TechBrief

The Asphalt Pavement Technology Program is an integrated, national effort to improve the long-term performance and cost effectiveness of asphalt pavements. Managed by the Federal Highway Administration through partnerships with state highway agencies, industry and academia, the program's primary goals are to reduce congestion, improve safety, and foster technology innovation. The program was established to develop and implement guidelines, methods, procedures and other tools for use in asphalt pavement materials selection, mixture design, testing, construction and quality control.

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The Use of Thin Asphalt Overlays for Pavement Preservation

This Technical Brief provides an overview of thin asphalt overlays placed as a pavement preservation treatment. This document defines thin asphalt overlays as dense graded mixtures placed less than 1½ inches in thickness. Gap-graded and open-graded mixtures may be specifically designed for thin placement but they are considered specialty mixtures and are not discussed in this document. Thin asphalt overlays placed for pavement preservation are functional overlays to extend the service life of the pavement and are not intended to add structural capacity. The key benefits of a thin asphalt overlay are improved ride, corrected rutting, impermeability, and reduced noise. Project selection, mix design criteria, construction considerations and expected performance are presented. Since some aspects of the technology are still evolving; best practices and areas of caution are included.

1. Introduction

A thin asphalt overlay, the top layer shown in Figure 1, is a dense graded, small nominal maximum aggregate size (NMAS) asphalt mixture placed at a thickness of less than 1½ inches using conventional asphalt production and placement operations. This definition distinguishes thin asphalt overlays as being constructed with dense-graded mixtures with the nominal maximum aggregate size (NMAS) of less than ½", and excludes other specialty asphalt mixtures occasionally used as thin overlays, such as open-graded friction course (OGFC), stone matrix asphalt (SMA), and ultra-thin bonded wearing course (UTBWC). Dense-graded mixtures utilized for thin lift overlays are often called No. 4 or ⅜-inch (4.75 mm or 9.5 mm) mixtures and the designations 4.75 mm and 9.5 mm mixtures will be used throughout this guide.

Highway agencies and asphalt industry groups have different terminology for thin asphalt overlays and may use some form of the term "thin asphalt" for all the mixtures identified above [Watson 2014]. Thinlay™ is a term coined by the National Asphalt Pavement Association (NAPA) for plant-produced and paver-placed asphalt mixtures designed for pavement preservation. A Thinlay further defines minimum lift thickness as ⅝ inch, but does not include a maximum lift thickness [Heitzman, et al. 2018; NAPA 2014]. Thinlays include 4.75 mm and 9.5 mm NMAS asphalt mixtures used in thin overlays, as defined above.

What Is Pavement Preservation

A Federal Highway Administration (FHWA) February 2016 memorandum [Waidelich 2016] retained the general definition for pavement preservation established in a September 2005 FHWA memorandum. [Geiger 2005]. Key phrases in the 2016 memorandum define highway preservation as "a vital component of achieving and sustaining a desired state of good repair…" and "…generally do not add capacity or structural value, but do restore the overall condition…" U.S. Code Title 23 Section 116 defines pavement preservation as "programs and activities employing a network level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety and meet road user expectations." The goal of a committed pavement preservation program is to keep good pavements in good condition, i.e., mitigate deterioration of a pavement network.

Figure 1. Picture of a thin asphalt overlay.

What Is a Pavement Preservation Treatment (PPT)?

There are a variety of thin surface treatments categorized as components of a pavement preservation program. Traditional PPTs include fog seals, sand seals, slurry seals, scrub seals, chip seals, micro-surfacing, combinations of seals, thin dense-graded asphalt mixtures, and special asphalt surface mixtures. PPTs that are called seals (including micro-surfacing) require emulsion distributors, chip spreaders, and slurry-mix trucks. Thin overlays using dense-graded asphalt mixtures and most special asphalt surface mixtures are placed using conventional asphalt mixture production and paving equipment. Each type of treatment can be a cost-effective PPT when placed at the proper time and for the proper reasons.

2. Benefits and Limitations

Previous studies on thin asphalt overlays present benefits and limitations specific to the data collected for each study's particular scope and objectives [Chou 2008; Bennert 2005; Rahman 2011; Irfan 2009]. Collectively, studies show benefits of thin asphalt overlays vary with condition of the pavement, level of traffic, and climate conditions. The quality of thin overlay materials and construction also impact performance. Some studies reported relatively low performance periods, but a deeper examination of the data reveals that one agency was using thin asphalt overlays to treat pavements with moderate to severe distress [Watson 2014]. Some reports more distinctly defined a thin asphalt overlay, while others combined results from multiple types of asphalt surfaces. In addition, reported data is impacted by thin asphalt overlay PPT availability in a region, supply and demand, and industry experience.

