# Thin Overlay Guidelines

*Project Selection, Design, and Construction*

Texas A&M Transportation Institute

Texas Department of Transportation

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by

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This guidebook is based on the publication *Austin District's Guidelines on the Use of Thin Surface Mixes (TSMs)*. The authors have permission to reuse the content. This publication expands the discussion to other types of thin overlays and incorporates findings from project 0-6742.

The successful use of thin overlays in the Austin District was in large part due to the support of Chuck Fuller, David Fuller, and Jimmy Whited of Ramming Paving, Inc. Their partnership and assistance in design and pilot implementation was invaluable. Angel Brothers and Durwood Greene also assisted in designing and constructing thin overlay projects for the Houston District. Field evaluations were assisted by Beata Kwater (Houston), Donald Bunch (Houston), Miles Garrison (Atlanta), and Brett Haggerty (San Antonio). Laboratory evaluations were assisted by Harry Bush (Vulcan), Rick Fuentes (Vulcan), Chris Haas (Old Castle), John Wedgeworth (Capitol Aggregates), and PaveTex Engineering and Testing, Inc.

# OVERVIEW

Thin hot mix asphalt (HMA) overlays are cost-effective, high-performance maintenance treatments. They can be laid at 1.0 to 0.5 inches thick and consist of quality aggregate and binder materials. The costs are generally more (per ton) than conventional overlay mixes; however, due to their thin application they cost less per square yard. The Austin District has realized a 30 percent savings per square yard over typical 2-inch-thick, conventional, dense-graded mixes.

*The Austin District has realized a 30 percent savings.*

There are three "flavors" of thin overlays, each having unique qualities and applications (TABLE 1). These have a small nominal maximum aggregate size between the #4 and 3/8 inch sieves, and have a minimum asphalt content of 6.0 or 6.5 percent. The most popular of these is the thin overlay mix (TOM), first developed in the TxDOT Austin District and now applied in many other districts throughout the state.

These mixes are flexible, crack resistant and rut resistant. Ride quality improvements are typically 25–35 percent better than the preexisting ride quality. Thin overlays have been documented to reduce noise levels by up to 10 dB from preexisting noise conditions, which equates to about half the perceived noise level. The TOM, SMA-F, and PFC-F have a coarse surface texture as shown in FIGURE 1, which contributes to high skid resistance. Data from the Austin District show that the use of TOMs realized a 30 percent savings over typical 2-inch, conventional, dense-graded mixes.


**FIGURE 1 – Coarse Surface Texture of TOM.**

**TABLE 1 – Types of Thin HMA Overlays.**

| Mix Types | Key Benefits |
|---|---|
| **Dense-Graded** | |
| • Ultra-thin (UT) mix (Item 347)<br>• Crack attenuating mix (CAM) (Special Specification [SS] 3262) | • Resists cracking<br>• Improves ride<br>• Minimizes in-vehicle noise |
| **Gap-Graded** | |
| • Thin overlay mix (TOM) (Item 347)<br>• Stone-matrix asphalt Type F (SMA-F) (Item 3262) | • Improves skid resistance<br>• Improves ride<br>• Resists rutting<br>• Resists cracking |
| **Open-Graded** | |
| • Permeable friction course Type F (PFC-F) (SS 3269) | • Improves skid resistance<br>• Improves ride<br>• Minimizes splash and spray<br>• Reduces ambient traffic noise |

# CANDIDATE PROJECTS

**What to Look For and Avoid**

## General Applications

Thin HMA overlays should only be used on structurally sound pavements requiring only restoration of the surface wearing course. Pavements needing extensive rehabilitation or requiring structural improvement should be avoided. As when applying conventional overlays, the district should perform any spot base repair, level-up, and crack sealing in isolated areas prior to placing thin overlays.

Thin overlays have been successful in overlaying pavements with fairly wide top-down cracks or shallow rutting. Roadways with distress associated with aging, such as block cracking, longitudinal cracking in the wheel path, shallow rutting, raveling, oxidation, and polishing (loss of skid), are all good candidates for thin overlays—and in many cases, without the need for milling. Historically, conventional mixtures like dense-graded (Item 341, Type C and D mixtures) have been used in a mill, seal, and inlay scenario to address these types of preventive maintenance situations. However, often these types of mixtures do not provide the long-term desired skid or cracking resistance, resulting in a very short life of the overlay. Thin overlays have been a good alternative given their good friction performance and long-term cracking resistance. In many cases, the need for milling and underseals can be eliminated.

