Illinois Department of Transportation
2300 South Dirksen Parkway / Springfield, Illinois / 62764

January 6, 2016

SUBJECT: FAP Route 347 (Roosevelt Rd.)
Section 2015-045RS
Cook County
Contract No. 62B05
Item No. 61, January 15, 2016 Letting
Addendum A

NOTICE TO PROSPECTIVE BIDDERS:

Attached is an addendum to the plans or proposal. This addendum involves revised and/or added material.

1. Replaced the Schedule of Prices
2. Revised the Table of Contents to the Special Provisions
3. Revised pages 14 & 23-34 of the Special Provisions
4. Deleted pages 15-17 of the Special Provisions
5. Added pages 99-117 to the Special Provisions
6. Revised sheets 3-6 of the Plans

Prime contractors must utilize the enclosed material when preparing their bid and must include any Schedule of Prices changes in their bidding proposal.

Bidders using computer-generated bids are cautioned to reflect any and all Schedule of Prices changes, if involved, into their computer programs.

Very truly yours,

Maureen M. Addis, P.E.
Acting Bureau Chief of Design & Environment

By: Ted B. Walschleger, P. E.
Engineer of Project Management

cc: John Fortmann, Region 1, District 1; Justan Mann, Tim Kell; Estimates

MS/kf

ILLINOIS DEPARTMENT OF TRANSPORTATION
SCHEDULE OF PRICES
CONTRACT NUMBER - 62B05

State Job # - C-91-376-15

Project Number *REVISED: JANUARY 5, 2016

Route FAP 347

County Name - COOK- -
Code - 31 - -
District - 1 - -
Section Number - 2015-045RS

Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
X5537800	SS CLEANED 12	FOOT	1,080.000				
X6030310	FR & LIDS ADJUST SPL	EACH	107.000				
Z0004562	COMB C C&G REM & REPL	FOOT	2,370.000				
Z0018500	DRAINAGE STR CLEANED	EACH	72.000				
Z0018600	DRAINAGE STR RECONST	EACH	2.000				
Z0030850	TEMP INFO SIGNING	SQ FT	51.400				
Z0048665	RR PROT LIABILITY INS	L SUM	1.000				
21101615	TOPSOIL F & P 4	SQ YD	66.000				
25200110	SODDING SALT TOLERANT	SQ YD	66.000				
40600275	BIT MATLS PR CT	POUND	33,229.000				
40600400	MIX CR JTS FLANGEWYS	TON	80.000				
40600827	P LB MM IL-4.75 N50	TON	2,031.000				
40600982	HMA SURF REM BUTT JT	SQ YD	672.000				
40603565	P HMA SC "E" N70	TON	4,825.000				
42001300	PROTECTIVE COAT	SQ YD	136.000				

ILLINOIS DEPARTMENT OF TRANSPORTATION
SCHEDULE OF PRICES
CONTRACT NUMBER - 62B05

State Job # - C-91-376-15

Project Number | **Route**

County Name - COOK- -
Code - 31 - -
District - 1 - -
Section Number - 2015-045RS

*REVISED: JANUARY 5, 2016

FAP 347

Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
42400200	PC CONC SIDEWALK 5	SQ FT	5,334.000				
42400800	DETECTABLE WARNINGS	SQ FT	300.000				
*DEL ~~44000153~~	~~HMA SURF REM 1~~	~~SQ YD~~	~~5,796.000~~				
*ADD 44000156	HMA SURF REM 1 3/4	SQ YD	5,796.000				
44000159	HMA SURF REM 2 1/2	SQ YD	43,431.000				
44000600	SIDEWALK REM	SQ FT	5,334.000				
44201789	CL D PATCH T2 12	SQ YD	169.000				
44201794	CL D PATCH T3 12	SQ YD	207.000				
44201796	CL D PATCH T4 12	SQ YD	317.000				
60300105	FR & GRATES ADJUST	EACH	5.000				
60300305	FR & LIDS ADJUST	EACH	25.000				
60406520	FR & LIDS OL (CHGO)	EACH	5.000				
60406530	FR & LIDS CL (CHGO)	EACH	5.000				
*ADD 66900200	NON SPL WASTE DISPOSL	CU YD	36.000				
*ADD 66900450	SPL WASTE PLNS/REPORT	L SUM	1.000				

ILLINOIS DEPARTMENT OF TRANSPORTATION
SCHEDULE OF PRICES
CONTRACT NUMBER - 62B05

State Job # - C-91-376-15

Project Number *REVISED: JANUARY 5, 2016

Route FAP 347

County Name - COOK- -
Code - 31 - -
District - 1 - -
Section Number - 2015-045RS

Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
*ADD 66900530	SOIL DISPOSAL ANALY	EACH	1.000				
67000400	ENGR FIELD OFFICE A	CAL MO	3.000				
67100100	MOBILIZATION	L SUM	1.000				
70102625	TR CONT & PROT 701606	L SUM	1.000				
70102630	TR CONT & PROT 701601	L SUM	1.000				
70102632	TR CONT & PROT 701602	L SUM	1.000				
70102635	TR CONT & PROT 701701	L SUM	1.000				
70102640	TR CONT & PROT 701801	L SUM	1.000				
70300100	SHORT TERM PAVT MKING	FOOT	9,501.000				
70300210	TEMP PVT MK LTR & SYM	SQ FT	834.000				
70300220	TEMP PVT MK LINE 4	FOOT	20,701.000				
70300240	TEMP PVT MK LINE 6	FOOT	1,812.000				
70300260	TEMP PVT MK LINE 12	FOOT	2,204.000				
70300280	TEMP PVT MK LINE 24	FOOT	445.000				
70301000	WORK ZONE PAVT MK REM	SQ FT	11,947.000				

ILLINOIS DEPARTMENT OF TRANSPORTATION
SCHEDULE OF PRICES
CONTRACT NUMBER - 62B05

State Job # - C-91-376-15

Project Number *REVISED: JANUARY 5, 2016

Route FAP 347

County Name - COOK- -
Code - 31 - -
District - 1 - -
Section Number - 2015-045RS

Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
78000100	THPL PVT MK LTR & SYM	SQ FT	834.000				
78000200	THPL PVT MK LINE 4	FOOT	20,701.000				
78000400	THPL PVT MK LINE 6	FOOT	1,812.000				
78000600	THPL PVT MK LINE 12	FOOT	2,204.000				
78000650	THPL PVT MK LINE 24	FOOT	445.000				
88600600	DET LOOP REPL	FOOT	384.000				

CONTRACT NUMBER **62B05**

THIS IS THE TOTAL BID **$** _____

NOTES:

1. **Each PAY ITEM should have a UNIT PRICE and a TOTAL PRICE.**
2. **The UNIT PRICE shall govern if no TOTAL PRICE is shown or if there is a discrepancy between the product of the UNIT PRICE multiplied by the QUANTITY.**
3. **If a UNIT PRICE is omitted, the TOTAL PRICE will be divided by the QUANTITY in order to establish a UNIT PRICE.**
4. **A bid may be declared UNACCEPTABLE if neither a unit price nor a total price is shown.**

TABLE OF CONTENTS

Revise the table in Article 1030.05(d)(5) of the Supplemental Specifications to read:

"CONTROL CHART REQUIREMENTS	High ESAL, Low ESAL, SMA & IL-4.75
Gradation 1/ 3/	% Passing Sieves: 1/2 in. (12.5 mm) 2/ No. 4 (4.75 mm) No. 8 (2.36 mm) No. 30 (600 µm)
Total Dust Content 1/	No. 200 (75 µm)
	Asphalt Binder Content
	Bulk Specific Gravity
	Maximum Specific Gravity of Mixture
	Voids
	Density
	VMA

1/ Based on washed ignition oven.

