straight and level while permitting for a free rolling installation with no impedance and elimination of many wrinkles and folds.

Geocomposite placement is based on manufacture recommendations. These follow information in previous sections for installing Geotextile Paving Fabric and AASHTO M 288 guidelines.

Paving Grids must adhere to the pavement, so the paver does not lift them. They can come differently.

- A special preinstalled adhesive that does not require an oil
- With a thin light weight fabric attached for adhering to oil but does not form a membrane.
- Pre - impregnated with an oil that requires a less oil.
- As a composite with fabric that uses fabric installation oil requirements.

Binders for Paving Grids can be hot oils or rapid set emulsions. There is no general standard. These will be between .06 to .18 gallons per yd^2 for Paving Grids without paving fabric. The rate may vary if the Paving Grid has a light thin fabric to act with the binder.

Composites use .22 - .25 gallons per yd^2 the same as a paving fabric. Some manufacturers recommend an increase of .01 per yd^2. Emulsions require a 30% increase in application rate to account for evaporation and the extra installation time. Oil pre-impregnated Paving Grids has an oil cost savings and uses approximately 25% less oil between 0.10 to 0.15 gallons yd^2.

The Paving Grids may have a correct side to install down for binding and upward side. Make sure the side with the preinstalled adhesive, light thin fabric or Composite Fabric is placed on the roadway or into the binder or oil.

The pavement surface must be dry, clean with no dirt or gravel. Sweep, power broom or vacuum it prior to installing Geocomposite. Fill cracks as necessary. Fill all cracks 1/4 inch (.63cm) or larger with an approved material. Repair and patch potholes.

Geogrids and Geocomposites should be placed as flat as possible without a minimum of wrinkles or folds. These must be addressed if sizeable. Each manufacturer has recommendations for their product and project specifications always take precedent.

Tensioning of the Geogrid or Composite other than to keep them installing level, straight and uniform is not recommended as it will impede their free rolling and create wrinkles and folds.

Wrinkles are handled the same as fabric. Slit and shingled in the direction of the paving and excess over 2 inches trimmed off. In some case based on manufacturer recommendations these are not overlapped but laid flat butted up.

Overlaps for Longitudinal joints are 2” to 6” (50.8 mm to.1525 mm) and transverse overlaps 6” to 1’ (.152.5 mm to 305 mm). Transverse overlaps need to be shingled in the direction of the paving, so the paver does not life the overlap. Additional oil spray is required at the overlaps. (Photo courtesy Huesker Inc)

All Geocomposite overlaps and wrinkles must be treated correctly with additional oil, brooming and seating. They require a double spray of oil to saturate the double thickness of fabric. Failure to do so ill have areas of unformed membranes allowing for water penetration and slip planes where a through bond from the previous asphalt to the new asphalt is interrupted.

Grids and Composites have minimal elongation and require slower installation speeds than a Fabric. Maximum installation speed for these will vary depending on the machines equipment and options and the materials properties. These may not be able to be placed effectively on curves with a machine and may require some hand placement.

Hand placement requires cutting smaller, crew manageable sections, of material on an angle or pie shape and overlapping the sections together matching to the curve with a number of pieces similar to a making a hexagon. All overlaps and wrinkles must be treated correctly with additional oil, brooming and seating.

Installing on milled surfaces is possible for both Paving Grids and Composites. Polyester grids and Composites and some fiberglass Grids and Composites conform to the milled surfaces depending on how they are manufactured. Some grids cannot be used. Check the manufacturers literature and recommendations and ASK QUESTIONS if not clear.

GEOGRIDS INSTALLED FOR STABILIZATION

Geogrids overlaps of adjoining rolls in both longitudinal and transverse directions are overlapped a per manufacture project specifications. Overlaps should be placed in the direction of the fill placement, to avoid separating. Securing overlaps is usually by placing small amounts or mounds of fill over the overlaps and before the main filling takes place.

Some manufactures recommend a longitudinal overlap of a minimum of 1’6” (41 mm) and some recommend a butting of the material edges. For transverse overlaps the width is subject to the grading, stiffness and thickness of subgrade.