For this technical guide, experienced agencies from four regions of the U.S. were interviewed to obtain information specifically on thin asphalt overlays used as a PPT as defined by this guide. Results of those interviews are presented in Table 1. The experience of another agency may vary from those documented below for a number of reasons.

Table 1. Common applications for thin asphalt overlays as a pavement preservation treatment.

Desired Outcome	Northeast		Southeast		Southwest	Northwest	
	NJ	ME	TN	MS	TX	OR	ID
Improve Ride	Y	Y	N	Y	N	N	Y
Correct Rutting	Y	Y	Y	N	N	Y*	Y*
Reduce Surface Aging	Y	Y	Y	Y	Y	N	Y
Seal/Fill Cracks	N	Y	Y	N	N	Y	Y
Improve Friction	N	N	N	N	Y	N	Y
Stop-Gap Temporary Surface	N	Y	N	Y	N	N	N
NJ — relatively new program (performance anticipated), formal pavement management selection process, 4.75 mm NMAS mixture placed 1-inch thick, PG 76−22, typical mill/fill to correct minor rutting, placed on high speed routes, competing with micro-surfacing and UTBWC							
ME — active pavement preservation program, formal pavement management selection process using 4 triggers, 9.5-mm NMAS mixture placed ¾-inch thick							
TN — active program for 8 years, formal pavement management selection program, placed on low and moderate volume routes, 4.75-mm NMAS mixture placed ⅝-inch thick on low distress and 9.5-mm NMAS mixture placed ¾-inch thick on moderate distress, PG 64 binder							
MS — active pavement preservation program, formal pavement management selection program, 9.5-mm NMAS mixture placed 1-inch thick started three years ago (performance anticipated), placed on low volume routes, competing with UTBWC							
TX — active use over last 4 years (performance anticipated), formal pavement management program, 4.75-mm NMAS mixture placed ½- to ¾-inch thick, must use friction aggregate, placed on all route types, competing with UTBWC							
OR — relatively new program (performance anticipated), 9.5-mm NMAS mixture placed 1-inch thick, placed on all high-speed routes, used for studded tire wear* and top-down cracking, addresses low and moderate severity distress typically late pavement preservation or early rehabilitation							
ID — active program over last 5 years (performance anticipated), formal pavement management selection process, 9.5-mm NMAS mixture placed 1- to 1½-inch thick, placed on high volume routes, used for studded tire wear,* competing with chip-seals							

*rutting caused by surface abrasion from studded tires

Benefits

The life-extending benefits of placing a thin asphalt overlay PPT are discussed in the following bullets. These benefits are based on a condition-appropriate decision to place a PPT [Wiser 2011].

- **Improve surface smoothness to achieve a better ride.** Both the traveling public and highway agencies recognize the value of a better ride. Placing a thin asphalt overlay with quality workmanship improves ride, but the level of improvement depends on the pre-treatment condition. [Newcomb 2009]
- **Reduce wheel path rutting to improve safety.** A thin asphalt overlay effectively corrects

rutting if the existing pavement rut depth is less than ¼ inches. [Watson 2014]

- **Reduce water intrusion to maintain pavement structure.** Thin asphalt mixtures are impermeable (hydraulic conductivity less than 125×10^{-5} cm/sec) when placed with compacted voids less than 10% [West 2011]. This effectively seals all minor and moderate surface cracks. Keeping water out of a pavement prevents loss of structural capacity due to moisture damage, which is needed to support traffic and minimizes fatigue damage. Larger working cracks, such as low temperature transverse cracks, reflect through a thin asphalt overlay relatively soon after placement and require sealing.
- **Restart surface aging process and slow asphalt binder property changes in the existing asphalt pavement.** When the thin overlay is placed early in the life of an existing pavement, aging of the existing surface is limited to the top ½ inch where exposure to heat and oxidation is extreme [Anderson 2014]. The thin asphalt overlay will slow aging distress in the existing surface, but will not provide rejuvenation of existing mixture.
- **Decrease pavement surface noise.** A new thin asphalt surface has low surface macro-texture. Low macro-texture reduces the level of noise generated at the tire–pavement surface interface. [Staiano 2015]

Thin asphalt overlays are placed with conventional production, placement, and compaction equipment and procedures. Using conventional paving practices allows an owner to consider the less tangible features like the level of experience and contractor availability when contracting PPT. Optimizing the benefits of a thin asphalt overlay PPT relies on placing the right mixture, for the right reasons, at the right time.