2/ Does not apply to IL-4.75.

3/ SMA also requires the 3/8 in. (9.5 mm) sieve."

Delete Article 1030.05(d)(6)a.1.(b.) of the Standard Specifications.

Delete Article 1030.06(b) of the Standard Specifications.

Delete Article 1102.01(e) of the Standard Specifications.

Revised 1/6/16

Add the following to the end of Note 1. of article 1030.03 of the Standard Specifications:

"A dedicated storage tank for the Ground Tire Rubber (GTR) modified asphalt binder shall be provided. This tank must be capable of providing continuous mechanical mixing throughout by continuous agitation and recirculation of the asphalt binder to provide a uniform mixture. The tank shall be heated and capable of maintaining the temperature of the asphalt binder at 300 °F to 350 °F (149 °C to 177 °C). The asphalt binder metering systems of dryer drum plants shall be calibrated with the actual GTR modified asphalt binder material with an accuracy of ± 0.40 percent."

Revise 1030.02(c) of the Standard Specifications to read:

"(c) RAP Materials (Note 3) ……..1031"

Add the following note to 1030.02 of the Standard Specifications:

Note 3. When using reclaimed asphalt pavement and/or reclaimed asphalt shingles, the maximum asphalt binder replacement percentage shall be according to the most recent special provision for recycled materials.

RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES (MODIFIED D-1 FOR PILOT PROJECTS ONLY)

Effective: November 1, 2012 Revise: January 1, 2016

Revise Section 1031 of the Standard Specifications to read:

"**SECTION 1031. RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES**

1031.01 Description. Reclaimed asphalt pavement and reclaimed asphalt shingles shall be according to the following.

(a) Reclaimed Asphalt Pavement (RAP). RAP is the material resulting from cold milling or crushing an existing hot-mix asphalt (HMA) pavement. RAP will be considered processed FRAP after completion of both crushing and screening to size. The Contractor shall supply written documentation that the RAP originated from routes or airfields under federal, state, or local agency jurisdiction.

Revised 1/6/16

(b) Reclaimed Asphalt Shingles (RAS). Reclaimed asphalt shingles (RAS). RAS is from the processing and grinding of preconsumer or post-consumer shingles. RAS shall be a clean and uniform material with a maximum of 0.5 percent unacceptable material, as defined in Bureau of Materials and Physical Research Policy Memorandum "Reclaimed Asphalt Shingle (RAS) Sources", by weight of RAS. All RAS used shall come from a Bureau of Materials and Physical Research approved processing facility where it shall be ground and processed to 100 percent passing the 3/8 in. (9.5 mm) sieve and 90 percent passing the #4 (4.75 mm) sieve. RAS shall meet the testing requirements specified herein. In addition, RAS shall meet the following Type 1 or Type 2 requirements.

(1) Type 1. Type 1 RAS shall be processed, preconsumer asphalt shingles salvaged from the manufacture of residential asphalt roofing shingles.

(2) Type 2. Type 2 RAS shall be processed post-consumer shingles only, salvaged from residential, or four unit or less dwellings not subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP).

1031.02 Stockpiles. RAP and RAS stockpiles shall be according to the following.

(a) RAP Stockpiles. The Contractor shall construct individual, sealed RAP stockpiles meeting one of the following definitions. Additional processed RAP (FRAP) shall be stockpiled in a separate working pile, as designated in the QC Plan, and only added to the sealed stockpile when test results for the working pile are complete and are found to meet tolerances specified herein for the original sealed FRAP stockpile. Stockpiles shall be sufficiently separated to prevent intermingling at the base. All stockpiles (including unprocessed RAP and FRAP) shall be identified by signs indicating the type as listed below (i.e. "Non- Quality, FRAP -#4 or Type 2 RAS", etc…).

(1) Fractionated RAP (FRAP). FRAP shall consist of RAP from Class I, Superpave HMA (High and Low ESAL) or equivalent mixtures. The coarse aggregate in FRAP shall be crushed aggregate and may represent more than one aggregate type and/or quality but shall be at least C quality. All FRAP shall be processed prior to testing and sized into fractions with the separation occurring on or between the #4 (4.75 mm) and 1/2 in. (12.5 mm) sieves. Agglomerations shall be minimized such that 100 percent of the RAP in the coarse fraction shall pass the maximum sieve size specified for the mix the FRAP will be used in.

(2) Restricted FRAP (B quality) stockpiles shall consist of RAP from Class I, Superpave (High ESAL), or HMA (High ESAL). If approved by the Engineer, the aggregate from a maximum 3.0 in. (75 mm) single combined pass of surface/binder milling will be classified as B quality. All millings from this application will be processed into FRAP as described previously.

Revised 1/6/16

(3) Conglomerate. Conglomerate RAP stockpiles shall consist of RAP from Class I, Superpave HMA (High and Low ESAL) or equivalent mixtures. The coarse aggregate in this RAP shall be crushed aggregate and may represent more than one aggregate type and/or quality but shall be at least C quality. This RAP may have an inconsistent gradation and/or asphalt binder content prior to processing. All conglomerate RAP shall be processed (FRAP) prior to testing. Conglomerate RAP stockpiles shall not contain steel slag or other expansive material as determined by the Department.

(4) Conglomerate "D" Quality (DQ). Conglomerate DQ RAP stockpiles shall consist of RAP from HMA shoulders, bituminous stabilized subbases or Superpave (Low ESAL)/HMA (Low ESAL) IL-19.0L binder mixture. The coarse aggregate in this RAP may be crushed or round but shall be at least D quality. This RAP may have an inconsistent gradation and/or asphalt binder content. Conglomerate DQ RAP stockpiles shall not contain steel slag or other expansive material as determined by the Department.

(5) Non-Quality. RAP stockpiles that do not meet the requirements of the stockpile categories listed above shall be classified as "Non-Quality".

RAP or FRAP containing contaminants, such as earth, brick, sand, concrete, sheet asphalt, bituminous surface treatment (i.e. chip seal), pavement fabric, joint sealants, plant cleanout etc., will be unacceptable unless the contaminants are removed to the satisfaction of the Engineer. Sheet asphalt shall be stockpiled separately.

