FORWARD

Approximately ***100 million square yards*** of Fabric Interlayer Systems are successfully being installed ***every year*** in the United States. The system is installed for two primary reasons:

1. Provide a Moisture Barrier to stop surface water from entering the road base.

   - FHWA studies show that one-third to one-half of all precipitation falling on a road surface can infiltrate through the pavement to the base and sub grade.

   - Pavement base materials that are saturated just 10% of the time can reduce the pavement's life by 50%.

2. Form a Stress Absorbing Membrane to ***increase pavement fatigue life*** and to ***retard reflective cracking.***

   - Laboratory tests indicate a 100 – 300% increase in fatigue life of a pavement with a Fabric Interlayer.

   - Field performance indicates a 50 – 100% delay in reflective cracking with a Fabric Interlayer.

   - Fabric Interlayers are shown to be equivalent to placing an additional 0.1 to 0.15 feet (three to four centimeters) of ACC overlay in terms of retarding crack reflection.

For the system to be an effective moisture barrier and stress relief layer, the fabric and binder must work as a uniform, asphalt saturated layer that is well bonded to the stable existing pavement below and the new pavement surface above.

Fabric Interlayer Systems will only be successful if placed on stable pavements. Many pavements with alligatored fatigue cracks are structurally adequate. Badly broken pavements that deflect under load are not candidates for an Interlayer System and should be removed and replaced.

Ambient temperature should be 50°F and rising at time of placement of an Interlayer System. Pavement should be 40°F minimum.

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ELEMENTS OF A QUALITY PAVING FABRIC INTERLAYER SYSTEM

The successful installation of a Paving Fabric Interlayer System is dependent upon the following elements:

I. ***Surface Preparation***

II. ***Binder Spread Rate***

III. ***Fabric Placement***

IV. ***Hot Mix Asphalt Placement***

I. SURFACE PREPARATION

A. Clean the existing pavement of dirt, water, oil and other foreign materials.

B. Cracks between 1/4" and 1/2" shall be filled with hot pour rubberized crack filler or other approved crack filler as specified by the Engineer. Wider cracks are to be repaired with a fine hot mix asphalt. This is a separate bid item.

C. Fill existing uneven, rutted, or extremely rough surfaces (coarse milled surfaces with deep corrugations) with a leveling course.

D. Remove any existing asphalt that deflects under load. Repair by placing a suitable geotextile between the native soil and the new aggregate base prior to paving with the appropriate hot mix asphalt. NOTE: Fabric Interlayer System should not be placed on new asphalt sections until the asphaltic concrete has been in place for 24 hours.

CAUTION: Pavement edges that have been milled adjacent to concrete curbs may require additional binder if a leveling course is not possible. This can be accomplished by pretacking the milled areas, as directed by the engineer, prior to applying the full width binder application. Pavement fabric shall not be placed in areas of conform tapers where the thickness of the overlying asphalt is 0.125 feet (40 mm) or less.

II. BINDER SPREAD RATE

The Interlayer will perform as a waterproofing, stress-reducing system only if the paving grade asphalt binder is uniformly applied (see Figure 1.) Binder such as AR-4000 or AC-10 typically should be applied between 290°F and 325°F. When ambient temperature exceeds 80°F more viscous binder, such as AR-8000 or AC-20, is suggested. Total required binder rate is typically estimated at 0.25 GSY.

Adequate binder is needed to:

A. BOND THE OLD PAVEMENT TO THE NEW OVERLAY

The standard for this is 0.05 gallons per square yard (0.23 liters per square meter.) Very tight surfaces may take slightly less; very porous surfaces may take slightly more (± 0.02 GSY.)

B. SATURATE THE FABRIC

Amoco, the manufacturer of Petromat®, stipulates that a 4.1 oz/sy fabric alone requires 0.20 GSY (0.68 l/m^2) to obtain saturation and low permeability. Less binder reduces the waterproofing and can result in disbonding.

