



# Illinois Department of Transportation

## Memorandum

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To: Regional Engineers  
From: Jack A. Elston, P.E.   
Subject: Special Provision for Ultra-Thin Bonded Wearing Course  
Date: October 1, 2021

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This special provision was developed by the Bureau of Research to provide a pavement preservation treatment that is thinner than a conventional hot-mix asphalt surface course and has enhanced bonding characteristics which allows it to be placed directly on portland cement concrete surfaces. It has been revised to work with the 2022 Standard Specifications.

Designer Note: Select the mixture composition based upon the roadway type and calculate the quantity of the rapid setting polymer modified emulsion (RSPME), i.e. tack coat, based upon the planned residual asphalt rate shown below. The planned thickness of each mixture is shown for the designers use in determining final elevations and is not something that can be altered.

Roadway Type	Mixture Composition	Planned Thickness	Planned Residual Asphalt Rate of RSPME
Interstate	IL-12.5 UTB	0.9 in.	0.19 lb/sq ft
Non-Interstate	IL-9.5 UTB	0.75 in.	0.14 lb/sq ft

The districts should include the BDE Check Sheet marked with the applicable special provisions for the January 21, 2022 and subsequent lettings. The Project Coordination and Implementation Section will include a copy in the contract.

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## ULTRA-THIN BONDED WEARING COURSE (BDE)

Effective: April 1, 2020

Revised: January 1, 2022

Description. This work shall consist of constructing an ultra-thin bonded (UTB) wearing course on a prepared pavement.

Materials. Materials shall be according to the following.

Item	Article/Section
(a) Fine Aggregate .....	1003.03
(b) Coarse Aggregate (Note 1).....	1004.03
(c) Mineral Filler .....	1011
(d) Performance Graded Asphalt Binder (Note 2) .....	1032.05
(e) Bituminous Materials (Note 3) .....	1032

Note 1. The blending, alternate use, and/or substitutions of aggregates from different sources for use in this work will not be permitted without the approval of the Engineer. Any blending shall be by interlocked mechanical feeders. The blending shall be uniform, compatible with the other components of the mix, and the equipment shall be approved by the Engineer.

If blending aggregates, the blend shall have a washed gradation performed every other day or a minimum of three tests per week. Testing shall be completed before the aggregate receives final acceptance for use in the mix.

Note 2. The asphalt binder shall be either SBR or SBS PG 70-22.

Note 3. The bituminous material used for tack coat shall be a rapid setting anionic polymer modified emulsion or a rapid setting cationic polymer modified emulsion. When using a cationic material, the supplier shall certify prior to the start of mix production, the material has a positive particle charge when tested according to AASHTO T 59. When using either a cationic or anionic material, the supplier shall certify prior to the start of mix production, the material meets the following requirements.

Tests on Emulsions (AASHTO T 59)	Result
Viscosity, Saybolt Furol, 77 °F (25 °C), s	20 - 100
Viscosity, Rotational Paddle, 77 °F (25 °C), mPa-s (AASHTO T 382)	40 - 200
Storage Stability Test, 24 hours, % <sup>1/</sup>	1 max.
Sieve Test, % retained on #20 (850 µm) sieve	0.05 max.
Residue from Distillation, %	63 min.
Demulsibility:	
35 ml, 0.02N CaCl <sub>2</sub> , %, <u>or</u>	40 min.
35 ml, 0.8% dioctyl sodium sulfosuccinate, %	40 min.

Tests on Residue from Evaporation	Result
Penetration, 77 °F (25 °C), 100 g, 5 s, 0.1 mm, (AASHTO T 49)	90 - 150
Elastic Recovery, 50 °F (10 °C), straight sided, 5 cm/min, 20 cm elongation, 5 min hold, % (AASHTO T 301)	50 min.
Ash Content, % (AASHTO T 59)	1 max.

1/ Upon examination of the storage stability test cylinder after standing undisturbed for 24 hours, the surface shall show minimal to no white, milky colored substance and shall be a homogenous brown color throughout. The material may be released prior to completion of the test based on approval of the Department.

Equipment. Equipment shall be according to the following.

Item	Article/Section
(a) Tandem Rollers (Note 1) .....	1101.01
(b) Hot-Mix Asphalt Plant .....	1102.01
(c) Spreading and Finishing Machine (Note 2) .....	1102.03
(d) Heating Equipment .....	1102.07

Note 1. A minimum of two tandem rollers (T<sub>B</sub>), operating in the static mode, sufficient to match paving production will be required.

Note 2. The spreading and finishing machine shall be a “spray-paver” capable of spraying the tack coat, applying the wearing course, and providing a smooth surface to the mat in one pass at the rate of 30 ft/min (9 m/min) or greater. The wearing course shall be spread over the tack coat within five seconds of applying the tack coat during normal paving speeds. No wheel or other part of the spray-paver shall come in contact with the tack coat before the wearing course is applied. The spray-paver shall also have the following:

- (1) a receiving hopper with a minimum of two heated twin screw feed augers,
- (2) an integral storage tank for tack coat material,
- (3) integral twin expandable emulsion spray bars located immediately in front of the asphalt spread augers and an activated screed,
- (4) variable width vibratory heated activated screed. The screed shall have the ability to be crowned at the center both positively and negatively and have vertically adjustable extensions to accommodate the desired pavement profile.

### CONSTRUCTION REQUIREMENTS

Mixture Design. The target values for the Job Mix Formula (JMF) shall fall within the following limits.