(b) RAS Stockpiles. Type 1 and Type 2 RAS shall be stockpiled separately and shall be sufficiently separated to prevent intermingling at the base. Each stockpile shall be signed indicating what type of RAS is present.

However, a RAS source may submit a written request to the Department for approval to blend mechanically a specified ratio of Type 1 RAS with Type 2 RAS. The source will not be permitted to change the ratio of the blend without the Department prior written approval. The Engineer's written approval will be required, to mechanically blend RAS with any fine aggregate produced under the AGCS, up to an equal weight of RAS, to improve workability. The fine aggregate shall be "B Quality" or better from an approved Aggregate Gradation Control System source. The fine aggregate shall be one that is approved for use in the HMA mixture and accounted for in the mix design and during HMA production.

Records identifying the shingle processing facility supplying the RAS, RAS type and lot number shall be maintained by project contract number and kept for a minimum of three years.

Revised 1/6/16

1031.03 Testing. FRAP and RAS testing shall be according to the following.

(a) FRAP Testing. When used in HMA, the FRAP shall be sampled and tested either during processing or after stockpiling. It shall also be sampled during HMA production.

(1) During Stockpiling. For testing during stockpiling, washed extraction samples shall be run at the minimum frequency of one sample per 500 tons (450 metric tons) for the first 2000 tons (1800 metric tons) and one sample per 2000 tons (1800 metric tons) thereafter. A minimum of five tests shall be required for stockpiles less than 4000 tons (3600 metric tons).

(2) Incoming Material. For testing as incoming material, washed extraction samples shall be run at a minimum frequency of one sample per 2000 tons (1800 metric tons) or once per week, whichever comes first.

(3) After Stockpiling. For testing after stockpiling, the Contractor shall submit a plan for approval to the District proposing a satisfactory method of sampling and testing the RAP/FRAP pile either in-situ or by restockpiling. The sampling plan shall meet the minimum frequency required above and detail the procedure used to obtain representative samples throughout the pile for testing.

Before extraction, each field sample of FRAP, shall be split to obtain two samples of test sample size. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedure. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

(b) RAS Testing. RAS shall be sampled and tested during stockpiling according to Bureau of Materials and Physical Research Policy Memorandum, “Reclaimed Asphalt Shingle (RAS) Sources”. The Contractor shall also sample as incoming material at the HMA plant.

(1) During Stockpiling. Washed extraction and testing for unacceptable materials shall be run at the minimum frequency of one sample per 200 tons (180 metric tons) for the first 1000 tons (900 metric tons) and one sample per 1000 tons (900 metric tons) thereafter. A minimum of five samples are required for stockpiles less than 1000 tons (900 metric tons). Once a ≤ 1000 ton (900 metric ton), five-sample/test stockpile has been established it shall be sealed. Additional incoming RAS shall be in a separate working pile as designated in the Quality Control plan and only added to the sealed stockpile when the test results of the working pile are complete and are found to meet the tolerances specified herein for the original sealed RAS stockpile.

(2) Incoming Material. For testing as incoming material at the HMA plant, washed extraction shall be run at the minimum frequency of one sample per 250 tons (227 metric tons). A minimum of five samples are required for stockpiles less than 1000 tons (900 metric tons). The incoming material test results shall meet the tolerances specified herein.

The Contractor shall obtain and make available all test results from start of the initial stockpile sampled and tested at the shingle processing facility in accordance with the facility's QC Plan.

Before extraction, each field sample shall be split to obtain two samples of test sample size. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedures. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

1031.04 Evaluation of Tests. Evaluation of test results shall be according to the following.

(a) Evaluation of FRAP Test Results. All test results shall be compiled to include asphalt binder content, gradation and, when applicable (for slag), G_{mm}. A five test average of results from the original pile will be used in the mix designs. Individual extraction test results run thereafter, shall be compared to the average used for the mix design, and will be accepted if within the tolerances listed below.

Parameter	FRAP
No. 4 (4.75 mm)	± 6 %
No. 8 (2.36 mm)	± 5 %
No. 30 (600 μm)	± 5 %
No. 200 (75 μm)	± 2.0 %
Asphalt Binder	± 0.3 %
G_{mm}	± 0.03 [1/]

1/ For stockpile with slag or steel slag present as determined in the current Manual of Test Procedures Appendix B 21, "Determination of Reclaimed Asphalt Pavement Aggregate Bulk Specific Gravity".

If any individual sieve and/or asphalt binder content tests are out of the above tolerances when compared to the average used for the mix design, the FRAP stockpile shall not be used in Hot-Mix Asphalt unless the FRAP representing those tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

The Contractor shall maintain a representative moving average of five tests to be used for Hot-Mix Asphalt production.

With the approval of the Engineer, the ignition oven may be substituted for extractions according to the Illinois Test Procedure, "Calibration of the Ignition Oven for the Purpose of Characterizing Reclaimed Asphalt Pavement (RAP)" or Illinois Modified AASHTO T-164-11, Test Method A.

Revised 1/6/16

(b) Evaluation of RAS Test Results. All of the test results, with the exception of percent unacceptable materials, shall be compiled and averaged for asphalt binder content and gradation. A five test average of results from the original pile will be used in the mix designs. Individual test results run thereafter, when compared to the average used for the mix design, will be accepted if within the tolerances listed below.

Parameter	RAS
No. 8 (2.36 mm)	± 5 %
No. 16 (1.18 mm)	± 5 %
No. 30 (600 µm)	± 4 %
No. 200 (75 µm)	± 2.5 %
Asphalt Binder Content	± 2.0 %

If any individual sieve and/or asphalt binder content tests are out of the above tolerances when compared to the average used for the mix design, the RAS shall not be used in Hot-Mix Asphalt unless the RAS representing those tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

(c) Quality Assurance by the Engineer. The Engineer may witness the sampling and splitting conduct assurance tests on split samples taken by the Contractor for quality control testing a minimum of once a month.

The overall testing frequency will be performed over the entire range of Contractor samples for asphalt binder content and gradation. The Engineer may select any or all split samples for assurance testing. The test results will be made available to the Contractor as soon as they become available.

The Engineer will notify the Contractor of observed deficiencies.

Differences between the Contractor's and the Engineer's split sample test results will be considered acceptable if within the following limits.

Test Parameter	Acceptable Limits of Precision	
% Passing:[1/]	FRAP	RAS
1/2 in.	5.0%	
No. 4	5.0%	
No. 8	3.0%	4.0%
No. 30	2.0%	3.0%
No. 200	2.2%	2.5%
Asphalt Binder Content	0.3%	1.0%
G_{mm}	0.030	

1/ Based on washed extraction.

In the event comparisons are outside the above acceptable limits of precision, the Engineer will immediately investigate.

Revised 1/6/16

(d) Acceptance by the Engineer. Acceptable of the material will be based on the validation of the Contractor's quality control by the assurance process.