III. FABRIC PLACEMENT

The fabric can be laid with mechanical equipment (see Appendix, Figure 2, *Components of Laydown Equipment*) or manually. The following elements are critical in fabric laydown:

A. *Right side up* - Paving fabric is designed to be laid with heat-treated (smooth) side up, fuzzy side down. This minimizes fabric pick-up by construction vehicles.

B. *Wrinkles* - The fabric must be laid as wrinkle free as possible. Brooming with equipment or by hand typically eliminates small wrinkles. Wrinkles one inch and larger are normally cut and lapped in the direction of the paving. Straight passes generally result in unwrinkled fabric. Curves should be gradual or cut and lapped in order to minimize wrinkles. Burning or melting of wrinkles is not recommended.

C. *Overlaps* - Transverse laps should be between 2 – 4". If greater than 4", the laps must be treated with additional binder and shingled in the direction of paving. Longitudinal laps should be 2 – 6" and must be treated with additional binder.

D. *Binder Temperature* - Temperature of the binder when the fabric is embedded is critical. Polypropylene fabrics may damage or shrink at temperatures which are too high (see Appendix, photos 3 – 6). Binder should be is less than 180°F (see photo 9.) Proper saturation will occur when a minimum 1½" lift of compacted hot mix is placed over binder and fabric. If fabric is embedded in binder that is hotter than 180°F (especially in hot weather) the fabric may become *prematurely saturated* and cause construction problems (see Appendix photos2 - 8.)

1. *Attempting to eliminate premature saturation by reducing application rate of the binder can cause system failure.* If premature saturation of the fabric is causing fabric to stick to tires, an effective corrective measure is to broadcast a thin layer of hot mix asphalt over the surface (also see page 16, Item 2 of this manual).

E. *Areas to Avoid Placement of Fabric:*

1. Tapered edges where thickness of compacted overlay will be less than 1-½"
2. Structurally unstable areas
3. Directly over very rough surfaces that have not received a leveling course
4. Wet or dirty surfaces

IV. PLACEMENT OF HOT MIX ASPHALT

Typically no more fabric is placed than can be overlaid the same day. Minimum lift thickness of 1½" (38mm) is recommended for Fabric Interlayer Systems. Two elements are critical in placement of the overlay:

A. *Temperature* - The asphaltic concrete should be no less than 250°F (121°C,) nor greater than 325°F (163°C) as it exits the asphalt lay down machine. The minimum temperature is required to get adequate density of the lift and wick the binder up through the fabric. The maximum temperature avoids premature aging (oxidizing) of the asphalt binder in the hot mix.

B. *Compaction* – Minimum compaction as required by the engineer is a combination of:

1. Adequate temperature of the hot mix
2. Sufficient rolling pressure
3. Adequate number of passes

INSPECTION

The following items are recommended for comprehensive inspection of Fabric Interlayers:

- **Noncontact thermometer**
- **Fabric knife**
- **Scale capable of 0.01 oz. or 2 gram increments**
- **Calculator**
- **Tack coat calculator reference chart**
- **Test units (for measuring binder rate)**
- **Self adhesive, pre-impregnated pavement membrane patches**

ELEMENTS OF INSTALLATION

Key elements of a successful Fabric Interlayer System installation:

I. **Preparation of Existing Pavement**

II. **Application of Binder**

III. **Checking Application Rate**

IV. **Placement of Fabric**

V. **Compaction of Overlay**

Deficiency in any one of the above may result in an unsatisfactory system and lead to premature system failure. The following methods help assure a satisfactory performing system.

I. PREPARATION OF EXISTING PAVEMENT

A. Visually inspect all areas to be paved for water, dirt, debris.

B. Check that uneven or very rough surfaces need to be leveled.

C. Verify that all cracks over 1/8" have been filled.

D. Check that all unstable areas have been removed and replaced.

II. APPLICATION OF BINDER

A. Check that distributor equipment has been previously calibrated or calibrate with AIA Kit.

B. Determine rate of binder to be applied. This will be the amount recommended by the manufacturer (typically 0.25 GSY.)

1. Check surface to determine if binder needs to be increased or decreased to accommodate the existing pavement condition (typically ±0.03 GSY.)

