

Ultra Thin Lift Overlay

Sample Construction Specification Guideline

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1. Scope

The scope of this sample construction specification guideline is limited and intended to provide general information regarding the design, component material specification, application, inspection, measurement, and payment of Ultra Thin Lift Overlay.

2. Description

An Ultra Thin Asphalt Pavement (UTAP) is a lift of hot mixed or warm mixed asphalt generally less than one inch in thickness used to extend the service life of a flexible pavement structure. An ultra thin asphalt pavement is recommended on pavement in relatively good condition to prevent or correct distresses such as raveling, oxidation, loss of friction, and minor top-down cracking.

3. Definitions

Maximum Sieve Size – Maximum sieve size is the smallest sieve size at which 100% of the aggregate passes.

Nominal Maximum Sieve Size – The nominal maximum sieve size is one sieve size larger than the first sieve to retain more than 10% of the aggregate.

Maximum Density Line – The maximum density line is a straight line plot on the FHWA 0.45 power gradation chart, which extends from the zero origin point of the chart through the plotted point of the combined aggregate gradation curve on the nominal maximum sieve size.

Mechanically Fractured Face – An angular, rough, or broken surface of an aggregate particle created by crushing as determined by ASTM Designation D5821.

4. Materials

4.1 Bituminous Material

Bituminous materials shall meet the applicable requirements for the grade specified in the plans and proposals.

4.2 Aggregate

The source of aggregates shall meet the applicable requirements of the state in which the project is performed or as approved by the agency.

4.2.1 Course Aggregate Blend

Mechanically fractured faces by weight of the combined mineral aggregate coarser than the No. 4 sieve shall be 90%, two faces.

4.2.2 Fine Aggregate Blend

Uncrushed natural sand shall pass the 3/8-inch sieve and can be used, excluding the content in Reclaimed Asphalt Pavement (RAP), as no greater than 30% of the total mineral aggregate by weight.

4.2.3 Combined Aggregate Blend

The gradation shall meet the requirements in the following table:

Sieve Sizes	Percent Passing
1/2"	100
3/8"	95-100
No. 4	75 min
No. 8	22-70
No. 16	-
No. 200	4-12

The ultra thin mixtures shall have a minimum fine aggregate angularity of 40.0 when tested on combined aggregate in accordance with ASTM Designation C1252, Method A.

The minus No. 40 fraction of the combined aggregate shall be non-plastic when tested according to AASHTO T90. The clay content shall not exceed 0.5% by weight of the total mineral aggregate when tested according to AASHTO T88.

4.3 Reclaimed Asphalt Pavement

RAP may be used in Ultra Thin Asphalt Pavement and shall be no greater than 25% of the total mix weight. RAP shall be separated into coarse and fine aggregate stockpiles using the 1/2-inch sieve as the break point.

4.4 Hydrated Lime

Hydrated lime shall conform to the following requirements:

- Calcium and magnesium oxides, nonvolatile basis, %, minimum 90
- Carbon dioxide, %, maximum 7
- Moisture loss, 2 hours at 20°C, maximum 3

Gradation of Residue:

- Retained on No. 30 sieve, %, maximum 2.5
- Retained on No. 200 sieve, %, maximum 15

4.5 Mineral Filler

Mineral filler shall consist of shell dust, limestone dust, Portland cement, or other calcareous type materials having a high affinity for asphalt. The source of the material shall be approved by the agency. Mineral filler shall meet the following gradation requirements:

- Passing the No. 30 sieve, % 100
- Passing the No. 50 sieve, not less than, % 95
- Passing the No. 200 sieve, not less than, % 65

5. Composition

Unless otherwise specified or permitted, the UTAP shall consist of a uniform mixture of asphalt, aggregate, mineral filler, hydrated lime, and, when required or necessary to obtain desired properties, an anti-stripping agent and/or other materials.

Hydrated lime shall be used in all UTAP at the rate of one percent (1%) by weight of the total dry aggregate. The aggregate, prior to the addition of the hydrated lime, shall contain sufficient surface moisture. The contractor shall obtain a shipping ticket for each shipment of hydrated lime. The contractor shall provide the agency with a copy of each shipping ticket from the supplier, including the date, time, and weight of hydrated lime shipped.

Mixtures will require the addition of an anti-stripping agent when the Tensile Strength Ratio (TSR) (MT-63) and/or the Boiling Water Test (MT-59) fail to meet the following criteria:

- TSR (MT-63)
- Wet Strength/Dry Strength – 85% minimum
- Interior Face Coating – 95% minimum
- Boiling Water Test (MT-59)
- Particle Coating – 95% minimum

6. Mixture Properties

Ultra Thin Asphalt Pavement shall be designed at Ndesign of 50 revolutions of the gyratory compactor.

