INDIANA DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS

ASPHALT BINDER FILM THICKNESS
ITM No. 589-13

1.0 SCOPE.

1.1 This ITM covers the procedure to calculate the asphalt binder film thickness of a Ultrathin Bonded Wearing Course (UBWC) Hot Mix Asphalt (HMA) paving mixture by applying surface area factors to the design aggregate gradation.

1.2 This ITM may involve hazardous materials, operations, and equipment and may not address all of the safety problems associated with the use of the test method. The user of the ITM is responsible for establishing appropriate safety and health practices and determining the applicability of regulatory limitations prior to use.

2.0 REFERENCED DOCUMENTS.

2.1 ITM Standards.

584 Bulk Specific Gravity of Aggregate Blends with Recycled Materials

2.2 Other References.

MS-2 Mix Design Methods for Asphalt Concrete by Asphalt Institute

3.0 TERMINOLOGY. Asphalt binder film thickness is the thickness, in mils (microns), of the total asphalt binder content minus the asphalt binder absorbed into the aggregate particle.

4.0 SIGNIFICANCE AND USE.

4.1 This ITM shall be used to determine the asphalt binder film thickness of a UBWC HMA paving mixture.

4.2 The minimum binder content of a UBWC HMA paving mixture shall be determined by achieving the specified asphalt binder film thickness.

5.0 PROCEDURES.

5.1 Obtain the proposed UBWC aggregate blend sheet.

5.2 The surface area factors used for each sieve size are as follows:

Surface Area (SA) Factors	
Sieve Size (mm)	**Units (ft^2/lb)**
4.75	2
2.36	4
1.18	8
0.600	14
0.300	30
0.150	60
0.075	160

The surface area for each sieve is obtained from the percent passing gradation data shown on the aggregate blend sheet. Determine and record the total aggregate surface area by summing the surface areas for each sieve as follows:

$$SA_{Total} = 2 + \left[\sum_{sieves} \left(\frac{\text{Percent Passing}}{100} \text{ x SA Factor} \right) \right]$$

5.3 Determine and record the following from the UBWC mix design:

5.3.1 Total asphalt binder content, Pb

5.3.2 Total aggregate bulk specific gravity, Gsb

5.3.3 Asphalt binder specific gravity, Gb

5.3.4 Aggregate effective specific gravity, Gse

5.4 Determine and record the volume of total asphalt binder as follows:

$$P_{b\,Volume} = \left(\frac{M_T \text{ x } \frac{P_b}{100}}{G_b \text{ x } \gamma_w} \right) \text{ x } \left(\frac{12 \text{ in}}{\text{ft}} \right)^3 \text{ [units of in}^3\text{]}$$

where:
$P_{b\,Volume}$ = volume of total asphalt binder
M_T = total mass of mixture (assume 100 pounds)
P_b = total asphalt binder content
G_b = asphalt binder specific gravity (assume 1.030 if not known)
γ_w = unit weight of water (62.416 lb/ft^3)

5.5 Determine and record the absorbed asphalt binder percentage as follows:

$$P_{ba} = 100 \text{ x } \left(\frac{G_{se} - G_{sb}}{G_{se} \text{ x } G_{sb}}\right) \text{ x } G_b$$

where:

P_{ba} = absorbed asphalt binder percentage
G_{se} = aggregate effective specific gravity
G_{sb} = total aggregate bulk specific gravity
G_b = asphalt binder specific gravity (assume 1.030 if not known)

5.6 Determine and record the weight of absorbed asphalt binder as follows:

$$P_{ba\ Weight} = M_T \text{ x } \frac{P_{ba}}{100} \text{ x } P_s \text{ [units of pounds]}$$

where:

$P_{ba\ Weight}$ = weight of absorbed asphalt binder
M_T = total mass of mixture (assume 100 pounds)
P_{ba} = absorbed asphalt binder percentage
P_s = percentage of aggregate = $1 - (Pb/100)$

5.7 Determine and record the volume of absorbed asphalt binder as follows:

$$P_{ba\ Volume} = \frac{P_{ba\ Weight}}{G_b \text{ x } \gamma_w} \text{ x } \left(\frac{12 \text{ in}}{\text{ft}}\right)^3 \text{ [units of in}^3\text{]}$$

where:

$P_{ba\ Volume}$ = volume of absorbed asphalt binder
$P_{ba\ Weight}$ = weight of absorbed asphalt binder
G_b = asphalt binder specific gravity (assume 1.030 if not known)
γ_w = unit weight of water (62.416 lb/ft^3)

5.8 Determine and record the volume of the effective asphalt binder percentage as follows:

$$P_{be\ Volume} = P_{b\ Volume} - P_{ba\ Volume} \text{ [units of in}^3\text{]}$$

where:

$P_{be\ Volume}$ = volume of effective asphalt binder
$P_{b\ Volume}$ = volume of total asphalt binder
$P_{ba\ Volume}$ = volume of absorbed asphalt binder

5.9 Determine and record the asphalt binder film thickness as follows:

$$T_f = \left(\frac{P_{be\ Volume}}{SA_{Total}\ x\ M_T\ x\ P_s}\right) x \left(\frac{1\ ft}{12\ in}\right)^2 x \left(\frac{1\ mil}{0.001\ in}\right) \text{ [units of mils]}$$

where:

T_f = average asphalt binder film thickness
$P_{be\ Volume}$ = volume of effective asphalt binder
SA_{Total} = total aggregate surface area (ft^2/lb)
M_T = total mass of mixture (assume 100 pounds)
P_s = percentage of aggregate = $1 - (Pb/100)$

6.0 **ACCEPTANCE CRITERIA.** The asphalt binder film thickness shall be 0.4 mils or greater.

7.0 **REPORT.** The asphalt binder film thickness shall be reported on the submitted DMF form.