2. Notify the distributor operator of the desired rate.

C. Check binder application. As the spreading operation begins, observe the spray pattern of the binder to assure a uniform application is occurring as shown in Appendix Figure 1, *Distributor Truck Sprays*. The width of the sprayed binder should exceed the width of the fabric by 2 – 4" on each side of the fabric.

CAUTION: Insufficient tack rate is the number one cause of poor Fabric Interlayer performance and failure.

III. CHECKING APPLICATION RATE

PRETEST of the binder application rate is recommended. Place three pre weighed test units (12"x 12") on the ground. One should be placed in the center of the spray bar (between the truck tires). The other two should be placed near the outside of the bar (outside of the truck tires). Have the operator turn off 3 nozzles on each side of the bar directly behind the truck tires. Since a triple overlap is the most desired spray pattern, the exclusion of the 3 nozzles on each side would leave the spray of the remaining operating nozzles just touching. Instruct the operator to shoot over the test units at .25gal/sy. After the application weigh the test units. Without fabric the only additional weight on the test unit will be the residual binder and that should be 104 grams per sq foot for application equivalence of .25 gal/sy (see of page 17 of this manual). With this simple 15 minute test you will be able to determine;

1. The truck's ACTUAL shot rate as compared to the setting of the computer
2. The uniformity of the spray application across the bar (all 3 test units should weigh the same
3. The spray pattern (triple coverage optimum) of the spreader truck as the operator has it set up

A. As the spreading operation proceeds, place a preweighed test unit ahead of the distributor spray bar. After the fabric spreading equipment has passed, remove the test unit. Cut the overlaid fabric around the outline of the test unit and weigh the complete "sandwich."

B. Calculating actual spread rate from retrieved test unit

1. Weigh and determine the total weight of the test unit with fabric

2. Deduct the predetermined test unit weight and cover fabric

3. The resulting net weight is the weight of binder applied and is then compared to the weights of applied binder as shown on the page 17 *Fabric & Binder Weight Chart.*

4. If the calculated application rate does not agree with the specified one, the rate should be adjusted as required to equal specified rate.

5. An exposure test of the Interlayer System can be done to observe the laid fabric under the overlay. Using a stick or small tool, push aside the newly laid hot mix to expose the fabric below. See if the fabric is saturated. If not, wait until the "breakdown" rolling has completed and expose the fabric again. If the fabric is not saturated at this point, it is doubtful that a successful system will be achieved. Determine if the cause is insufficient binder or improperly placed overlay.

6. The second check is to take a tank reading at the beginning of the spreading operation and then read again during the project at the end of any roll of fabric. Subtract the two and then refer to the *Binder Consumption* chart in the Appendix, chart i. If fewer gallons have been applied than are shown on the chart for any given number of rolls, the binder application rate is too low. Have the installer adjust as necessary.
7. Weight tickets and tank gauges may not be accurate. Application spot checks, as outlined above, should be used to verify total binder quantities taken from weight tickets and calibrated stick measurements. Divide the total gallons of binder on weight tickets by the total area of the Interlayer System project. The resulting gallons per unit area should match the amounts calculated on the application spot checks.

IV. PLACEMENT OF FABRIC

A. Check condition of fabric rolls. The manufacturer wraps the rolls of fabric in plastic to protect the rolls from exposures to sun and water. The rolls should be stored up off the ground and uniformly supported. If the wrap has been removed or damaged, check the condition of the rolls. If sun exposure has occurred, the outside fabric layers may be damaged. If the rolls have taken on water, the core may not be strong enough to support the fabric during placement. Wet fabric will cause water to be encapsulated in the system and cause a variety of problems at the time of construction as well seriously degrade the system.