The soil CBR usually determines the overlap.

- Greater than 3 is usually a minimum of 12” (305 mm)
- 1 – 3 is usually 24” (610 mm)
- 0.5 – 1 is usually 36” (915 mm)
- Less than .05 is usually 40” or (1016 mm) and the use of mechanical ties is recommended.

Each manufacturer has different recommendations and again READ THE LITERATURE.

Placing the fill on the Geogrid again varies by each manufacturer recommendations and the project contract specifications.

Some manufacturers recommend the fill material be stockpiled and then spread by a mechanical means such as an excavator, bulldozer or loader with an opening bucket. Some manufactures recommend end dumping onto the Geogrid to prevent damage to Geogrid by construction vehicles.

Some manufacturers permit the use of rubber-tired equipment to on the Geogrid at very slow speeds less than 10 mph and without sudden braking.

Manufacturers recommendations state track equipment should not be allowed onto the Geogrid until a minimum of six inches (152 mm) of fill is on top of the Geogrid.

Compaction is normally in accordance with Earthworks Specification RTA 3051. When there is very soft subgrade (water saturated soils) compaction of the lowest layer of fill may have to be reduced from RTA 3051. Check the projection specifications

OTHER FABRIC BASED PRODUCTS

Pre-coated peel and stick fabric waterproofing membranes a composite of nonwoven fabric coated with a rubberized asphalt adhesive mastic which bonds to the existing pavement surface.

These can come as regular duty double composite or triple layer composite incorporation another synthetic for higher tensile strength. These are often used where constant high loads exist, freeways, major roadways, truck terminals and airports.

Their use is to repair potholes, cracks, joints, large cracks and seal bridge decks. They create both a limited localized water proofing membrane and also absorb and dissipate various pavement stresses that cause reflective cracking

Triple layer or more composites are used where constant high loads exist, freeways, major roadways, truck terminals and airports

These are usually installed by manually rolling it out and seating it in place. Most preformed membranes have a paper on one side that peels off exposing the sticky adhesive. Installation is by hand rolling as the paper is peeled off.

These membranes come in small widths from 12 to 36 inches. Installation guidelines vary for each manufacturer.

APPENDIX 1

AASHTO M288-17 FOR PAVING FABRICS

Table 8 – Paving Fabric Property Requirements (a)

Test Methods	Units	Requirements
Grab Strength ASTM D 4632	N	450
Ultimate Elongation ASTM D 4632	%	> 50
Mass Per Unit Area ASTM D 5261	gm/m2	140
Asphalt Retention1 ASTM D 6140	l/m2	*b c*
Melting Point ASTM D 276	C	150

a. All numeric values represent MARV in the weaker principal direction. (Refer to Section 10.2.)

b. Asphalt required to saturate paving fabric only. Asphalt retention must be provided in manufacturer certification. (Refer to Section 5.) Value does not indicate the asphalt application rate required for construction. Refer to Appendix for discussion of asphalt application rate.

c. Product asphalt retention property must meet the MARV value provided by the manufacturer certification. (Refer to Section 5.)

SUBSECTION 5. CERTIFICATION

5.1. The contractor shall provide to the engineer a certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns, and other pertinent information to fully describe the geotextile.

5.2. The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request.

5.3. The manufacturer's certificate shall state that the furnished geotextile meets MARV requirements of the specification as evaluated under the manufacturer's quality control program. A person having legal authority to bind the manufacturer shall attest to the certificate.

5.4. Either mislabeling or misrepresentation of materials shall be reason to reject those geotextile products.

SUBSECTION 10.2 PAVING FABRIC REQUIREMENTS

The paving fabric shall meet the requirements of Table 8. All numeric values in Table 8 represent MARV in the weaker principal direction.