Determining the cost to place a thin asphalt overlay is straightforward; however, the benefits of thin asphalt overlay as a PPT are best quantified in terms of the time to next preservation or rehabilitation action (service life extension) [Watson 2014]. A simple cost–benefit example is given in Figure 2. The estimated cost of the thin overlay project is divided by the number of lane-miles and further divided by the anticipated years of service life extension to establish a cost-effective value based on dollars per unit lane-mile and years of service life extension.

Estimated Thin Overlay Cost	$500,000	dollars
Project Length	÷ 16	lane-miles
Anticipated Service Life Extension	÷ 9	years
Computed Cost-Effectiveness	= $3,472	dollars per lane-mile per year extension

Figure 2. Example of determining simple cost–benefit.

Selecting one or more life-extending benefits described above is a better evaluation of the service life value of a thin asphalt overlay, but is more difficult to quantify. Placing a value on the benefit includes both added years of service of that benefit and level of service provided by that benefit. As an example, a thin asphalt overlay and chip seal both extend pavement service life, but the level of service, as defined by smoothness and texture of these two PPTs, are different. A thin asphalt overlay will improve smoothness more than a chip seal and the small macrotexture of the thin asphalt overlay surface will generate less tire–pavement interface noise than the chip seal. These benefits are a part of the value of using a thin asphalt overlay.

Most agencies are still collecting data to better define the service life extension of PPTs to determine a simple cost-effectiveness. Agencies that examine data that measures both the years of service as well as the level of service benefit are in a position to make better PPT decisions. Research is developing analysis procedures to quantify and compare service value benefits, which agencies can use to improve the cost–benefit ratio.

Limitations

The limitation(s) of thin asphalt overlays are common among all PPTs and is the dependence on the existing pavement needing to be in good to fair condition to be a candidate for the treatment. Pavements that have experienced further deterioration or that have distresses that extend into structural failures are not candidates for any PPTs. This limits the plausible uses for thin asphalt overlay as PPTs, and if agencies choose to use the treatment in cases of severe distress, they can expect poor performance of the treatment relative to normal service life extension expectations.

3. When to Apply

After a pavement is initially constructed or reconstructed, it evolves through three phases of performance as shown in Figure 3. In the first phase, it maintains good performance and exhibits minor or no distress. In the second phase, a pavement exhibits moderate levels of distress and is classified as a fair pavement. Finally, a pavement is deemed a poor performer as distresses become increasingly severe. The optimum time to apply a thin asphalt overlay PPT is when the existing pavement is nearing the end of good performance [Peshkin 2004]. The optimal timing can be identified when the existing pavement exhibits the following characteristics:

- **Low cracking distress** — minimal, low severity, non-load related cracking
- **Low rutting distress** — minor compaction of surface mixture predominantly associated with post-construction traffic loading, not due to instability of the asphalt mixture or pavement
- **Good structure** — pavement structure is adequate to support traffic load for a target performance period (Falling Weight Deflectometer (FWD) testing is the recommended method to properly measure structural distress in the pavement)
- **Ride quality** — measured roughness is such that a single thin lift will adequately achieve roughness values below the agency’s threshold criteria for the route type
- **Proper drainage** — there are no locations with poor drainage affecting the pavement surface or structure

Pavement preservation requires timely placement of a PPT to effectively extend pavement service life. After the decision to apply a thin asphalt overlay for pavement preservation, project development must be completed in an acceptable time window. A pavement preservation program requires a short concept-design-construction process. If the process is too long, construction may occur after the pavement condition reaches moderate distress and the PPT will not achieve optimum benefits.

A PPT is intended to extend service life of an existing pavement, but is generally not intended to increase structural capacity of a pavement. Generally, the structural value of a PPT is negligible, but thin asphalt overlays can achieve an incremental increase in structural capacity if placed prior to structural damage occurring. Structural damage in the pavement occurs before fatigue cracks visually appear on the surface, so a pavement evaluation should include a detailed examination of the existing pavement’s current structural condition.