Thin overlays have been used successfully on high-volume trafficked roadways. FIGURE 2 shows one of the first TOMs placed by the Austin District on IH 35 near Georgetown. The traffic volume for this section of roadway is greater than 80,000 average daily traffic with over 10 percent trucks. After 5 years, the mix is still performing well.

**FIGURE 2 – TOM on IH 35 Under Construction – Placed in 2009 and Still Performing Excellently.**

TABLE 2 gives general guidance on when and when *not* to use thin overlays. Detailed application scenarios for each mix type follow.

## Applications for TOM and SMA-F

Some applications where a TOM or SMA-F is a good alternative to a 1.5- to 2-inch dense-graded mix include the following:

- Roadways requiring high friction resistance, (high traffic volume, moderate to high posted speeds, and other roadway features that contribute to crashes, especially wet-weather crashes).
- Roadways requiring a tough, durable mix to resist shear forces. This includes areas with turning, stopping, and acceleration movements, such as intersections or ramps.
- Low- to moderate-volume FM/RM roads that have high deflections. Conventional dense-graded overlays tend to crack prematurely. More flexible, crack-resistant mixes should provide a longer service life.
- Any roadway where a crack-resistant overlay is required due to excessive cracking. TOMs with a good underseal provide an effective crack-resistant surface.

*TOMs are recommended when a crack-resistant overlay is required.*

This mix should not be placed directly on a flushed pavement.

**TABLE 2 – General Guidance on Candidate Pavements.**

| When to Use Thin Overlays | When NOT to Use Thin Overlays |
|---|---|
| **Roadway applications** | |
| • Where maintaining the existing grade is important (curb and gutter, bridge underpasses, guardrail height clearances, etc.).<br>• On roads that perform well with surface treatments, but—due to noise concerns or ride quality—are not good candidates for an additional seal coat.<br>• On low-volume roadways that need an overlay, but have shoulders in good condition that do not need the overlay. (Avoid problems with shoulder drop-off.)<br>• As the final surface in new pavement construction to minimize future maintenance costs.<br>• On concrete pavements/bridge decks, provided it is well bonded to the concrete via asphalt rubber seal or non-tracking tack coat. | • On pavements where the existing surface has high air voids (permeable friction courses [PFCs] and, in some cases, coarse matrix high binder [CMHB]). These should be milled first.<br>• On pavements judged to be structurally deficient (in continuous need of patching, FIGURE 3d).<br>• Directly on top of granular base (should apply surface treatment first).<br>• On excessively rough pavements (unless a level-up is placed first).<br>• Where cross-slope correction is required (unless a level-up is placed first). |
| **Visual distress** | |
| • Shallow rutting ≤ 0.5 inch.<br>• Top-down cracking.<br>• Block cracking (FIGURE 3a).<br>• Less than 20 percent moderate fatigue cracking (assuming spot repair prior to overlay).<br>• Longitudinal cracking in the wheel path (FIGURE 3b).<br>• Overlaying notch-and-widen sections.<br>• Transverse cracking (used in conjunction with an underseal).<br>• Raveling (FIGURE 3c).<br>• Highly oxidized.<br>• Polished surface (loss of skid). | • Widespread deep rutting > 0.5 inch deep.<br>• Surface cracks wider than 3/8 inch.<br>• Areas of extensive, deep (> 4 inches) patching (> 20 percent; this assumes the pavement is structurally inadequate).<br>• Moderate to severe alligator cracking (more than 20 percent by area of the section).<br>• Areas where layer debonding or subsurface stripping is suspected (needs ground-penetrating radar and coring survey to verify).<br>• Pavements with more than two failures per mile (as shown in FIGURE 3e and 3f). |
| **Structural condition** | |
| • *Flexible Pavement Design System* (FPS) 21 analysis predicts an overlay of 2 inches or less.<br>• Structural Condition Index (SCI) greater than 0.7 (SCI = existing structural capacity/required structural capacity; reference TxDOT Research Project 0-4322). | • FPS 21 analysis requires an overlay of more than 2 inches.<br>• SCI less than 0.7. |


**FIGURE 3 – Good and Bad Candidates for Thin Overlays.**

## Applications for UT Mix

Texas has many miles of low-volume roadways where the only preventive maintenance treatment over the years has been regular applications of seal coats. Multiple seal coats can sometime lead to surface stability problems. The newly developed UT mix offers TxDOT an economic alternative for areas where repeat seal coats are not the optimal treatment.