B. Install the fabric with calendered (smooth) side up. The "fuzzy" side of the fabric is applied on the bottom next to the binder. The fabric should be installed with light tension to minimize wrinkles. Cut wrinkles in excess of one inch and lap in the direction of paving. Burning and melting wrinkles is not acceptable.

C. Do not allow the fabric to be embedded in the binder at elevated temperatures.

1. Optimum temperature for embedment is 180°F or below.

2. Using a noncontact temperature-sensing device, monitor the binder temperature on the pavement just prior to fabric embedment.

3. If the temperature of the binder is to high construction problems (bleeding) may result or damage to the fabric (shrinkage) may occur (see Appendix photo 5.)

D. Care should be taken to insure that the distributor does not place binder that is too hot during successive passes of fabric. Hot oil will be sprayed directly on previously laid fabric at overlap joints. The previously placed fabric can withstand hotter temperatures than newly placed because the previously absorbed asphalt acts as an insulator. If the original fabric shrinks and curls at the edges of the overlap, instruct the distributor operator to allow the temperature of the binder to fall to an acceptable level before resuming work.

V. COMPACTION OF OVERLAY

A minimum overlay of 1½" is recommended with Fabric Interlayers. Temperature of the asphalt mix at time of placement, as well as proper compaction, is critical to a successful Paving Fabric Interlayer. The thermal mass of the asphalt needs to be sufficient to reheat and draw the cooled binder up through the Fabric Interlayer (see Appendix photos 9 and 10.) It will then saturate the fabric and bond to the new asphalt. Optimum temperature for laydown is 300°F. Caltrans has established the following guidelines:

- Maximum asphalt placement temperature .....325°F
- Minimum asphalt temperature to begin rolling.....250°F
- Complete all rolling before new mat drops below.....150°F

Monitor the respective temperatures with a noncontact thermometer to insure the above guidelines are met.

TECHNICAL REFERENCES

APPRECIATION IS OWED TO THE MANY DOCUMENTS AND INDIVIDUALS THAT WERE CONSULTED TO ACCOMPLISH THIS GUIDE. SPECIAL THANKS TO:

- Mounque Barazone, Geotextile Apparatus Company, "The Definitive Guide to Paving Fabric and Installation"
- Alan Curtis, Chec Consultants, Inc., "Pavement Maintenance Practices Manual"
- Mark L. Marienfeld, P.E. Thomas L. Baker, P.E., "Paving Fabric Interlayer System as a Pavement Moisture Barrier," TRB Paper No. 981112
- Mark L. Marienfeld, P.E., Sandy K. Guram, "Overview of Field Installation Procedures for Paving Fabrics"
- Roger D. Smith, P.E., "Guidelines for Quality Control in Paving Fabric Installations"

ADDITIONAL INFORMATION WAS ACQUIRED FROM:

- "California Standard Specifications," State of California
- *Geotechnical Fabrics Report*
- *Pavement Maintenance and Reconstruction*
- "Standard Specifications for Public Works Construction," Green Book

COMMON INSTALLATION PROBLEMS

1. NON-UNIFORM TACK SPRAY PATTERN

   Possible causes:

   - Rough pavement surface or large, unfilled cracks
   - Missing or clogged spray nozzles
   - Binder temperature too low

2. PREMATURE SATURATION

   Possible causes:

   - Elevated binder temperature at time of fabric embedment
   - Fabric underweight
   - Binder too low in viscosity
   - Fabric embedment pressure too high

3. WRINKLED FABRIC

   Possible causes:

   - Uneven pavement surface
   - Nonaligned fabric placement
   - Damaged fabric rolls
   - Laydown equipment out of alignment

4. INCOMPLETE FABRIC SATURATION

   Possible causes:

   - Insufficient binder application rate
   - Insufficient overlay compaction
   - Insufficient overlay temperature