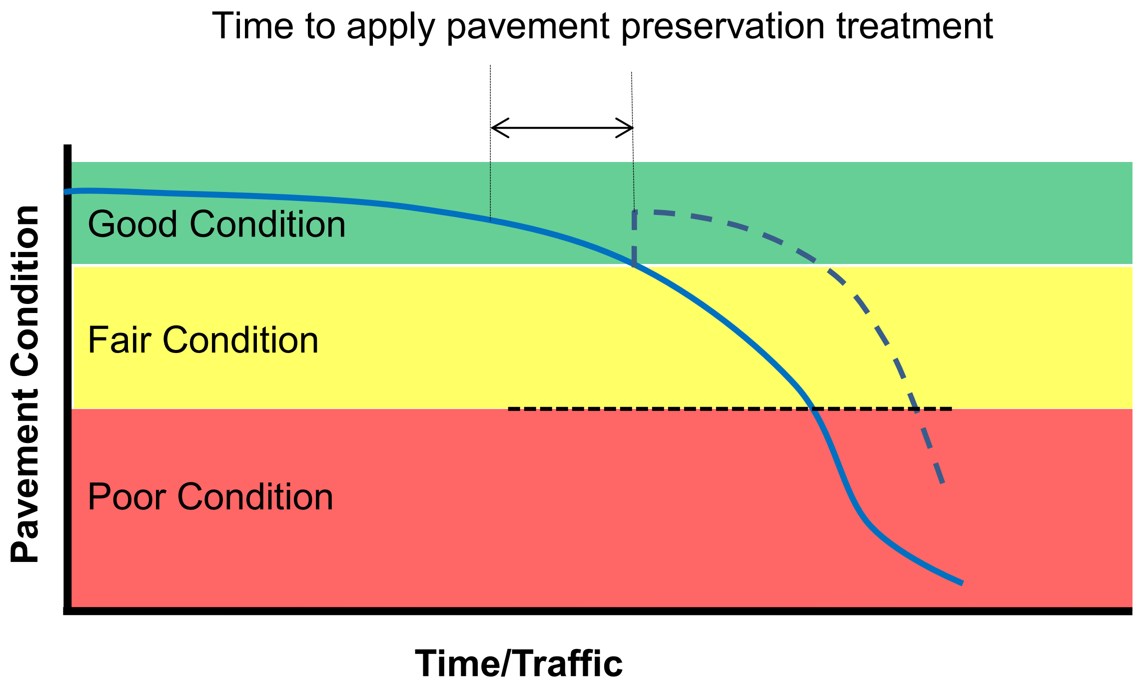

Figure 3. Concept for proper time to place a pavement preservation treatment.

Any pavement layer not providing the intended pavement function is improved by proper rehabilitation methods to directly address the functional shortcomings. Placement of a PPT to cover visible surface distress may fail relatively soon after placement as the underlying pavement continues to deteriorate. Existing pavements that exhibit the following distress conditions are not appropriate candidates for applying PPT. Some distress can be addressed with proper surface preparation as discussed in section 5.

- Rutting due to mixture instability or insufficient pavement structure is not a good candidate for a thin asphalt overlay PPT. If rutting is related to normal consolidation due to traffic, then depth of rutting will determine when to mill the existing surface to level the cross slope before placing a thin asphalt overlay.
- Fatigue cracked pavements are not good candidates for a thin asphalt overlay PPT, unless the distress is addressed with full depth repairs or the removal of top down fatigue cracks with milling before placing a thin asphalt overlay.
- Moderate or severe transverse thermal cracking or a pattern of reflective cracks in an existing asphalt pavement with multiple overlays will quickly reflect through a new thin asphalt overlay. Full depth repairs can serve as remedial action to address the reflective cracking which are inevitable if no remedial action is performed.
- Delamination and raveling pavements are not good candidates, unless the raveling is limited to surface aggregates or surface preparation removes the pavement distress.
- Severe roughness (poor ride) will not allow for achieving a desired ride quality by simply placing a thin asphalt overlay, unless the pavement undergoes surface preparation such as milling or profile milling prior to paving.

4. Dense-Graded Asphalt Mixture Design for Thin Asphalt Overlays

Highway agencies and the asphalt industry continue to explore the use of new materials and mixture designs to address paving needs. Mixtures for thin asphalt overlays utilize the same materials and mixture design process as conventional asphalt pavements, with a few exceptions. The exceptions stem from the fact that thin overlays are placed at reduced thicknesses, which then require mixtures with smaller nominal maximum aggregate sizes (NMAS), which are the 4.75 mm and 9.5 mm. Some agencies have observed field performance and continued to research thin asphalt overlays, which have led them to revisions of mixture design criteria for thin asphalt overlay applications. Current national mixture design criteria for 9.5 and 4.75 mm mixtures are found in AASHTO M 323 and are summarized in Tables 2, 3 and 4.