The low cost and thinness of the UT mix are expected to make it a very valuable alternative for TxDOT's maintenance forces for a range of applications:

- Sections with multiple seal coats that have become unstable. These must be milled off and a thin overlay placed (FIGURE 4).
- Rural and low-volume sections with skid problems.
- On low-volume roadways as an economical replacement for chip seals or when substantial variations in texture exist, or where minor rutting is present (FIGURE 5).

This mix should not be placed directly on a flushed pavement.

## Applications for PFC-F Mixes

Of the thin overlays, the PFC-F mix provides the best macrotexture. The open-graded structure allows for better drainage, reduction in splash and spray, visibility of pavement markings, and reduction of tire-pavement noise. Some good applications are:

- Roadways requiring high friction resistance, (high traffic volume, moderate to high posted speeds, and other roadway features that contribute to crashes, especially wet-weather crashes).
- Roadways with flushed surface treatments and other asphalt-rich surfaces (FIGURE 6).
- Urban roadways through noise-sensitive areas.

This mix is not recommended for use under high shear areas from turning, stopping, and accelerating, such as intersections and side accesses. The mix has a shorter life expectancy than the more durable TOM and SMA-F.

**FIGURE 4 – Surface Stability Problems due to Multiple Chip Seals (Must Be Milled Prior to Placement of Thin Overlay).**

**FIGURE 5 – Surfaces Exhibiting Minor Rutting Are Acceptable.**

**FIGURE 6 – PFC-F Can Be Placed over This Flushed Seal Coat.**

# MATERIALS AND DESIGN

## Making a Quality Mix

The following are the critical material properties and considerations when designing thin overlays. By definition, these mixes are flexible, durable, and resistant to rutting and cracking. Compromising any of the material properties or mix design requirements will cause the mix to fall short of the expected performance.

*Compromising any of the material properties or mix design requirements will cause the mix to fall short of the expected performance.*

### High-Quality Aggregate

TABLE 3 shows the gradation requirements.

To withstand high levels of stress within a thin section of material, the aggregate used in thin overlays must be hard and durable. A $MgSO_4$ soundness loss of 20 or less is proposed in Item 347. This is comparable to the soundness requirements for other rock-to-rock contact mixes, such as stone mastic asphalt or PFC. Use Surface Aggregate Classification (SAC) A aggregate for high-volume roadways and/or roadways requiring a high level of surface friction to address the potential for wet-weather crashes. Recent research has shown that mixes can be produced with a SAC B aggregate and still meet performance test requirements, as long as the maximum soundness loss of 20 is not exceeded; of course, the lower the soundness loss the better. In addition, SAC B aggregate with a soundness of 10 or less has been documented to maintain similar skid resistance as SAC A aggregate. For non-critical sections, SAC B aggregate with greater soundness loss may still be blended up to 25 percent with SAC A.

Recycled asphalt pavement and shingles (RAP and RAS) are not permitted in any of the thin overlays. These products would make the overall asphalt mix too stiff and prone to cracking, especially with thinner lift applications. The goal is to produce a flexible surface course.

*RAP and RAS are not permitted in any of the thin overlays.*

### Binder Grade

Polymer-modified asphalt (such as PG 70 or 76) is critical to provide the elasticity to resist cracking and the stiffness to resist rutting. In all cases, the binder MUST be polymer modified. PG 76-22 is the preferred binder type for high-volume roadways or roadways with significant amounts of truck traffic, especially with high summer temperatures. When specifying PG 70-22, sample and test the binder to assure the elasticity recovery is met because some PG 70-22 asphalt can be obtained with little to no polymer modification. The CAM, SMA-F and PFC-F require PG 76.

### Asphalt Content

#### *Minimum Asphalt Content*

Most of the thin overlay designs placed around the state thus far have optimum design asphalt contents ranging from 6.2 to 6.8 percent for TOMs and 6.8 to 7.4 percent for UT mixes. Currently,