INSPECTION CHECK LIST

1. **SURFACE PREPARATION**
   - □ Existing pavement is free of dirt, water, oil and debris
   - □ Cracks greater than 1/8” are filled
   - □ Uneven or unstable areas repaired

2. **BINDER APPLICATION**
   - □ Check application rate, nozzle overlap, & total spray width

     Binder Application Rate Test:
   - □ Weigh test unit
   - □ Place test unit on pavement immediately prior to binder application
   - □ Remove coated test unit from pavement
   - □ Weigh test unit; deduct test unit weight and fabric weight (if applicable.)
   - □ Calculate binder rate. Compare to specified rate.

3. **FABRIC APPLICATION**
   - □ Fabric is placed smooth side up, fuzzy side down
   - □ Wrinkles are 1” or less, cross laps less than 2”, longitudinal laps 6”

4. **EMBEDMENT TEMPERATURE TEST**
   - □ Noncontact thermometer (180°F or less)

5. **FABRIC SATURATION**
   - □ Displace hot mix; expose fabric; confirm saturation

6. **COMPACTION**
   - □ Minimum compacted lift thickness (1 – 1½”)

FABRIC INTERLAYER GUIDE SPECIFICATION

The fabric for the Asphalt-Fabric Interlayer shall be a needlepunched, thermally bonded on one side, 100% polypropylene staple fiber fabric, which conforms to the following properties:

Tensile Strength, either direction, (lbs.), ASTM D-4632	101 minimum
Elongation at Break, either direction, (%), ASTM D-4632	50 minimum
Mullen Burst Strength, (PSI), ASTM D3786	180 minimum
Weight (oz/SY), ASTM D-3776	4.1 minimum (140 g/M^2)
Asphalt Retention by Fabric (GSY)^O ASTM D-6140	26.9 oz/SY residual minimum^O (914 g/M^2)

^{O}*Binder requirement increases as weight of fabric increases.*

The fabric shall have a demonstrated field performance of compatibility with recycling methods and construction survivability.

Prior to placing the fabric, the existing pavement to receive the fabric shall be cleaned to the satisfaction of the Engineer of all materials such as, but not limited to, vegetation, sand, dirt, gravel, and water.

Fabric shall not be placed under overlays of less than **1-½"** of ***compacted*** thickness in the **1**st lift.

Cracks between 1/4" and 1/2" shall be filled with hot pour rubberized crack filler or other crack filler as specified by the Engineer. Wider cracks are to be repaired with fine hot mix asphalt. (This is a separate bid item.)

Remove any existing asphalt that deflects under load. Repair by placing a suitable geotextile between the native soil and the new aggregate base prior to paving with the appropriate hot mix asphalt (This is a separate bid item.). Optimum Interlayer system installation includes exposing the new asphalt (leveling course or repairs) to traffic prior to the installation of the fabric interlayer. *NOTE: The Fabric Interlayer System should not be placed on new asphalt sections until the asphaltic concrete has either been exposed to traffic or sealed to prevent absorption of Interlayer tack coat.

Placement of the fabric shall be made only under the following conditions:

1. The ambient air temperature is above 50^{o}F and rising.
2. The pavement is dry and pavement temperature is 40^{o}F and rising.

The fabric shall be placed into the asphaltic binder with a minimum of wrinkles that lap. Large wrinkles (1" and larger) shall be slit and lapped in the direction of paving. Burning or torching of wrinkles will not be allowed. All fabric shall be broomed in order to maximize pavement contact and remove air bubbles. The width of liquid asphalt application will be the fabric width, plus four inches. The fabric shall overlap two to six inches at the longitudinal joints and no more than two inches at the transverse joints. No joints shall be lapped with more than two layers of fabric. Transverse joints shall be shingled in the direction of the paving.

Fabric shall not be embedded in the asphaltic binder until the in-place binder has cooled to 180°F or below as determined by non-contact thermometer.