Mixture design criteria for 9.5 mm mixtures generally follow conventional requirements for coarser mixtures while some criteria for 4.75 mm mixtures are notably different. In Table 2, the 4.75 mm mixture gradation allows up to five percent 9.5 mm aggregate and the intermediate control points are set on the 1.18 mm sieve. In Table 3, the 4.75 mm mixture FAA requirements are higher for lower traffic levels. In Table 4, the 4.75 mm mixture allows for a range of target air voids at N-design and the dust-to-binder ratio is higher.

Asphalt binder grade selection follows standard guidelines, and the engineer can adjust the selected grade to achieve desired performance characteristics of an asphalt mixture placed as a thin overlay. For example, rutting is a critical performance characteristic of a surface mixture and some engineers increase the high temperature grade of the binder to reduce the risk of rutting. Some engineers will specify a polymer modified binder to improve reflective crack resistance and retain the low temperature grade of the asphalt binder to resist low temperature cracking in the lift. The asphalt binder content can increase with finer gradation mixtures, particularly for 4.75 mm fine dense-graded mixtures. RAP and RAS, discussed later in the section, impact binder properties and reduce virgin binder content.

Using multiple stockpiles helps provide for flexibility in design and production. A minimum of two aggregate stockpiles are essential to build a gradation over a narrow range of particle sizes. Stockpiles with different gradations give a mixture designer and plant operator flexibility to adjust the mixture gradation by changing blend proportions. Aggregates utilized in thin asphalt overlay mixtures need to have the same quality properties required for conventional surface mixtures. More dust (particles passing the No. 200 sieve) is needed in 4.75 mm mixtures to improve rut resistance by stiffening the mastic.

Moisture susceptibility testing should be performed on mixtures intended for thin asphalt overlays. When utilizing AASHTO T 283, proper saturation may be more difficult to achieve since these mixtures have low permeability at the specified test density.

Table 2. Aggregate Gradation Control Points (after AASHTO M 323).

Sieve Size (mm)	9.5 mm NMAS		4.75 mm NMAS	
	Min % passing	Max % passing	Min % passing	Max % passing
12.5	100	—	100	—
9.5	90	100	95	100
4.75	—	90	90	100
2.36	32	67	—	—
1.18	—	—	30	55
0.075	2	10	6	13

Table 3. Aggregate Consensus Properties (after AASHTO M 323).

Design ESALs (million)	CAA		FAA		SE	F&E	
	<100 mm from surface		<100 mm from surface		% min	% max	
	9.5 mm NMAS	4.75 mm NMAS	9.5 mm NMAS	4.75 mm NMAS	9.5 and 4.75 mm	9.5 mm NMAS	4.75 mm NMAS
<0.3	55/—	—	—	40	40	—	—
0.3 to <3	75/—	—	40	45	40	10	—
3 to <10	85/80	—	45	45	45	10	—
10 to <30	95/90	—	45	45	45	10	—
>30	100/100	—	45	45	50	10	—

Abbreviations in this table are defined in AASHTO M 323

Table 4. Mixture Design Requirements (after AASHTO M 323).

Design ESALs (million)	$\%G_{mm}$@N-design		VMA		VFA		Dust-to-Binder Ratio	
	9.5 mm NMAS	4.75 mm NMAS	9.5 mm NMAS	4.75 mm NMAS	9.5 mm NMAS	4.75 mm NMAS	9.5 mm NMAS	4.75 mm NMAS
<0.3	96.0	94.0–96.0*	15.0	16.0	70–80	67–79*	0.6–1.2	1.0–2.0
0.3 to <3	96.0	94.0–96.0*	15.0	16.0	65–78	66–77*	0.6–1.2	1.0–2.0
3 to <10	96.0	94.0–96.0*	15.0	16.0	63–76*	66–77*	0.6–1.2	1.5–2.0
10 to <30	96.0	94.0–96.0*	15.0	16.0	63–76*	66–77*	0.6–1.2	1.5–2.0
>30	96.0	94.0–96.0*	15.0	16.0	63–76*	65–75*	0.6–1.2	1.5–2.0

Abbreviations in this table are defined in AASHTO M 323.
****Values in this table are correct. Values in M 323-7 (as of 2014) are not properly footnoted.***

Reclaimed asphalt pavement (RAP) can be successfully incorporated into a thin asphalt overlay mixture. To meet the gradation requirements of a mixture, it will be necessary to consistently size the RAP according to the mixture NMAS. When the contractor sizes the RAP with fractionation, they select the fractionation screen (from ⅜ to ⅛ inch) that meets the needs of the mixture [Copeland 2011]. A RAP stockpile with a consistent and proper gradation could be an additional aggregate source for adjusting production gradation. Use locally acceptable reclaimed binder ratios to determine the allowable RAP content. RAP improves mixture cost-effectiveness by replacing virgin aggregate, replacing virgin asphalt binder, and reducing the need for binder modifiers.