**TABLE 3 – Mix Gradations.**

| Sieve Size | Dense-Graded | | Gap-Graded | | Open-Graded |
|---|---|---|---|---|---|
| | UT Mix | CAM | TOM | SMA-F | PFC-F |
| 1/2 inch | 100 | 100 | 100 | 100 | 100 |
| 3/8 inch | 98–100 | 95–100 | 95–100 | 70–100 | 95–100 |
| #4 | 70–95 | 70–90 | 40–60 | 30–60 | 20–55 |
| #8 | 40–65 | 40–65 | 17–27 | 20–40 | 0–15 |
| #16 | 20–45 | 20–45 | 5–27 | 10–30 | 0–12 |
| #30 | 10–35 | 10–30 | 5–27 | 10–30 | 0–8 |
| #50 | 10–20 | 10–20 | 5–27 | 5–20 | 0–8 |
| #200 | 2–12 | 2–10 | 5–9 | 2–10 | 0–4 |

Item 347 and other cited special specifications require a minimum asphalt content of 6.0 percent for TOMs, CAMs, SMA-Fs, and PFC-S, and 6.5 percent for UT mixes. The specification also calls for paying for the binder as a separate bid item to further guarantee achievement of the target asphalt cement (AC) content, and the operational tolerance does not allow the contractor to produce the mix below the minimum AC requirement.

### *Gyratory Compactors*

Most thin overlay mixes are tough and harsh, requiring top-quality angular materials. The Superpave gyratory compactor (SGC) does not have the angle/energy to adequately compact this type of material. Compacting these mixes in the SGC often requires the addition of rounded field sands and dirty screenings, but these materials often have a detrimental impact on performance tests. The Texas gyratory compactor (TGC) is able to compact the material and can establish adequate binder content. Using a TGC is required for TOMs and UT mixes. The SMA-F and CAM *may* be designed with the SGC if desired, but the contractor is likely to run into the same problems.

The PFC-F should be designed with the SGC.

### *Operational Tolerances*

The TOMs are typically designed with a laboratory-molded density requirement of 97.5 percent. However, in testing the trial batch, the laboratory-molded densities often exceed the specified operational tolerances of ±1 percent, often exceeding 98.5 percent. Under normal operations, this would cause the designer to reduce the design asphalt content. This can be done provided that the performance test requirements or the minimum asphalt content is not violated. Several TOMs and UT mixes have been placed with laboratory-molded densities on the trial batch at close to 99 percent with no reported performance problems. The TOMs are gap-graded mixes and are very stable under loading. The UT mixes when placed very thin tend to cool very quickly; therefore, the likelihood of over-densification is minimal. This issue will continue to be evaluated.

## Performance Test Requirements

To ensure high performance, thin overlays must pass stringent performance tests. This includes passing the Hamburg wheel tracking test for the PG grade of the binder used for rut resistance (FIGURE 7) and lasting more than 300 cycles in the Texas overlay tester for cracking resistance for design purposes (FIGURE 8). The CAM should last 750 overlay cycles. The PFC-F mixes are specified to pass only 10,000 cycles in the Hamburg test, but this requirement is still under consideration.