ULTRA-THIN BONDED, MIXTURE COMPOSITION (% PASSING)		
Sieve Size	IL-12.5 UTB	IL-9.5 UTB
3/4 in. (19 mm)	100	--
1/2 in. (12.5 mm)	85 - 100	100
3/8 in. (9.5 mm)	55 - 80	85 - 100
No. 4 (4.75 mm)	22 - 38	22 - 38
No. 8 (2.36 mm)	19 - 32	19 - 32
No. 16 (1.18 mm)	15 - 24	15 - 24
No. 30 (600 µm)	11 - 18	11 - 18
No. 50 (300 µm)	8 - 14	8 - 14
No. 100 (150 µm)	5 - 10	5 - 10
No. 200 (75 µm)	4 - 5.5	4 - 5.5
Asphalt Binder, %	4.6 - 6.1	4.8 - 6.1

The need for an anti-stripping additive shall be determined according to Article 1030.05(c).

The effective binder film thickness shall be a minimum of  $0.3 \pm 0.03$  mils ( $10 \pm 1$  µm). The percent asphalt binder of the mix shall be determined by calculating the binder film thickness in accordance with Illinois Test Procedure (ITP) 406.

Draindown from the loose mixture shall not exceed 0.10 percent when tested according to Illinois Modified AASHTO T 305. The draindown shall be tested at the job mix formula asphalt content plus 0.5 percent. The temperature shall be the mixing temperature plus 59 °F (15 °C). The temperature shall not exceed 350 °F (175 °C).

The mixture shall not contain reclaimed materials.

The mixing temperature shall be according to Illinois Modified AASHTO T 312.

Preparation of Mineral Aggregates. The aggregates shall be heated in such a manner as to assure the mixing temperature is uniformly maintained. The aggregates shall be dried to less than 0.3 percent residual moisture by weight. This may require the aggregate to be processed twice through the drier.

Mix Production. After target values have been determined for the JMF, an adjustment/plant change may be made according to the following limitations.

Parameter	Adjustment
3/8 in. (9.5 mm)	± 5 %
No. 4 (4.75 mm)	± 5 %
No. 8 (2.36 mm)	± 5 %
No. 200 (75 µm)	± 1.5 %
Asphalt Binder Content <sup>1/</sup>	± 0.3 %

1/ The quantity of anti-stripping additive will not be included in this percentage.

Adjustments outside the above limitations will require a new mix design.

Placing. The placement conditions of Article 406.06(c) shall apply, except the surface of the existing pavement shall be cleaned using a mechanical or vacuum sweeper; and the mixture shall only be placed when the pavement and ambient air temperatures are at least 50 °F (10 °C) at the time of placement and the forecast is for rising temperatures.

The IL-12.5 UTB mixture shall be placed at a rate of 90 lb/sq yd (50 kg/sq m). The IL-9.5 UTB mixture shall be placed at a rate of 75 lb/sq yd (40 kg/sq m). These placement rates are based on a mixture with a unit weight of 100 lb/sq yd/in. (2.1 kg/sq m/mm) and a specific gravity of 2.5. Mixtures with a different specific gravity will require an adjusted placement rate to maintain the planned thickness.

The tack coat shall be uniformly spray applied with the spreading and finishing machine at a temperature of 120 - 180 °F (50 - 80 °C). The rate of application shall be accurately and continuously monitored to ensure a uniform application over the entire width to be overlaid. The rate of application shall be determined as follows.

- (a) Determination of In-Place Air Voids. Two 6 in. (150 mm) specimens shall be prepared according to AASHTO T 312 to 80 gyrations. The percent air voids shall be determined according to AASHTO T 269. The air void determination shall be the average of the two specimens. 2.5 percent air voids shall be added to the lab determined air voids to approximate in-place air voids.
- (b) Calculated Application Rate. Calculate the volume of 1 sq yd (1 sq m) of mix at a depth of 70 percent of the nominal maximum aggregate size. Multiply that volume by the percent of in-place air voids. Convert the volume to gal (L). Express the result in lb/sq ft (kg/sq m).

The Engineer will make field adjustments to the calculated application rate no greater than  $\pm 0.05$  lb/sq ft ( $\pm 0.25$  kg/sq m) based on the existing surface condition. Once the target application rate is established, the tolerance shall be  $\pm 0.01$  lb/sq ft ( $\pm 0.05$  kg/sq m).

Compaction. Compaction shall consist of each area of the mat receiving a minimum of two passes with a tandem roller, before the material temperature has fallen below 180 °F (80 °C).

Opening to Traffic. The wearing course may be opened to traffic when it has hardened to the satisfaction of the Engineer.

Quality Control/Quality Assurance. Material testing shall be according to Articles 1030.06 and 1030.09, except the following tests will not be required.

- (a) Bituminous Core Density
- (b) Nuclear Density

(c)  $G_{mm}$  and  $G_{mb}$  testing

Additionally, the Contractor shall have a representative present during construction that is familiar with the lay down of the product and its design methods.

Method of Measurement. The bituminous material for tack coat will be measured for payment as specified in Section 1032.

The wearing course will be measured for payment in place and the quantity computed in square yards (square meters).

Basis of Payment. The tack coat will be paid for at the contract unit price per pound (kilogram) of residual asphalt for RAPID SETTING POLYMER MODIFIED EMULSION.

The wearing course will be paid for at the contract unit price per square yard (square meter) for ULTRA-THIN BONDED WEARING COURSE, of the mixture composition and friction aggregate specified.

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