5. Preservation Project Development and Pavement Structure Design

The project selection process described in Section 3 uses pavement condition data derived from network level measurements. Proper preservation project development must include an in-depth pavement evaluation using coring and non-destructive testing to examine the type, extent, severity and cause of distress. Roadway drainage, pavement cross-slope and profile, rutting, cracking, and isolated locations with severe distress need to be evaluated.

A preservation project will provide good performance for a longer period of time when roadway and pavement surface preparations address fair and poor pavement conditions. Common pavement preparation techniques include:

- Milling or micro-milling the existing pavement profile to reduce roughness
- Milling or micro-milling the existing pavement if rut depth is greater than ¼ inch to establish cross slope and ensure uniform mat placement thickness (correct the rut)
- Patching an isolated location(s) with severe distress to regain pavement condition
- Sealing or filling moderate and severe cracks to reduce water intrusion (often done a year ahead of the preservation project)

Pavement preservation treatments are generally not intended to add structural capacity to a pavement, but thin asphalt overlay preservation treatments can add incremental increases in structural capacity. A thin asphalt overlay will not increase fatigue life when fatigue damage is already occurring in the pavement. FWD measurements should be made to evaluate the structural integrity of the existing pavement. If a thin asphalt overlay is placed prior to structural damage occurring in the pavement, an incremental increase in structural capacity is achieved.

6. Construction Practices and Quality Control

Thin asphalt overlays use conventional asphalt paving equipment and many commonly accepted construction practices. Modifications to construction practices and those critical to successful thin asphalt overlay paving are listed below [FHWA 2002]. The following practices should be reflected in construction specifications and emphasized with construction personnel.

- Mixtures for use as thin asphalt overlays have modified mixture design criteria. Plant operators and quality control (QC) technicians need to know and follow these criteria. For example, acceptable ranges for both dust content and dust-to-binder ratio for a 4.75 mm mixture are higher than many conventional mixtures.
- Thin asphalt overlay mixtures have a narrow acceptable gradation band and may be designed with a limited number of different aggregate stockpiles. This may increase criticality of plant personnel attentiveness in managing stockpiles to maintain uniform gradation and moisture content.
- Thin asphalt overlay mixtures may be designed with a limited number of different aggregate stockpiles. This can lead to aggregate components making up large proportions of the mixture and when this occurs it may be necessary to feed that material from multiple bins or to recalibrate the cold feed bin to account for the high feed rate.
- Thin asphalt overlay mixtures use higher percentages of fine aggregates, which commonly retain higher amounts of moisture in stockpiles. Efforts to reduce moisture in these fine aggregate stockpiles can help improve plant efficiency and possibly production rate by reducing the time and energy required to dry the virgin aggregates.
- Prior to placement of a thin asphalt overlay it is important to remove excess crack sealant that may migrate into the mixture and cause the mat to become unstable and/or interfere with the compaction process.
- Thin asphalt overlays should be placed with minimum lift thicknesses three times the mixture NMAS. Coarser conventional mixtures may require lift thicknesses of four times the NMAS, but the thin overlay mixtures are typically designed with finer gradations, allowing the relatively few coarser particles to re-orient in the mixture as the lift is compacted. [Brown 2004]
- Thin asphalt overlays will fail rapidly if not properly bonded to the existing surface. Clean the existing surface and place the tack coat at the specified rate in a uniform application to the existing surface. A common application rate is 0.04 to 0.08 gal/sy based on residual binder. [Watson 2014]

- The ability to improve ride is one key benefit of a thin asphalt overlay when compared to other pavement preservation treatments. Producing a smooth finished surface requires a continuous paving operation that places a lift with uniform density and temperature.
- Thin lifts of asphalt will rapidly cool after placement, through the transfer or loss of heat into the underlying pavement and the air. Roller operators must know how much time is available to complete compaction. Examples of free software applications that predict the available compaction time are PaveCool (http://www.dot.state.mn.us/app/pavecool/index.html) and MultiCool (http://www.asphaltpavement.org/multicool).
- Warm-mix technologies can be used to extend the time for compaction, if necessary.
- A properly developed rolling pattern following closely behind the paver is needed to ensure compaction occurs within the shortened time available before the mixture cools. The paver speed, mix transportation, and plant production rate should be balanced with the rolling operations to help achieve process efficiency and uniform compaction.
- Static rollers are often sufficient for compacting a thin asphalt lift. Rollers should only operate in vibratory mode if a test area shows that doing so will not over-compact the mixture by crushing or breaking aggregates or causing the mixture to shove, become rough, or unstable.