The equipment for placing the fabric shall be mechanized and capable of handling full rolls of fabric. The equipment used to place the fabric is subject to approval by the Engineer.

Pavement fabric shall not be placed in areas of conform tapers where the compacted thickness of the overlying asphalt is less than 0.125 feet (40 mm). The tack rate is recommended to be increased .03 to .05 G/SY in all grind areas. Placement of fabric is recommended from edge of pavement to edge of pavement when proper tack rate and minimum asphalt overlay thickness are accomplished.

To enhance the bond of the fabric with the existing pavement and to smooth out any wrinkles and folds in the fabric, the Contractor may be required to pneumatically roll the fabric after it is placed. The Engineer will make the determination if this is necessary. (This is a recommended procedure, if an open-graded friction course or chip seal is to be placed over the fabric.)

Turning of the paving machine or of other vehicles on the fabric should be gradual and shall be kept to a minimum to avoid damage to the fabric. Should equipment tires stick to the fabric during pavement operations, small quantities of paving asphalt concrete shall be broadcast on the fabric to prevent pick-up. ***DO NOT*** ***decrease*** tack rate in order to minimize pick-up on tires.

The contract price per square yard for the Fabric Membrane Interlayer shall include full compensation for furnishing all labor and material. Asphalt tack coat will be a separate contract item.

ASPHALT TACK COAT

The surface area to receive the fabric shall be sprayed with paving asphalt to be used as a binder. The original asphalt shall have a minimum absolute viscosity of 2200 Poise at 140°F unless otherwise ordered by the Engineer. Higher original poise binder is recommended as ambient temperature increases Binder shall be applied at approximately 33.6 oz/SY, ±4 oz/SY (1.14 kg/m^2, ±0.14 kg/m^2) {~0.25 GSY, ±0.03 GSY.} The Engineer shall determine the exact rate. Rate to be verified AIA test method, scale tags and/or core samples**.** The Contractor's attention is directed to Section 92.104, "Applying Asphalt," of the State of California Standard Specifications. Good practice dictates that the asphalt binder be spread in the range of 290°F to 325°F.

Trucks shall be equipped with a calibrated measuring rod and external truck mounted gauge which shows gallons used from distributor truck. **Spot rate checks will be performed as per the *Fabric Interlayer Guide**.** Tack rate in gallons is calculated using asphalt cement weight of 238 gallons per ton.

The contract price per ton of asphalt tack coat shall include full compensation for spreading and delivery to jobsite per plans and specifications as directed by the Engineer.

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FABRIC & BINDER WEIGHT PER AREA CHART

Fabric Mass/Area and Corresponding Weight for 12" x 12" Swatches
(Fabric weight is given as an average; individual samples should be weighed.)

MASS/AREA	12" X 12"	30 CM X 30 CM
5.0 oz/SY	0.56 oz.	15.9 g
4.5 oz/SY	0.50 oz.	14.2 g
4.0 oz/SY	0.45 oz.	12.8 g
3.5 oz/SY	0.40 oz.	11.4 g

Binder Application Rate and Corresponding Weights for 12" x 12" Area at 70°F

APPLICATION RATE (GSY)	EQUIVALENT MASS (OZ.)	EQUIVALENT MASS (GRAM)
0.30	4.47	127
0.29	4.32	122
0.28	4.17	118
0.27	4.02	114
0.26	3.87	110
0.25	3.72	105
0.24	3.57	101
0.23	3.42	97
0.22	3.27	93
0.21	3.12	88
0.20	2.98	84
0.19	2.83	80
0.18	2.68	76
0.17	2.53	72
0.16	2.38	67
0.15	2.23	63
0.14	2.08	59
0.13	1.93	55
0.12	1.78	50
0.11	1.63	46
0.10	1.49	42

Note: Weight per gallon of the asphalt binder changes as the temperature changes. This chart reflects the various weights of asphalt binder (AR-4000) at 70°F.