1031.05 Quality Designation of Aggregate in RAP and FRAP.

(a) RAP. The aggregate quality of the RAP for homogenous, conglomerate, and conglomerate "D" quality stockpiles shall be set by the lowest quality of coarse aggregate in the RAP stockpile and are designated as follows.

(1) RAP from Class I, Superpave/HMA (High ESAL), or (Low ESAL) IL-9.5L surface mixtures are designated as containing Class B quality coarse aggregate.

(2) RAP from Superpave/HMA (Low ESAL) IL-19.0L binder mixture is designated as Class D quality coarse aggregate.

(3) RAP from Class I, Superpave/HMA (High ESAL) binder mixtures, bituminous base course mixtures, and bituminous base course widening mixtures are designated as containing Class C quality coarse aggregate.

(4) RAP from bituminous stabilized subbase and BAM shoulders are designated as containing Class D quality coarse aggregate.

(b) FRAP. If the Engineer has documentation of the quality of the FRAP aggregate, the Contractor shall use the assigned quality provided by the Engineer.

If the quality is not known, the quality shall be determined as follows. Fractionated RAP stockpiles containing plus #4 (4.75 mm) sieve coarse aggregate shall have a maximum tonnage of 5,000 tons (4,500 metric tons). The Contractor shall obtain a representative sample witnessed by the Engineer. The sample shall be a minimum of 50 lb (25 kg). The sample shall be extracted according to Illinois Modified AASHTO T 164 by a consultant prequalified by the Department for the specified testing. The consultant shall submit the test results along with the recovered aggregate to the District Office. The cost for this testing shall be paid by the Contractor. The District will forward the sample to the Bureau of Materials and Physical Research Aggregate Lab for MicroDeval Testing, according to Illinois Modified AASHTO T 327. A maximum loss of 15.0 percent will be applied for all HMA applications. The fine aggregate portion of the fractionated RAP shall not be used in any HMA mixtures that require a minimum of "B" quality aggregate or better, until the coarse aggregate fraction has been determined to be acceptable thru a MicroDeval Testing.

Revised 1/6/16

1031.06 Use of FRAP and/or RAS in HMA. The use of FRAP and/or RAS shall be a Contractor's option when constructing HMA in all contracts.

(a) FRAP. The use of FRAP in HMA shall be as follows.

(1) Coarse Aggregate Size (after extraction). The coarse aggregate in all FRAP shall be equal to or less than the nominal maximum size requirement for the HMA mixture to be produced.

(2) Steel Slag Stockpiles. FRAP stockpiles containing steel slag or other expansive material, as determined by the Department, shall be homogeneous and will be approved for use in HMA (High ESAL and Low ESAL) mixtures regardless of lift or mix type.

(3) Use in HMA Surface Mixtures (High and Low ESAL). FRAP stockpiles for use in HMA surface mixtures (High and Low ESAL) shall have coarse aggregate that is Class B quality or better. FRAP shall be considered equivalent to limestone for frictional considerations unless produced/screened to minus 3/8 inch.

(4) Use in HMA Binder Mixtures (High and Low ESAL), HMA Base Course, and HMA Base Course Widening. FRAP stockpiles for use in HMA binder mixtures (High and Low ESAL), HMA base course, and HMA base course widening shall be FRAP in which the coarse aggregate is Class C quality or better.

(5) Use in Shoulders and Subbase. FRAP stockpiles for use in HMA shoulders and stabilized subbase (HMA) shall be FRAP, Restricted FRAP, conglomerate, or conglomerate DQ.

(b) RAS. RAS meeting Type 1 or Type 2 requirements will be permitted in all HMA applications as specified herein.

Revised 1/6/16

(c) FRAP and/or RAS Usage Limits. Type 1 or Type 2 RAS may be used alone or in conjunction with FRAP in HMA mixtures up to a maximum of 5.0 percent by weight of the total mix.

When FRAP is used alone or FRAP is used in conjunction with RAS, the percent of virgin asphalt binder replacement (ABR) shall not exceed the amounts indicated in the table below for a given N Design.

Max Asphalt Binder Replacement for FRAP with RAS Combination

HMA Mixtures [1/ 2/]	Maximum % ABR		
Ndesign	Binder/Leveling Binder	Surface	Polymer Modified [3/]
30L	55	45	30
50	45	40	30
70	45	35	30
90	45	35	30
4.75 mm N-50			40
SMA N-80			30

1/ For Low ESAL HMA shoulder and stabilized subbase, the percent asphalt binder replacement shall not exceed 50 % of the total asphalt binder in the mixture.

2/ When the binder replacement exceeds 15 % for all mixes, except for SMA and IL-4.75, the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 % binder replacement using a virgin asphalt binder grade of PG64-22 will be reduced to a PG58-28). When constructing full depth HMA and the ABR is less than 15 %, the required virgin asphalt binder grade shall be PG64-28.

3/ When the ABR for SMA or IL-4.75 is 15 % or less, the required virgin asphalt binder shall be SBS PG76-22 and the elastic recovery shall be a minimum of 80. When the ABR for SMA or IL-4.75 exceeds 15%, the virgin asphalt binder grade shall be SBS PG70-28 and the elastic recovery shall be a minimum of 80.

1031.07 HMA Mix Designs. At the Contractor's option, HMA mixtures may be constructed utilizing RAP/FRAP and/or RAS material meeting the detailed requirements specified herein.

(a) FRAP and/or RAS. FRAP and /or RAS mix designs shall be submitted for verification. If additional FRAP or RAS stockpiles are tested and found to be within tolerance, as defined under "Evaluation of Tests" herein, and meet all requirements herein, the additional FRAP or RAS stockpiles may be used in the original design at the percent previously verified.

(b) RAS. Type 1 and Type 2 RAS are not interchangeable in a mix design. A RAS stone bulk specific gravity (Gsb) of 2.300 shall be used for mix design purposes.

1031.08 HMA Production. HMA production utilizing FRAP and/or RAS shall be as follows.

To remove or reduce agglomerated material, a scalping screen, gator, crushing unit, or comparable sizing device approved by the Engineer shall be used in the RAS and FRAP feed system to remove or reduce oversized material. If material passing the sizing device adversely affects the mix production or quality of the mix, the sizing device shall be set at a size specified by the Engineer.

If during mix production, corrective actions fail to maintain FRAP, RAS or QC/QA test results within control tolerances or the requirements listed herein the Contractor shall cease production of the mixture containing FRAP or RAS and conduct an investigation that may require a new mix design.

(a) RAS. RAS shall be incorporated into the HMA mixture either by a separate weight depletion system or by using the RAP weigh belt. Either feed system shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for all rates of production and batch sizes. The portion of RAS shall be controlled accurately to within ± 0.5 percent of the amount of RAS utilized. When using the weight depletion system, flow indicators or sensing devices shall be provided and interlocked with the plant controls such that the mixture production is halted when RAS flow is interrupted.

(b) HMA Plant Requirements. HMA plants utilizing FRAP and/or RAS shall be capable of automatically recording and printing the following information.