Mixtures shall be designed such that the percent of maximum specific gravity (G_{mm}) shall be between 94.0 and 96.0.

There will not be voids in mineral aggregate (VMA) requirement. However, the specified volume of effective binder (the difference between total air voids and VMA) shall be a minimum of 12%.

Dust/Binder Ratio (Percent Passing No. 200/Effective Binder Content) shall be between 1.0 and 2.0.

7. Job Mix Formula

At least 10 working days prior to the proposed use of each mixture, the contractor shall submit in writing to the agency a proposed job mix formula. The job mix formula shall be signed by a Certified Mixture Design Technician (CMDT).

The mixture shall conform thereto within the range of tolerances specified for the particular mixture. No change in properties or proportion of any component of the job mix formula shall be made without permission of the agency.

A job mix formula may be transferred to other contracts in accordance with conditions set forth by the agency.

The contractor shall not place any UTAP prior to receiving from the agency.

When a change in source of materials, unsatisfactory mixture production results such as segregation, bleeding, shoving, rutting over 1/8 inch, raveling and cracking, or changed conditions make it necessary, a new job mix formula will be required.

8. Single Lift Laying Thickness

The minimum lift thickness for Ultra Thin Asphalt Pavement shall be 1/2 inch, and the maximum lift thickness shall not exceed one inch.

9. Contractor's Quality Management Program

The contractor shall have full responsibility for quality management and maintain a quality control system that will furnish reasonable assurance that the mixtures and all component materials incorporated in the work conform to contract requirements. The contractor shall have responsibility for the initial determination and all subsequent adjustments in proportioning materials used to produce the specified mixture. Adjustments to plant operation and spreading and compaction procedures shall be made immediately when results indicate that they are necessary. Mixture produced by the contractor, without the required testing or personnel on the project, shall be subject to removal and replacement by the contractor at no additional cost to the agency.

10. Personnel Requirements

The contractor shall provide at least one Certified Asphalt Technician-I (CAT-I) full time during UTAP production at each plant site used to furnish material to the project. Sampling shall be conducted by a certified technician or by plant personnel under the direct observation of a certified technician. All testing, data analysis, and data posting will be performed by the CAT-I or by an assistant under the direct supervision of the CAT-I. The contractor shall have a Certified Asphalt Technician-II (CAT-II) available to make any necessary process adjustments. An organizational chart, including names, telephone numbers, and current certification of all those responsible for the quality control program, shall be posted in the contractor's laboratory while the project is in progress.

11. Testing Requirements

As a minimum, the contractor's quality management program shall include the following:

- (a) Bituminous Material. Provide engineer with samples in a sealed, one-quart metal container at the frequency as determined by the agency.
- (b) Mechanically Fractured Face. Determine mechanically fractured face content of aggregates retained on the No. 4 sieve, at a minimum of one test per day of production.
- (c) Mixture Gradation. Conduct extraction tests for gradation determination on the mixture. Sample and test according to the requirements of the agency.
- (d) Total Voids and Volume of effective binder (Vbe). Determine total voids and Vbe, at Ndesign, from the results of bulk-specific gravity tests on laboratory compacted specimens. Sample and test according to requirements of the agency.
- (e) Asphalt Content. Sample according to the requirements of the agency and determine the asphalt content using an incinerator oven. (AASHTO T308, Method A)
- (f) Stripping Tests. Conduct a minimum of one stripping test at the beginning of the project production and thereafter, at least once per each two weeks of production. Should either the TSR or the boiling water stripping tests fail, a new anti-strip additive or rate shall be established or other changes made immediately that will result in a mixture that conforms to the specifications; otherwise, production shall be suspended until corrections are made.

(g) Quality Control Charts. Plot the individual test data, the average of the last four tests, and the control limits for the following items as a minimum:

Mixture Gradation (Percent Passing)

Sieves: 1/2-inch, 3/8-inch, No. 4, No. 8, No. 30, and No. 200

Asphalt Content, Percent

Maximum Specific Gravity

Total Voids at Ndesign, Percent

Vbe at Ndesign, Percent

Keep charts up-to-date and posted in a readily observable location. Charts may be kept on a computer; however, the charts shall be printed out a minimum of once each production day and displayed in the laboratory. Note any process changes or adjustments on the Air Voids chart.

(h) Sampling Frequency. Conduct those tests as required above at the following frequency for each mixture produced based on the estimated plant tonnage at the beginning of the day.

Total Estimated Production, tons	Number of Tests
0-500	1
501-1000	2
1001-1500	3
1501-2000	4
2001+	5

(i) Sample Requirements. Obtain the asphalt mixture samples from trucks at the plant. Obtain aggregate samples from cold feed bins or aggregate stockpile. Save a split portion of all mixture samples at the laboratory site in a dry and protected location for 14 calendar days. At the completion of the project, the remaining samples may be disposed of with the approval of the engineer. The above testing frequencies are for the estimated plant production for the day.