*Thin overlays must pass stringent performance tests.*

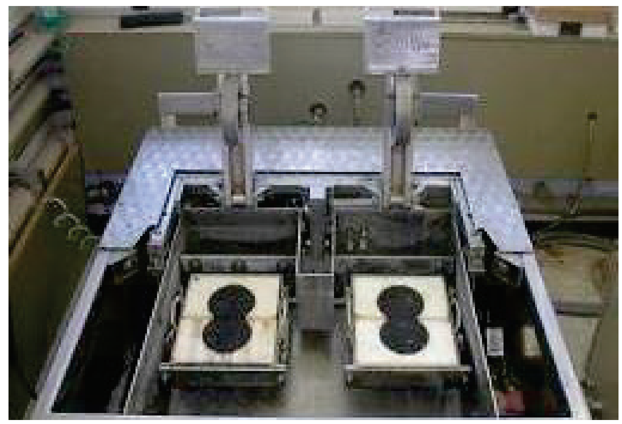

**FIGURE 7 – Hamburg Wheel Tracking Test.**

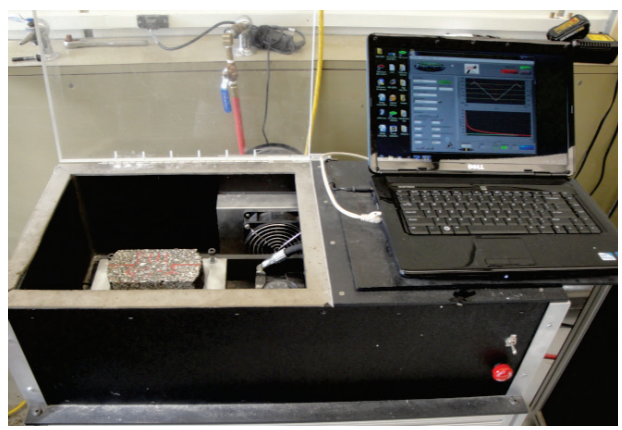

**FIGURE 8 – Texas Overlay Tester.**

## Example Designs

Many of the thin overlays placed in Texas at this time have used the locally available sandstone from Central Texas. Typical results are shown in TABLE 4. However, many other high-quality aggregates could be used to make these high-performance mixes. TABLE 4 shows laboratory mix designs incorporating a variety of different aggregates along with the resulting performance test data.

**TABLE 4 – TOM Laboratory Mixture Designs Using Different Aggregate Sources.**

| District | Aggregate | Coarse SAC | Scrn. SAC | Binder Grade | Percent Binder | HWTT mm @ 20k[1] | Overlay Cycles |
|---|---|---|---|---|---|---|---|
| **TOM** | | | | | | | |
| Austin | Sandstone | A | B | 76-22 | 6.7 | 6.4 | 1000+ |
| Austin | Dolomite | A | B | 70-22 | 6.5 | 8.8 | 980 |
| Austin | Sandstone | A | B | 70-22 | 7.0 | 8.4 | 905 |
| San Antonio | Trap-Rock | A | B | 76-22 | 6.2 | 6.3 | 1000+ |
| Tyler | Granite | A/B | B | 76-22 | 6.4 | 2.3 | 677 |
| El Paso | Igneous | A/B | B | 76-22 | 6.5 | 5.1 | 682 |
| Houston | Granite | A | B | 76-22 | 6.7 | 3.9 | 1000+ |
| Houston | Quartzite | A | B | 76-22 | 6.7 | 5.4 | 1000+ |
| Houston | Limestone | B | B | 70-22 | 6.7 | 5.4 | 1000+ |
| **UT Mix** | | | | | | | |
| Austin | Sandstone | A | A | 76-22 | 7.3 | 5.8 | 750 |
| Atlanta | Gravel | A | A | 76-22 | 6.8 | 3.9 | 849 |
| Brownwood | Limestone | B | B | 76-22 | 7.3 | 9 | 735 |
| Brownwood | Limestone | B | B | 76-22 | 6.5 | 7.4 | 667 |
| **SMA-F** | | | | | | | |
| Atlanta | Quartzite | A | A | 70-22 | 6.4 | 6.9 | 1000+ |
| Bryan | Sandstone | A/B | B | 76-22 | 6.7 | 3.8 | 300 |
| **CAM** | | | | | | | |
| Odessa | Gravel | A | B | 76-22 | 8.8 | 9 | 1000+ |
| Odessa | Limestone | B | B | 76-22 | 8.1 | 10.5 | 700 |
| **PFC-F** | | | | | | | |
| Lufkin | Sandstone | A | | 76-22 | 6.5 | NA | 462 |
| Brownwood | Limestone | B/B | | 76-22 | 6.5 | 7.8 | 395 |

1 – 10,000 cycles for PFC-F designs NA – Not available

# CONSTRUCTION

## Tips for Success

The following are some key factors that contribute to the successful construction of thin overlays.

### Preparing and Repairing

It is critical to perform spot repair in localized areas with significant distress. Mill and fill areas with fatigue cracking, failures, or shallow rutted areas. If there are a number of areas requiring deep full-depth repair, the pavement structure may not be sound, and a thin overlay may not be appropriate in such a case.

### Level-Up

Thin overlays usually provide a 25 to 30 percent decrease in roughness as measured by the international roughness index (IRI.) However, if the section has a roughness greater than 120 inch/mile, a level-up layer will be required.

### Milling

Milling is recommended when the existing pavement exhibits the following conditions.

- A highly oxidized, stiff pavement surface that is prone to further distress if left under an overlay.
- A need for cross-slope corrections.
- Minor to moderate ride issues that need to be corrected, requiring profile milling.

- Extensive thermal cracking or top-down cracking greater than 40 percent by area.
- Extensive recent crack seals on the existing pavement.

If milling is required, micro-milling is recommended to create a finer finish with small peak-to-valley depths to prevent compaction and ride issues.