Most common components of quality control and quality assurance for conventional asphalt paving are the same for paving a thin asphalt overlay. Measuring material properties, such as asphalt content and gyratory specimen air voids, can follow standard procedures. Lift thickness can be measured from cores or pre- and post-paving construction surveys. It is appropriate to adjust quality criteria for in-place field density and smoothness due to the thickness of the lift.

Conventional methods for measuring in-place field density for specification compliance are not recommended. There is a high probability that cores cannot be cut and trimmed without damage that may erroneously lower measured density. Tests with a nuclear or non-nuclear gauge measure a zone of material below the gauge that is deeper than one inch. Therefore, the density of existing material below the thin asphalt lift influences the gauge reading. Requiring a test-strip to establish an acceptable rolling pattern is the recommended adjustment to a construction specification. The rolling pattern becomes the method specification for acceptance. Although a rolling pattern specification may permit higher in-place air voids, thin asphalt overlays can still provide an impermeable layer as described in the benefits listed in section 2.

Smoothness of a finished thin asphalt overlay is measured with the same equipment and procedures specified by an agency for conventional pavements, but the acceptance criteria may change. Smoothness achieved by a single thin asphalt lift is greatly dependent on smoothness of the underlying pavement. A thicker conventional single lift asphalt overlay is only expected to improve ride about 50% [Newcomb 2009; Hung 2014]. A smoothness specification needs to account for condition of the existing pavement to define acceptable smoothness of the finished thin asphalt surface. One approach is to require smoothness of the finished thin lift surface to be based on the calculated percent improvement from the smoothness of the underlying surface.

7. Performance

Performance of a thin asphalt overlay PPT will vary with condition of the existing pavement and climate. If a thin asphalt overlay is placed on existing pavement in good condition, expected performance of the thin asphalt overlay is better than if it were applied to a fair or poor condition pavement. As existing pavement condition drops with time, the delay in placing a thin asphalt overlay will reduce expected performance. As discussed in Section 3, the following pavement conditions will negatively influence the performance of a thin asphalt overlay.

- Wide and active cracks will reflect through a new thin asphalt overlay.
- Rutting caused by pavement structure instability and pavements with fatigue cracking

distresses have structural failures that will not be addressed by a PPT.

- Surface roughness (ride) above agency thresholds may not attain a good ride by simply placing a thin asphalt overlay.

Table 5 presents the reported pavement service life from agencies that construct thin asphalt overlays meeting the definition of this guide (dense-graded, paved less than 1½ inches thick). The first row are agencies interviewed for this technical guide and the second row are survey responses from other agencies reported in NCHRP Synthesis 464. The table is divided into four climate zones. Values in the table do not distinguish between methods of quantifying service life extension, but most are commonly based on the period from construction of the thin asphalt overlay to the next construction action. Values do not distinguish between traffic levels or condition of the existing pavement prior to the overlay. It is generally accepted that years of service life on low-traffic volume routes is longer than high-volume routes.

Table 5. Observed service life extension of thin asphalt overlays (in years).

	Climate (SHRP designation)			
	Warm-Dry (Dry, No Freeze)	Warm-Wet (Wet, No Freeze)	Cold-Dry (Dry, Freeze)	Cold-Wet (Wet, Freeze)
State/Service Life/ Unit Cost ($/ton)	TX 7–10 yrs $140/ton	TN 6–10 yrs $84–85/ton MS tbd yrs $80–100/ton	OR ≈10 yrs $70/ton ID 10–12 yrs $40–60/ton	NJ >7 yrs $115–140/ton ME 8–10 yrs $80–85/ton
NCHRP Synthesis 464 State/Service Life	OK 5–8 yrs	SC 5–8 yrs LA 12+ yrs AL 8–12 yrs	WA 5–8 yrs CO 5–8 yrs	WV 5–8 yrs MI 5–8 yrs MO 5–10 yrs PA 5–8 yrs