If production is discontinued or interrupted, the tests will be conducted at the previously established sample tonnage points for the materials that are actually produced. If the production exceeds the estimated tonnage, sampling, and testing will continue at the testing increments previously established for the day. A testing increment is defined as the estimated daily tonnage divided by the required number of tests from the table in Subsection 907-411.02.3.3 paragraph (h).

In addition to the above program, aggregate stockpile gradation tests (AASHTO T11 and T27) shall be conducted every other production day. Fine aggregate angularity tests (ASTM C1252, Method A) shall be conducted on the first day of production and once for every eight production samples thereafter, with a minimum of one test per production week.

12. Documentation

The contractor shall document all observations, records of inspection, adjustments to the mixture, and test results on a daily basis. All tests conducted by the contractor in accordance with Section 11 (g) shall be included in the running average calculations. If single tests are performed as a check on individual UTAP properties, between regular samples, without performing all tests required in Section 11 (g), those individual tests shall not be included in the running average calculations for that particular property. The contractor shall record the results of observations and records of inspection as they occur in a permanent field record. The contractor shall record all process adjustments and job mix formula (JMF) changes on the air void charts. The contractor shall provide copies of all test data sheets and the summary reports to the agency on a daily basis. The contractor shall provide a written description of any process change, including blend proportions, to the agency as they occur. Information provided to the agency must be received by no later than 9:00 a.m. the day after the UTAP is produced. Fourteen days after the completion of the placement of the UTAP, the contractor shall provide the engineer with the original testing records and control charts in a neat and orderly manner.

13. Control Limits

13.1 General

The following control limits for the JMF warning limits are based on a running average of the last four data points:

Sieve Sizes – % Passing	JMF Limits	Warning Limits
1/2"	+/- 5.5	+/- 4.0
3/8"	+/- 5.5	+/- 4.0
No. 4	+/- 4.0	+/- 3.0
No. 8	+/- 4.0	+/- 3.0
No. 30	+/- 4.0	+/- 3.0
No. 200	+/- 2.0	+/- 1.5
Asphalt Content, %	-0.3 to +0.5	-0.2 to +0.4
Design Total Voids at Ndesign, %	+/- 1.3	+/- 1.0
Vbe at Ndesign, %	-1.5	-1.0

13.2 Warning Bands

Warning bands are defined as the area between the JMF limits and the warning limits.

13.3 Job Mix Formula Adjustments

A request for a JMF adjustment signed by a CAT-II may be made to the agency by the contractor. Submit sufficient testing data with the request to justify the change. The requested change will be reviewed by the agency. If current production values meet the mixture design requirements, a revised JMF will be issued. Adjustments to the JMF to conform to actual production shall not exceed the tolerances specified for the JMF limits. Regardless of such tolerances, any adjusted JMF gradation shall be within the range given herein. The JMF asphalt content may only be reduced if the production Vbe meets or exceeds the minimum design Vbe requirements for the mixture being produced.

14. Acceptance

14.1 General

Acceptance for mixture quality (Vbe and total voids at Ndesign, gradation, and asphalt content) will be based on random samples tested in accordance with the project plans. Smoothness will be accepted by lots as set out in the project plans.

14.2 Mixture Quality

All obviously defective material or mixture will be subject to rejection by the agency. Such defective material or mixture shall not be incorporated into the finished work. If the defective material has already been placed on the project, the material shall be removed and replaced at no additional cost to the agency. The agency will base final acceptance of the asphalt mixture production on the results of the contractor's testing for total voids and Vbe at Ndesign, gradation, and asphalt content as verified by the agency in the manner herein before described and the uniformity and condition of the completed pavement. Areas of pavement that exhibit non-uniformity or failures (materials or construction related) such as but not limited to segregation, bleeding, shoving, rutting over 1/8 inch, raveling, slippage, or cracking will not be accepted. Such areas will be removed and replaced at no additional cost to the agency. Bituminous mixture placed prior to correction for deficiencies in Vbe and total voids at Ndesign, gradation, or asphalt content, as determined by the agency as satisfactory to remain in place, will be paid for in accordance with the following pay factors times the contract unit price per ton:

Pay Factor for Mixture Quality*		
Item	Produced In Warning Bands	Produced Outside JMF Limits, Allowed To Remain In Place
Gradation	0.90	0.75
Asphalt Content	0.85	0.75
Total Voids at Ndesign	0.70	0.50
Vbe at Ndesign	0.90	0.75

*The minimum single payment will apply.