(1) Dryer Drum Plants.

a. Date, month, year, and time to the nearest minute for each print.

b. HMA mix number assigned by the Department.

c. Accumulated weight of dry aggregate (combined or individual) in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).

d. Accumulated dry weight of RAS and FRAP in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).

e. Accumulated mineral filler in revolutions, tons (metric tons), etc. to the nearest 0.1 unit.

f. Accumulated asphalt binder in gallons (liters), tons (metric tons), etc. to the nearest 0.1 unit.

g. Residual asphalt binder in the RAS and FRAP material as a percent of the total mix to the nearest 0.1 percent.

h. Aggregate RAS and FRAP moisture compensators in percent as set on the control panel. (Required when accumulated or individual aggregate and RAS and FRAP are printed in wet condition.)

i. When producing mixtures with FRAP and/or RAS, a positive dust control system shall be utilized.

j. Accumulated mixture tonnage.

k. Dust Removed (accumulated to the nearest 0.1 ton (0.1 metric ton))

(2) Batch Plants.

a. Date, month, year, and time to the nearest minute for each print.

b. HMA mix number assigned by the Department.

c. Individual virgin aggregate hot bin batch weights to the nearest pound (kilogram).

d. Mineral filler weight to the nearest pound (kilogram).

f. RAS and FRAP weight to the nearest pound (kilogram).

g. Virgin asphalt binder weight to the nearest pound (kilogram).

h. Residual asphalt binder in the RAS and FRAP material as a percent of the total mix to the nearest 0.1 percent.

The printouts shall be maintained in a file at the plant for a minimum of one year or as directed by the Engineer and shall be made available upon request. The printing system will be inspected by the Engineer prior to production and verified at the beginning of each construction season thereafter.

1031.09 RAP in Aggregate Surface Course and Aggregate Wedge Shoulders, Type B. The use of RAP or FRAP in aggregate surface course and aggregate shoulders shall be as follows.

(a) Stockpiles and Testing. RAP stockpiles may be any of those listed in Article 1031.02, except “Non-Quality” and “FRAP”. The testing requirements of Article 1031.03 shall not apply. RAP used shall be according to the current Bureau of Materials and Physical Research’s Policy Memorandum, “Reclaimed Asphalt Pavement (RAP) for Aggregate Applications”

(b) Gradation. The RAP material shall meet the gradation requirements for CA 6 according to Article 1004.01(c), except the requirements for the minus No. 200 (75 µm) sieve shall not apply. The sample for the RAP material shall be air dried to constant weight prior to being tested for gradation.”

Revised 1/6/16

HOT MIX ASPHALT QUALITY CONTROL FOR PERFORMANCE (BMPR)
Effective: January 1, 2012 Revised: January 16, 2015

Description. This special provision describes the procedures for production, placement and payment of hot-mix asphalt (HMA). This special provision shall apply to all pay items as specified in plans. This work shall be according to the Standard Specifications except as modified herein.

Exceptions may be approved for small tonnage less than 800 (725 metric) tons and miscellaneous mixture applications as defined by the Engineer.

Delete Articles:	406.06(b)(1), 2nd Paragraph	(Temperature requirements)
	406.06 (e), 3rd Paragraph	(Pavers speed requirements)
	406.07(b)	(Rolling)
	406.07(c)	(Density)
	1030.05(a)(4, 5, 9)	(QC/QA Documents)
	1030.05(d)(2)a.	(Plant Tests)
	1030.05(d)(2)b.	(Dust-to-Asphalt and Moisture Content)
	1030.05(d)(2)d.	(Small Tonnage)
	1030.05(d)(2)f.	(HMA Sampling)
	1030.05(d)(3)	(Required Field Tests)
	1030.05(d)(4)	(Control Limits)
	1030.05(d)(5)	(Control Charts)
	1030.05(d)(7)	(Corrective Action for Field Tests (Density))
	1030.05(e)	(Quality Assurance by the Engineer)
	1030.05(f)	(Acceptance by the Engineer)
	1030.06(a), 3rd paragraph	(Before start-up…)
	1030.06(a), 7th paragraph	(After an acceptable…)
	1030.06(a), 8th paragraph	(If a mixture…)
	1030.06(a), 9th paragraph	(A nuclear/core…)

Definitions:

(a) Quality Control (QC): All production and construction activities by the Contractor required to achieve the required level of quality.

(b) Quality Assurance (QA): All monitoring and testing activities by the Engineer required to assess product quality, level of payment, and acceptability of the product.

(c) Pay Parameters: Pay Parameters shall be field Voids in the Mineral Aggregate (VMA), voids, and density. Field VMA will be calculated using the combined aggregates bulk specific gravity (G_{sb}) from the mix design.

Revised 1/6/16

REMOVAL AND DISPOSAL OF REGULATED SUBSTANCES

This work shall be according to Article 669 of the Standard Specifications and the following:

Qualifications. The term environmental firm shall mean an environmental firm with at least five (5) documented leaking underground storage tank (LUST) cleanups or that is pre-qualified in hazardous waste by the Department. Documentation includes but not limited to verifying remediation and special waste operations for sites contaminated with gasoline, diesel, or waste oil in accordance with all Federal, State, or local regulatory requirements and shall be provided to the Engineer for approval. The environmental firm selected shall not be a former or current consultant or have any ties with any of the properties contained within and/or adjacent to this construction project.

General. This Special Provision will likely require the Contractor to subcontract for the execution of certain activities.

All contaminated materials shall be managed as either "uncontaminated soil" or non-special waste. This work shall include monitoring and potential sampling, analytical testing, and management of a material contaminated by regulated substances. The Environmental Firm shall continuously monitor all soil excavation for worker protection and soil contamination. **Phase I Preliminary Engineering information is available through the District's Environmental Studies Unit.** Soil samples or analysis without the approval of the Engineer will be at no additional cost to the Department. The lateral distance is measured from centerline and the farthest distance is the offset distance or construction limit whichever is less.

The following areas in each listed municipality should be monitored by the Environmental Firm for soil contamination and worker protection:

W. Roosevelt Road (Intersection of S. Springfield Ave and W. Roosevelt Road)

- Station 106+25 (CL W. Roosevelt Road), 30 feet LT and 30 feet RT, excavation associated with ADA ramps (Intersection of S. Springfield Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.
- Station 106+85 (CL W. Roosevelt Road), 30 feet LT and 30 feet RT, excavation associated with ADA ramps (Intersection of S. Springfield Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.

W. Roosevelt Road (Intersection of S. Independence Boulevard and W. Roosevelt Road.)

- Station 113+95 (CL W. Roosevelt Road), 35 feet LT and 35 feet RT, excavation associated with ADA ramps (Intersection of S. Independence Boulevard and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.

Added 1/6/16

W. Roosevelt Road (Intersection of S. Lawndale Avenue and W. Roosevelt Road)

- Station 120+10 (CL W. Roosevelt Road), 30 feet LT and 30 feet RT, excavation associated with ADA ramps (Intersection of S. Lawndale Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.