SUBSECTION A6. PAVING FABRICS

X1.6. *Materials:*

X1.6.1.1. The sealant material used to impregnate and seal the paving fabric, as well as bond it to both the base pavement and overlay, shall be a paving grade asphalt recommended by the paving fabric manufacturer, and approved by the engineer.
X1.6.1.1.1. Uncut asphalt cements are the preferred sealants; however, cationic and anionic emulsions may be used provided the precautions outlined in Section X6.3.3 are followed. Cutbacks and emulsions that contain solvents shall not be used.

X1.6.1.1.2. The grade of asphalt cement specified for hot-mix design in each geographic location is generally the most acceptable material.

X1.6.1.2. Washed concrete sand may be spread over an asphalt saturated paving fabric to facilitate movement of equipment during construction or to prevent tearing or delamination of the paving fabric. Hot-mix broadcast in front of construction vehicle tires may also be used to serve this purpose. If sand applied, excess quantities shall be removed from the paving fabric prior to placing the surface course.
X1.6.1.2.1. Sand is not usually required. However, ambient temperatures are occasionally sufficiently high to cause bleed-through of the asphalt sealant resulting in undesirable paving fabric adhesion to construction vehicle tires.

X1.6.2. *Equipment:*

X1.2.1. The asphalt distributor shall be capable of spraying the asphalt sealant at the prescribed uniform application rate. No streaking, skipping, or dripping will be permitted. The distributor shall also be equipped with a hand spray having a single nozzle and positive shut-off valve.

X1.6.2.2. Mechanical or manual lay down equipment shall be capable of laying the paving fabric smoothly.

X1.6.2.3. The following miscellaneous equipment shall be provided: stiff bristle brooms or squeegees to smooth the paving fabric; scissors or blades to cut the paving fabric; brushes for applying asphalt sealant to paving fabric overlaps.
X1.6.2.4. Pneumatic rolling equipment to smooth the paving fabric into the sealant and sanding equipment may be required for certain jobs. Rolling is especially required on jobs where thin lifts or chip seals are being placed. Rolling helps ensure paving fabric bond to the adjoining pavement layers in the absence of heat and weight associated with thicker lifts of asphaltic pavement.

X1.6.3. *Construction:*

X1.6.3.1. Neither the asphalt sealant nor the paving fabric shall be placed when weather conditions, in the opinion of the engineer, are not suitable. Air and pavement temperatures shall be sufficient to allow the asphalt sealant to hold the paving fabric in place. For asphalt cements, air temperature shall be 10ºC and rising. For asphalt emulsions, air temperature shall be 15ºC and rising.

X1.6.3.2. The surface on which the paving fabric is to be placed shall be reasonably free of dirt, water, vegetation, or other debris. Cracks exceeding 3 mm in width shall be filled with suitable crack filler. Potholes shall be properly repaired as directed by the engineer. Fillers shall be allowed to cure prior to paving fabric placement.

X1.6.3.3. The specified rate of asphalt sealant application must be sufficient to satisfy the asphalt retention properties of the paving fabric, and bond the paving fabric and overlay to the old pavement.

NOTE X9 —When emulsions are used, the application rate must be increased to offset water content of the emulsion.

X1.6.3.3.1. Application of the sealant shall be by distributor spray bar, with hand spraying kept to a minimum. Temperature of the asphalt sealant shall be sufficiently high to permit uniform spray pattern. For asphalt cements the minimum temperature shall be 145ºC. To avoid damage to the paving fabric, however, the distributor tank temperature shall not exceed 160ºC.

X1.6.3.3.2. Spray patterns for asphalt emulsion are improved by heating. Temperatures in the 55ºC to 70ºC range are desirable. A temperature of 70ºC shall not be exceeded since higher temperatures may break the emulsion.

X1.6.3.3.3. The target width of asphalt sealant application shall be the paving fabric width plus 150 mm. The asphalt sealant shall not be applied any farther in advance of paving fabric placement than the distance the contractor can maintain free of traffic.

X1.6.3.3.4. Asphalt spills shall be cleaned from the road surface to avoid flushing and paving fabric movement.

X1.6.3.3.5. When asphalt emulsions are used, the emulsion shall be cured prior to placing the paving fabric and final wearing surface. This means essentially no moisture remaining.