14.3 Acceptance Procedure for Density

The density requirement for UTAP shall be rolled to refusal. Refusal is defined as the number of roller passes to maximize the in-place unit weight of the mixture. On the first day of production and every three production days thereafter, a 500-foot test strip shall be evaluated to determine the required number of roller passes. Three random sites within the test strip shall be selected and monitored with the nuclear density gauge to determine refusal.

14.4 Acceptance Procedure for Pavement Smoothness

Prior to placement of UTAP, the contractor shall determine the existing surface profile at no additional cost to the state. The finished UTAP lift shall have a profile index no greater than that of the existing surface. Acceptable profiler and method will be determined by the agency and set forth in the plans.

14.5 Surface Correction

In the event surface correction is needed, it shall be accomplished by removal and replacement. All such corrections shall be at no additional cost to the agency. The finished pavement surface will be measured for riding quality.

15. Nuclear Gauges

15.1 Nuclear Moisture Density Gauge

The nuclear gauge unit used to monitor density shall contain a full data processor that holds all calibration constants necessary to compute and directly display wet density, moisture, and dry density in pounds per cubic foot. The data processor shall compute and display the percent moisture and percent density based on dry weight.

15.2 Nuclear Asphalt Content Gauge

The contractor shall furnish and calibrate, unless designated otherwise in the contract, a Troxler Nuclear Asphalt Content Gauge Model 3241 or updated model, or a Campbell Nuclear Asphalt Content Gauge Model AC-2 or an approved equal.

16. Construction Requirements

16.1 General

It is recommended that the Hot Mix Asphalt Paving Handbook be used for reference outlining acceptable UTAP construction practices. This publication is widely available online and through the National Asphalt Pavement Association.

16.2 Weather Limitations

The UTAP mixture shall not be placed when weather conditions prevent the proper handling and finishing or the surface on which it is to be placed is wet or frozen. At the time of placement, the air and pavement surface temperature limitations shall be equal to or exceed 55°F for Ultra Thin Hot Mix and 40°F for Ultra Thin Warm Mix, regardless of the compacted lift thickness.

When paving operations are discontinued because of rain, the mixture in transit shall be protected until the rain ceases. The surface on which the mixture is to be placed shall be swept to remove as much moisture as possible, and the mixture may then be placed subject to removal and replacement at no additional cost to the agency if contract requirements are not met.

17. Tack Coat

Tack coat shall be the same neat grade asphalt cement used in the mixture being placed or those materials specified for tack coat. The tack coat shall be applied to previously placed Hot Mix Asphalt (HMA) and between lifts, unless otherwise directed by the engineer. The tack coat shall be applied as a spray coating and through a standard asphalt distributor or other approved equipment. The application rate of the tack will be 0.10-0.20 gallons per square yard as determined by the agency.

18. Spreading and Finishing

Grade control for HMA pavements shall be established by string line at least 500 feet ahead of spreading, unless placement is adjacent to curb and gutter, concrete pavement, or other allowed grade control. The mixture shall be spread to the depth and width that will provide the specified compacted thickness, line, grade, and cross section. Placing of the mixture shall be as continuous as possible. On areas where mechanical spreading and finishing is impracticable, the mixture may be spread, raked, and luted by hand tools.

Immediately after screeding and prior to compaction, the surface shall be checked by the contractor and irregularities adjusted. When the edge is feathered as in a wedge lift, it may be sealed by rolling. Irregularities in alignment and grade along the edges shall be corrected before the edges are rolled. Hauling, spreading, and finishing equipment shall be furnished, capable of, and operated in such a manner that the rolling operation will satisfactorily correct any surface blemishes. The longitudinal joint in the subsequent lift shall offset that in the underlying by approximately six (6) inches. However, the joint in the top lift shall be at the centerline or lane line.

19. Joints

Joints between previously placed pavement and pavement being placed shall be formed so as to ensure a thorough and continuous bond. Transverse construction joints shall be formed by cutting the previously placed mixture to expose the full depth of the lift.

The contact surface of transverse joints and longitudinal joints, except hot joints, shall be sprayed with a thin uniform tack coating before additional mixture is placed against the previously placed material.

Longitudinal joints shall be formed by overlapping the screed on the previously placed material for a width of at least one (1) inch and depositing the quantity of mixture to form a smooth, tight joint.

20. Method of Measurement

Ultra thin asphalt pavement of the type specified will be measured by the ton. Bituminous tack coat for the ultra thin asphalt pavement shall be measured by the gallon.

21. Basis of Payment

Ultra thin asphalt pavement, measured as prescribed above, will be paid for at the contract unit price per ton; the price shall be full compensation for completing the work.

Bituminous tack coat, measured as prescribed above, will be paid for at the contract unit price per gallon; the price shall be full compensation for completing the work.