W. Roosevelt Road (Intersection of S. St. Louis Avenue and W. Roosevelt Road)

- Station 132+80 (CL W. Roosevelt Road), 30 feet LT, excavation associated with ADA ramps (Intersection of S. St. Louis Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.
- Station 133+35 (CL W. Roosevelt Road), 30 feet LT, excavation associated with ADA ramps (Intersection of S. St. Louis Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.

W. Roosevelt Road (Intersection of S. Sacramento Avenue and W. Roosevelt Road)

- Station 166+05 (CL W. Roosevelt Road), 35 feet RT, excavation associated with ADA ramps (Intersection of S. Sacramento Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.
- Station 166+65 (CL W. Roosevelt Road), 35 feet RT, excavation associated with ADA ramps (Intersection of S. Sacramento Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.

W. Roosevelt Road (Intersection of S. Mozart Avenue and W. Roosevelt Road)

- Station 176+55 (CL W. Roosevelt Road), 30 feet RT, excavation associated with ADA ramps (Intersection of S. Mozart Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.

W. Roosevelt Road (Intersection of S. Washtenaw Avenue and W. Roosevelt Road)

- Station 186+65 (CL W. Roosevelt Road), 30 feet LT, excavation associated with ADA ramps (Intersection of S. Washtenaw Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.

W. Roosevelt Road (Intersection of S. Campbell Avenue and W. Roosevelt Road)

- Station 197+80 (CL W. Roosevelt Road), 45 feet RT, excavation associated with ADA ramps (Intersection of S. Campbell Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.
- Station 198+20 (CL W. Roosevelt Road), 45 feet RT, excavation associated with ADA ramps (Intersection of S. Campbell Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.

Added 1/6/16

- Station 199+70 (CL W. Roosevelt Road), 45 feet LT, excavation associated with ADA ramps (Intersection of S. Campbell Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.
- Station 200+10 (CL W. Roosevelt Road), 45 feet LT, excavation associated with ADA ramps (Intersection of S. Campbell Avenue and W. Roosevelt Road, Chicago). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: VOCs, SVOCs and Metals.

HOT-MIX ASPHALT – MIXTURE DESIGN VERIFICATION AND PRODUCTION (MODIFIED FOR PILOT PROJECTS ONLY)

Effective: November 1, 2013 Revised: January 1, 2016

Description. This special provision provides the requirements for Hamburg Wheel, and Tensile Strength Testing for High ESAL, IL-4.75, and Stone Matrix Asphalt (SMA) hot-mix asphalt (HMA) mixes during mix design verification and production. In addition, this special provision provides the requirements for Illinois Flexibility Index Test (I-FIT) and Disk Compact Tension (DCT) testing for Low ESAL, High ESAL, IL-4.75, and Stone Matrix Asphalt (SMA) HMA mixes (excluding Class D patches, pavement patching and incidental HMA) during mix design verification and production. This special provision also provides the plant requirements for hydrated lime addition systems used in the production of High ESAL, IL-4.75, and SMA mixes.

Mix Design Testing. Add the following referenced AASHTO, ASTM and Illinois standards in Article 1030.04 of the Standard Specifications:

IL Modified AASHTO T 324	Hamburg Wheel Test
IL Modified AASHTO T 283	Tensile Strength Test
Illinois Test Procedure (ITP) 405	Illinois Flexibility Index Test (I-FIT) (see attached)
ASTM D 7313	Disk-Shaped Compact Tension (DCT) Test[1/]

1/ DCT Testing Temperature equal to specified asphalt binder performance grade (PG) low temperature + 10 °C

Added 1/6/16

Add the following to Article 1030.04 of the Standard Specifications.

"(d) Verification Testing. High ESAL, IL-4.75, and SMA mix designs submitted for verification will be tested to ensure that the resulting mix designs will pass the required criteria for the Hamburg Wheel Test (Illinois Modified AASHTO T 324), Tensile Strength Test (Illinois Modified AASHTO T 283) and the I-FIT (ITP 405). Low ESAL mix designs submitted for verification will be tested to ensure that the resulting mix designs will pass the required criteria for the I-FIT. For informational purposes, the Contractor shall provide the mixture fracture energy from the DCT Test (ASTM D 7313) for all mixes subject to I-FIT testing. The Department will perform a verification test on gyratory specimens compacted by the Contractor. If the mix fails the Department's verification test, the Contractor shall make necessary changes to the mix and provide passing Hamburg Wheel, Tensile Strength, and I-FIT test results from a private lab. The Department will verify the passing results.

All new and renewal mix designs shall meet the following requirements for verification testing.

(1) Hamburg Wheel Test Criteria. The maximum allowable rut depth shall be 0.5 in. (12.5 mm). The minimum number of wheel passes at the 0.5 in. (12.5 mm) rut depth criteria shall be based on the high temperature binder grade of the mix as specified in the mix requirements table of the plans.

Illinois Modified AASHTO T 324 Requirements [1/]

PG Grade	Number of Passes
PG 58-xx (or lower)	5,000
PG 64-xx	7,500
PG 70-xx	15,000
PG 76-xx (or higher)	20,000

1/ When produced at temperatures of 275 ± 5 °F (135 ± 3 °C) or less, loose Warm Mix Asphalt shall be oven aged at 270 ± 5 °F (132 ± 3 °C) for two hours prior to gyratory compaction of Hamburg Wheel specimens.

(2) Tensile Strength Criteria. The minimum allowable conditioned tensile strength shall be 60 psi (415 kPa) for non-polymer modified performance graded (PG) asphalt binder and 80 psi (550 kPa) for polymer modified PG asphalt binder. The maximum allowable unconditioned tensile strength shall be 200 psi (1380 kPa).

(3) I-FIT Flexibility Index (FI) Criteria.[1/] The minimum allowable FI shall be as follows:

Minimum Flexibility Index (FI)	
HMA	8.0

1/ Existing mix designs shall also meet the FI Criteria for verification testing."

Added 1/6/16

Production Testing. Revise Article 1030.06(a) of the Standard Specifications to read:

"(a) High ESAL, IL-4.75, WMA, and SMA Mixtures. A 300 ton (275 metric tons) test strip will be required at the beginning of HMA production for each mixture. The test strip shall be according to the Manual of Test Procedures for Materials "Hot Mix Asphalt Test Strip Procedures", except the minimum 3000 ton (2750 metric ton) quantity requirement does not apply and the mixture sampled to represent the test strip shall include material sufficient for the Department to conduct Hamburg Wheel testing according to Illinois modified AASHTO T 324 and I-FIT testing according to ITP 405.

Before start-up, target values shall be determined by applying gradation correction factors to the JMF when applicable. These correction factors shall be determined from previous experience. The target values, when approved by the Engineer, shall be used to control HMA production. Plant settings and control charts shall be set according to target values.