## Bonding

This is the most critical issue with thin overlays. If a thin overlay has a poor bond to the existing roadway, it will fail quickly. If it is to be placed directly over an existing HMA surface, then it is recommended that a bonding course, such as non-tracking tack or a spray-applied underseal membrane, be used to bond the overlay. A spray-paver may be used. As shown in FIGURE 9, commonly used conventional tack materials pick up excessively in the wheel paths, especially under heavy loads such as materials transfer device.

*Bonding is the most critical construction issue with thin overlays.*

**FIGURE 9 – Poor Performance of Conventional Tack Coat Material under Heavy Loads.**

There are several good tack coat products that have entered the market, and TxDOT is preparing specifications for these non-tracking materials, which "track" less than conventional tack coats. The Construction Division can provide guidance in this area. Low application rates about 0.03 to 0.06 gals/yd$^2$ are recommended. A tensile or shear bond strength test can be conducted on field cores to measure the effectiveness of the tack coat. The pull-off tester (tension) and shearing apparatus are shown in FIGURE 10 and FIGURE 11.

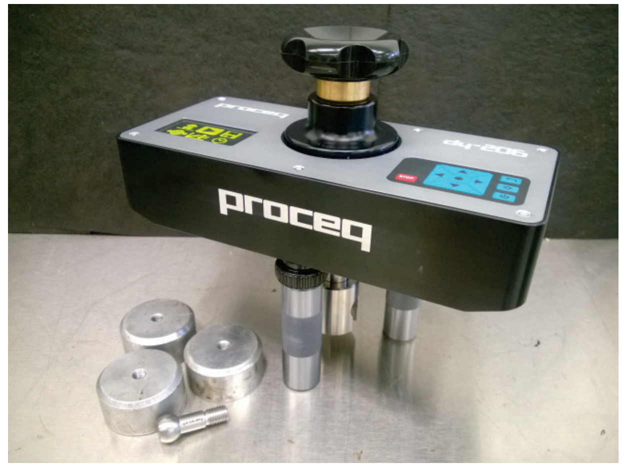


**FIGURE 10 – Pull-Off Bond Strength Tester.**

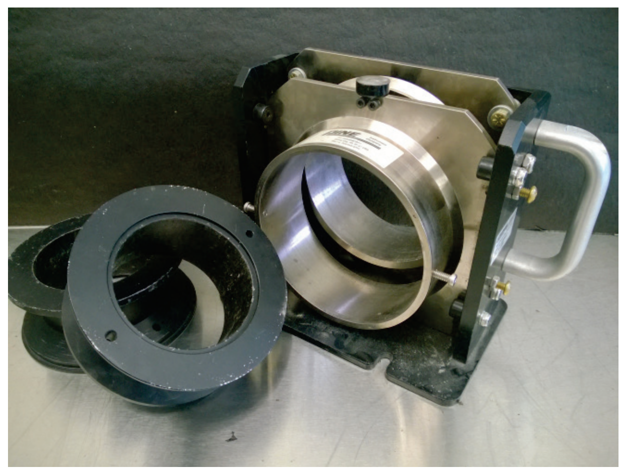

**FIGURE 11 – Interlayer Shear Strength Apparatus.**

It is also essential that the tack coat be applied in a uniform manner. This uniformity can be verified using ASTM E2995 *Estimating the Application Rate of Bituminous Distributors*. In this procedure, pre-weighed calibration pads are placed transversely on the roadway in front of the distributor. The distributor then drives over the pads, spraying asphalt (FIGURE 12). The calibration pads are removed from the roadway and re-weighed.

**FIGURE 12 – Measuring Tack Rate and Uniformity.**

## Underseals

A seal coat is often placed underneath the overlay to address two issues: bonding and waterproofing. Since thin overlays have such high asphalt contents, the mix has good sealing characteristics, which lessen the need for underseals. Underseals under thin surface mixtures should only be used when:

- There are significant unsealed cracks in the existing roadway.
- Milling will expose underlying cracking.
- Voids from distress such as stripping will be exposed after milling.
- The overlay will be placed on newly widened pavement sections. (Place underseal over everything to seal construction joints.)
- There are inadequate funds or opportunity to seal or repair pavement distresses.