8. Summary

For this guide, thin asphalt overlays are constructed with dense-graded, 9.5 mm or 4.75 mm NMAS mixtures placed at thicknesses of less than 1½ inches. Some highway agencies and industry groups may define thin asphalt overlays as a broader range of asphalt mixtures, including specialty asphalt mixtures such as OGFC, SMA, and/or UTBWC. Thin asphalt overlays are a viable pavement preservation treatment alternative. When placed on an existing asphalt pavement showing relatively low levels of distress, thin asphalt overlays improve ride, correct rutting, create an impermeable surface, and decrease noise. Proper project selection, evaluation of the pavement condition, and pavement preparation are important tasks to achieve good performance. National criteria for mix design are given in AASTHO M 323. Thin asphalt overlays may require some modification to construction specifications and practices. Cost-effectiveness is a function of the construction cost and the anticipated years of service and is reported as unit cost per lane-mile per year of service. Costs of asphalt overlays may be reduced by placing a thin lift and may be further lowered (reduced) with the proper use of recycled materials in the mixture. The anticipated service life is influenced by the existing pavement distress, traffic, and climate. A number of agencies routinely place thin asphalt overlays as part of their pavement preservation program.

References

Anderson, R.M. (2014) Optimal Timing of Preventive Maintenance for Addressing Environmental Aging in Hot-Mix Asphalt Pavements Minnesota Report MN/RC 2014-45

Bennert, T. et al. (2005) Comparison of Thin-Lift Hot-Mix Asphalt Surface Course Mixes in New Jersey, Transportation Research Record 1929

Brown, E.R., M. Heitzman (2013) Thin HMA Overlays for Pavement Preservation and Low Volume Asphalt Roads, NCAT Report 13-05

Brown, E.R., M.R. Hainin, A. Cooley, G. Hurley (2004) Relationships of HMA In-Place Air Voids, Lift Thickness, and Permeability — Volume One, NCHRP Web Document 68

Copeland, A. (2011) Reclaimed Asphalt Pavement in Asphalt Mixtures: State of the Practice, FHWA Office of Infrastructure Research and Development, FHWA-HRT-11-021

Chou, E., et al. (2008) Effectiveness of Thin Hot Mix Asphalt Overlay on Pavement Ride and Condition Performance, FHWA/OH 2008/4

FHWA (2002) Thin Hot-Mix Asphalt Overlay, Pavement Preservation Checklist Series 3, FHWA-IF-02-049

Geiger, D.R. (2005) Pavement Preservation Definitions, Federal Highway Administration memorandum

Heitzman, M.A., E.R. Brown, J. Hickey (2018) Thinlays for Pavement Preservation, Information Series 141, National Asphalt Pavement Association

Hung, S.S., et al. (2014) Effects of Milling and Other Repairs on Smoothness of Overlays on Asphalt Pavements, Transportation Research Record: Journal of the Transportation Research Board Issue 2408

Irfan, M., et al. (2009) Determining the Service Life of Thin Hot-Mix Asphalt Overlay by Means of Different Performance Indicators, Transportation Research Record 2108

Kargah-Ostadi, N. (2015) Monitoring Pavement Surface Macro-Texture and Friction, a Case Study, TRB 94th Annual Meeting Compendium of Papers, Paper Number 15-5771

NAPA (2014) Thinlays: The Pavement Preservation Tool of Choice, NAPA Position Paper SR 210.

Newcomb, D.E. (2009) Thin Asphalt Overlays for Pavement Preservation, NAPA IS 135

Peshkin, D.G. et al. (2004) Optimal Timing of Pavement Preventive Maintenance Treatment Applications, NCHRP Report 523

Rahman, F. et al. (2011) Experience with Thin Superpave Mixture of Small Aggregate Top Size in Kansas, Transportation Research Record 2205

Staiano, M.A. (2015) Implications of Tire-Pavement Noise & Texture Measurements, TRB 94th Annual Meeting Compendium of Papers, Paper Number 15-1868

Waidelich, W.C. (2016) Guidance on Highway Preservation and Maintenance, Federal Highway Administration memorandum

Wang, T. et al. (2012) Impact of Climate Conditions on Effectiveness of Asphalt Pavement Preservation Techniques, Transportation Research Record 2292

Watson, D., M. Heitzman (2014) Thin Asphalt Concrete Overlays — A Synthesis of Highway Practice, NCHRP Synthesis 464

West, R.C., et al. (2011) Laboratory Refinement and Field Validation of 4.75 mm Superpave Designed Asphalt Mixtures, Volume 1, NCAT Report 11-01

Wiser, L. (2011) Results of Long-Term Pavement Performance SPS-3 Analysis: Preventive Maintenance of Flexible Pavements, TechBrief FHWA-HRT-11-049, Federal Highway Administration

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