Before constructing the test strip, target values shall be determined by applying gradation correction factors to the JMF when applicable. After any JMF adjustment, the JMF shall become the Adjusted Job Mix Formula (AJMF). Upon completion of the first acceptable test strip, the JMF shall become the AJMF regardless of whether or not the JMF has been adjusted. If an adjustment/plant change is made, the Engineer may require a new test strip to be constructed. If the HMA placed during the initial test strip is determined to be unacceptable to remain in place by the Engineer, it shall be removed and replaced.

The limitations between the JMF and AJMF are as follows.

Parameter	Adjustment
1/2 in. (12.5 mm)	± 5.0 %
No. 4 (4.75 mm)	± 4.0 %
No. 8 (2.36 mm)	± 3.0 %
No. 30 (600 µm)	*
No. 200 (75 µm)	*
Asphalt Binder Content	± 0.3 %

* In no case shall the target for the amount passing be greater than the JMF.

Any adjustments outside the above limitations will require a new mix design.

Added 1/6/16

Mixture sampled to represent the test strip shall include additional material sufficient for the Department to conduct the following tests:

- Hamburg Wheel testing according to Illinois Modified AASHTO T 324 (approximately 60 lb (27 kg) total).

- I-FIT testing according to the ITP 405 (approximately 200 lb (91 kg) total which allows additional aging research testing at the Bureau of Materials and Physical Research).

Additional material shall also be sampled and tested, by the Contractor, per the DCT test (ASTM D 7313). The DCT test results shall be submitted to the Department within 15 days from the time it was sampled.

The Contractor shall immediately cease production upon notification by the Engineer of a failing Hamburg Wheel test and/or I-FIT per the criteria specified in Article 1030.04(d)(1) and (3) herein. All prior produced material may be paved out provided all other mixture criteria is being met. No additional mixture shall be produced until the Engineer receives passing Hamburg Wheel test and I-FIT results.

The Department may conduct additional Hamburg Wheel or I-FIT testing on production material as determined by the Engineer."

Add the following to Article 1030.06(b) of the Standard Specifications:

"The Department will perform I-FIT testing according to the ITP 405 for Low ESAL mixtures (excluding Class D patches, pavement patching and incidental HMA) during mixture production. Approximately 200 lb (91 kg) total of mix shall be sampled (which allows additional aging research testing at the Bureau of Materials and Physical Research).

Additional material shall also be sampled and tested per the DCT test (ASTM D 7313). The DCT test results shall be submitted to the Department within 15 days from the time it was sampled.

The Contractor shall immediately cease production upon notification by the Engineer of a failing I-FIT per the criteria specified in Article 1030.04(d)(3) herein. All prior produced material may be paved out provided all other mixture criteria is being met. No additional mixture shall be produced until the Engineer receives passing I-FIT results.

The Department may conduct additional I-FIT testing on production material as determined by the Engineer."

Revise the title of Article 1030.06(b) of the Standard Specifications to read:

"(b) Low ESAL Mixtures."

Added 1/6/16

System for Hydrated Lime Addition. Revise the fourth sentence of the third paragraph of Article 1030.04(c) of the Standard Specifications to read:

"The method of application shall be according to Article 1102.01(a)(10)."

Replace the first three sentences of the second paragraph of Article 1102.01(a)(10) of the Standard Specifications to read:

"When hydrated lime is used as the anti-strip additive, a separate bin or tank and feeder system shall be provided to store and accurately proportion the lime onto the aggregate either as a slurry, as dry lime applied to damp aggregates, or as dry lime injected onto the hot aggregates prior to adding the liquid asphalt cement. If the hydrated lime is added either as a slurry or as dry lime on damp aggregates, the lime and aggregates shall be mixed by a power driven pugmill to provide a uniform coating of the lime prior to entering the dryer. If dry hydrated lime is added to the hot dry aggregates in a dryer-drum plant, the lime shall be added in such a manner that the lime will not become entrained into the air stream of the dryer-drum and that thorough dry mixing shall occur prior to the injection point of the liquid asphalt. When a batch plant is used, the hydrated lime shall be added to the mixture in the weigh hopper or as approved by the Engineer."

Basis of Payment. Replace the seventh paragraph of Article 406.14 of the Standard Specifications with the following:

"For mixes designed and verified under the Hamburg Wheel criteria, the cost of furnishing and introducing anti-stripping additives in the HMA will not be paid for separately, but shall be considered as included in the contract unit price of the HMA item involved.

If an anti-stripping additive is required for any other HMA mix, the cost of the additive will be paid for according to Article 109.04. The cost incurred in introducing the additive into the HMA will not be paid for separately, but shall be considered as included in the contract unit price of the HMA item involved.

No additional compensation will be awarded to the Contractor because of reduced production rates associated with the addition of the anti-stripping additive."

Added 1/6/16

Illinois Test Procedure 405
Effective Date: January 1, 2016
Determining the Fracture Potential of Asphalt Mixtures Using the Illinois Flexibility Index Test (I-FIT)

SCOPE

This test method covers the determination of fracture energy (G_f) and post peak slope of asphalt mixtures using semicircular specimens in the Illinois Flexibility Index Test (I-FIT) conducted at an intermediate test temperature. These parameters are used to calculate the Flexibility Index (FI) to predict the resistance to fracture of an asphalt mixture. The index is used as part of the asphalt mixture evaluation and approval process. The method also includes procedures for calculating other relevant parameters derived from the load-displacement curve.

These procedures apply to test specimens having a nominal maximum aggregate size (NMAS) of 19 mm or less. Lab compacted and field core specimens can be used. Lab compacted specimens shall be 150 ± 1 mm in diameter and 50 ± 1 mm thick. When field cores are used, specimens shall be 150 ± 8 mm in diameter and 25 to 50 mm thick. A thickness correction factor will need to be developed and applied for field cores tested at a thickness less than 45 mm.

The I-FIT specimen is a half disc with a notch cut parallel to the loading and the vertical axis of the semicircular disc.

This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish and follow appropriate health and safety practices and determine the applicability of regulatory limitations prior to use.

REFERENCED DOCUMENTS

AASHTO Standards:

- T 166, Bulk Specific Gravity (G_{mb}) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
- T 209, Theoretical Maximum Specific Gravity (G_{mm}) and Density of Hot Mix Asphalt (HMA)
- T 269, Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
- T 283, Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage
- T 312, Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor

ASTM Standards:

- D 8, Standard Terminology Relating to Materials for Roads and Pavements
- D 3549/D 3549M, Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens
- D 5361/D 5361M, Standard Practice for Sampling Compacted Bituminous Mixtures for Laboratory Testing

Added 1/6/16

TERMINOLOGY

Definitions:

critical displacement, u_1, —the intersection of the post-peak slope with the displacement-axis.

displacement at peak load, u_0, —recorded displacement at peak load.

fracture energy, G_f —the energy required to create a unit surface area of a crack.

flexibility index, *FI* — an index intended to characterize the damage resistance of asphalt mixtures.

linear variable displacement transducer, LVDT—sensor device for measuring linear displacement.

ligament area, $Area_{lig}$—cross-sectional area of the specimen through which the crack propagates, calculated by multiplying the test specimen thickness and ligament length.

load line displacement, LLD—the displacement measured in the direction of the load application.