If it is determined that an underseal is required, the following material selection, rates, and construction have been used with success:

- TIER I or II underseals have been used with success. Polymer-modified binder, whether asphalts or emulsions, should be used. TIER I underseals have been used for high-volume roadways to ensure no damage to the underseal in case traffic is allowed prior to overlay. Do **not** use TIER III underseals. Soft binders specified under TIER III binder options have a history of bleeding through thin overlays. This bleeding occurs especially at the start and end of distributor runs. With the high concentration of asphalt at the interface, this has led to isolated shear failures, like shoving or rutting.
- Grade 5 aggregate is recommended. In some cases, Grade 4 aggregate may be too coarse, and there is the possibility of the aggregate penetrating through the surface.
- Given the importance of bonding, lighter aggregate rates, such as 1 CY/300 SY, have been used to increase the exposure of the asphalt and promote adhesion. In addition, over-applying aggregate can cause delamination of the overlay due to a lack of bonding.
- All underseals must be engineered to the materials available and the road conditions.
- Proper seal coat or underseal practices, such as sweeping and vacuuming the surface before applying the underseal, are critical to assure proper bonding and prevent delamination.

## Mixture Placement

**Warm Mix Additives** are recommended as a compaction aide if the haul distance is greater than 40 miles. The ambient air temperature is recommended to be greater than 70°F for placement, but this can be reduced to 60°F if warm-mix asphalt (WMA) additive is used. No reduction in plant production temperatures is proposed. Thin overlays should always be produced with a production temperature greater than 300°F.

*Ambient temperatures should be greater than 70°F.*

If absolutely necessary to pave at temperatures below 70°F, then the use of the **Pave IR System** is highly recommended to monitor temperature uniformity. The contractor should also ensure there is adequate trucking to minimize pavement stops.

**Material Transfer Vehicles (MTVs)**, such as shuttle buggies, are highly recommended. Given the cooling rate of thin overlays, MTVs help maintain optimal compaction temperature and uniformity of thin overlay mixtures during placement. MTVs also help minimize the effects of thermal segregation, which can lead to low density and moisture infiltration.

## Management of Windrows

As with all other applications, it is important to eliminate "chunks" of hot mix that are often seen at the end of windrows. The contractor should have dedicated personnel to remove these chunks or cold clods. The chunks that form at the top of the haul truck bed occur more often during night jobs or when weather is cool. Experience has shown that they do not remix, especially for these thin lifts. These areas in the final mat often lead to localized pop-outs.

Delivery trucks that can supply the material in windrows are recommended so that cold chunks can be easily seen and removed.

## Compaction

TOM, SMA-F, and some UT mixes are tough to compact. Pneumatic-tired rollers are not permitted because of excessive pick-up. The use of dual steel wheel rollers working in tandem is recommended (FIGURE 13) and should be mandatory when operating at ambient temperatures below 70°F. It is the contractor's job to select the best rolling pattern. A pattern that has worked well in the Austin District for the TOMs is three passes where each pass consists of one vibratory pass (low amplitude) followed by one static back. It is recommended to minimize the amount of vibratory compaction to lessen the risk of washboarding. Having the rollers close to the paver for the initial pass is essential. Avoid over-compaction of the TOMs, especially those incorporating WMA as a compaction aide. The completed TOM should have a coarse surface texture as shown in Figure 1.

**FIGURE 13 – Dual Steel Wheel Rollers Working in Tandem for Compaction.**

For the UT mix and CAM, the Austin District has found that static compaction is adequate, typically between four and five passes.

For the PFC-F, one to three static roller passes is adequate to seat the aggregate and achieve stone-on-stone contact.

These high-asphalt content mixes tend to be very sticky and it is important that the rollers have adequate release agent.

## Acceptance in the Field

Measuring field density on these thin lifts is not possible with conventional methods (bulk core voids and nuclear density gage), and measuring mat thickness and yield is insufficient to assess the final density.

The TxDOT water flow test (Tex-246-F) (FIGURE 14) is recommended for density acceptance and for adjusting rolling patterns. For TOM and SMA-F projects, the water flow should be greater than 150 seconds (impermeable). To guard against over-compaction (loss of macrotexture) the flow time should be less than 6 minutes for high-speed/critical sections and less than 10 minutes for lower-speed/non-critical sections. For UT mixes, the water flow should be greater than 300 seconds (impermeable) with no upper limit. Water flow for PFC-F mixes should be less than 20 seconds (permeable).

For dense and gap-graded thin overlays, thermal profiles are critical to identify segregation, which may lead to low density, permeability, and water infiltration. MTVs can help minimize the potential for thermal segregation. When moderate or severe thermal segregation is identified, perform water flow testing to verify adequate density and impermeability in these affected areas.

**FIGURE 14 – The TxDOT Water Flow Test.**

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