X1.6.3.4. The paving fabric shall be placed onto the asphalt sealant with minimum wrinkling prior to the time the asphalt has cooled and lost tackiness. As directed by the engineer, wrinkles or folds in excess of 25 mm shall be slit and laid flat.

X1.6.3.4.1. Brooming and/or pneumatic rolling will be required to maximize paving fabric contact with the pavement surface.

X1.6.3.4.2. Overlap of paving fabric joints shall be sufficient to ensure full closure of the joint, but should not exceed 150 mm. Transverse joints shall be lapped in the direction of paving to prevent edge pickup by the paver. A second application of asphalt sealant to the paving fabric overlaps will be required if in the judgement of the engineer additional asphalt sealant is needed to ensure proper bonding of the double paving fabric layer.

X1.6.3.4.3. Removal and replacement of paving fabric that is damaged will be the responsibility of the contractor.

NOTE X10 — The problems associated with wrinkles are related to thickness of the asphalt lift being placed over the paving fabric. When wrinkles are large enough to be folded over, there usually is not enough asphalt available from the tack coat to satisfy the requirement of multiple layers of paving fabric. Therefore, wrinkles should be slit and laid flat. Sufficient asphalt sealant should be sprayed on the top of the paving fabric to satisfy the requirement of the lapped paving fabric.

NOTE X11- In overlapping adjacent rolls of paving fabric it is desirable to keep the lapped dimension as small as possible and still provide a positive overlap. If the lapped dimension becomes too large, the problem of in adequate tack to satisfy the two lifts of paving fabric and the old pavement may occur.

If this problem does occur, then additional asphaltic sealant should be added to the lapped areas. In the application of the additional sealant, care should be taken not to apply too much since excess will cause flushing.

X1.6.3.4.4. Trafficking the paving fabric will be permitted for emergency & construction vehicles only.

X1.6.3.5. Placement of the hot-mix overlay should closely follow paving fabric laydown. The temperature of the mix shall not exceed 160ºC. In the event asphalt bleeds through the paving fabric causing construction problems before the overlay is placed, the affected areas shall be blotted by spreading sand. To avoid movement of, or damage to, the seal-coat saturated paving fabric, turning of the paver and other vehicles shall be gradual and kept to a minimum.

X1.6.3.6. Prior to placing a seal coat (or thin overlay such as an open-graded friction course), lightly sand the paving fabric at a spread rate of 0.65 to 1 kg per m2, and pneumatically roll the paving fabric tightly into the sealant.

ADVISORY

It is recommended that for safety considerations, trafficking of the paving fabric should not be allowed.

However, if the contracting agency elects to allow trafficking, the following verbiage is recommended: “If approved by the engineer, the seal-coat saturated paving fabric may be opened to traffic for 24 to 48 hours prior to installing the surface course. Warning signs shall be placed which advise motorists that the surface may be slippery when wet. The signs shall also post the appropriate safe speed.

Excess sand shall be broomed from the surface prior to placing the overlay.
If, in the judgement of the engineer, the fabric surface appears dry and lacks tackiness following exposure to traffic, a light tack coat shall be applied prior to the overlay.”

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Mounque “Monk” Barazone was inducted into the Pavement Hall of Fame in 2019 after his 40 year career in Geosynthetics since 1980.

He is the owner of Geotextile Apparatus Company founded in 1980.

His Earth Fabrics, Inc.was the largest distributor of Geosynthetics, corrugated steel pipe and other materials on the west coast until selling the company in 1991.

He was one of the first people to install fabrics and he developed many of the current installation techniques. He received Six United States and Foreign Patents for Paving Fabric Installation Machines and Roll Pullers™for unloading trucks and containers. He has numerous Patents Pending.

His equipment is used in worldwide. He consults on installations projects worldwide, teaches courses internationally and has been published dozens of times internationally in multiple languages.

His factory was burned totally in the July 2018 wildfires in California. The company restarted with Roll Pullers in October 2018 and machines in April 2019.

He moved his factory from California to Northern Ohio the end of 2022.

QUESTIONS?

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