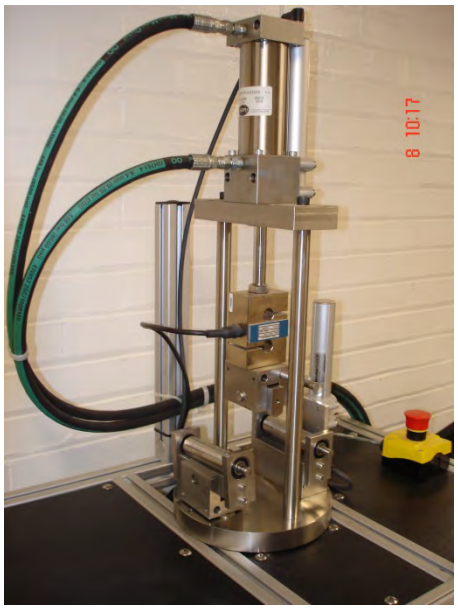
post-peak slope, m, —slope at the first inflection point of the load-displacement curve after the peak.

SUMMARY OF METHOD

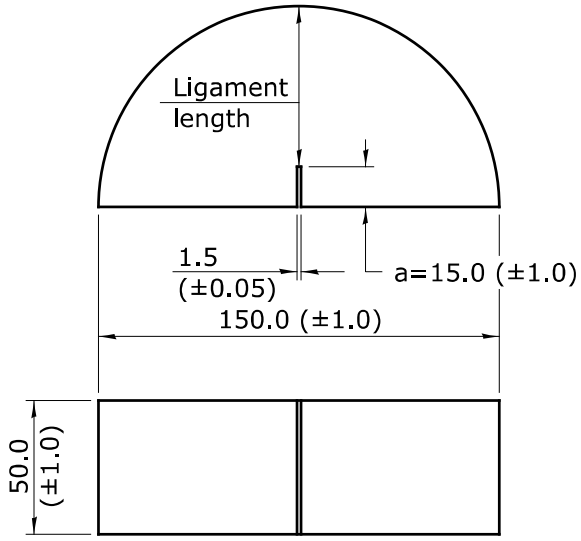
An asphalt pavement core or Superpave Gyratory Compactor (SGC) compacted asphalt mixture specimen is trimmed and cut in half to create a semicircular shaped test specimen. A notch is sawn in the flat side of the semicircular specimen opposite the curved edge. The specimen is conditioned and maintained through testing at 25°C (77°F). The specimen is positioned in the fixture with the notched side down centered on two rollers. A load is applied along the vertical radius of the specimen and the loads and Load Line Displacement (LLD) are measured during the entire duration of the test. The load is applied such that a constant LLD rate of 50 mm/min is obtained and maintained for the duration of the test. The I-FIT test fixture and I-FIT specimen geometry are shown in Figure 1.

Fracture Energy (G_f), post-peak slope (m), displacement at peak load (u_0), strength, critical displacement (u_1), and a FI are calculated from the load and LLD results.

Added 1/6/16



I-FIT Fixture



I-FIT Lab Compacted Specimen

Figure 1— I-FIT Fixture and test specimen and configuration (dimensions in millimeters)

SIGNIFICANCE AND USE

The I-FIT test is used to determine fracture resistance parameters of an asphalt mixture at an intermediate temperature. From the fracture parameters obtained at intermediate temperature, the FI of an asphalt mixture is calculated. The FI is calculated from the G_f and post-peak slope of load-displacement curve. The FI provides a means to identify brittle mixes that are prone to premature cracking. The range for an acceptable FI will vary according to local environmental conditions, application of the mixture, nominal maximum aggregate size (NMAS), asphalt performance grade (PG), air voids, and expectation of service life, etc.

The calculated G_f indicates an asphalt mixture's overall capacity to resist cracking related damage. Generally, a mixture with higher G_f can withstand greater stresses with higher damage resistance. The FI should not be directly used in structural design and analysis. FI values obtained using this procedure are used in ranking cracking resistance of alternative mixes for a given layer in a structural design. G_f is a specimen size, loading time, and temperature dependent property. Fracture mechanisms for viscoelastic materials are influenced by crack front viscoelasticity and bulk material (far from crack front) viscoelasticity. Total calculated G_f from this test includes the amount of energy dissipated by crack propagation, viscoelastic mechanisms away from the crack front, and other inelastic irreversible processes (frictional and damage processes at the loading and support points).

Added 1/6/16

G_f is used as part of the FI to identify mixtures with increased fracture resistance.

This test method can be used to measure and evaluate the cracking resistance of asphalt mixtures containing various asphalt binders, modifiers of asphalt binders, aggregate blends, fibers, and recycled materials.

The specimens can be readily obtained from SGC compacted cylinders or from field cores with a diameter of 150 mm.

APPARATUS

Testing Machine—A I-FIT test system consisting of a closed-loop axial loading device, a load measuring device, a bend test fixture, specimen deformation measurement devices, and a control and data acquisition system. A constant displacement-rate device such as a closed loop, feedback-controlled servo-hydraulic load frame shall be used.

Note 1—An electromechanical, screw driven machine may be used if results are comparable to a closed loop, feedback-controlled servo-hydraulic load frame.

Axial Loading Device—The loading device shall be capable of delivering a minimum load of 10N in compression with a minimum resolution of 5N.

Bend Test Fixture—The fixture is composed of a loading head, a steel base plate, and two steel rollers with a diameter (D) of 25 mm. The tip of the loading head has a contact curvature with a radius of 12.5 mm. The horizontal loading head shall pivot relative to the vertical loading axis to conform to slight specimen variations. Illustrations of the loading and supports are shown in Figures 2 and 3.

Method A—Typically the two 25 mm steel rollers are mounted on bearings through their axis of rotation and attached to the steel base plate with brackets. One of the steel rollers pivots on an axis perpendicular to the axis of loading to conform to slight specimen variations. A distance of 120 mm between the two steel rollers is maintained throughout the test.

Method B—An alternate fixture design uses two 25 mm steel rollers that each rotate in a U-shaped roller support steel block. The initial roller position is fixed by springs and backstops that establish the initial test spans dimension of 120 mm. The support rollers are allowed to rotate away from the backstops during the test; but remain in contact with the sample.

Internal Displacement Measuring Device— The displacement measurement can be performed using the machine's stroke (position) transducer if the resolution of the stroke is sufficient (0.01 mm or lower). The fracture test displacement data may be corrected for system compliance, loading-pin penetration and specimen compression by performing a calibration of the testing system.

External Displacement Measuring Device— If an internal displacement measuring device does not exist or has insufficient precision, an externally applied displacement measurement device such as a linear variable differential transducer (LVDT) can be used (Figure 2 and Figure 3).

Added 1/6/16

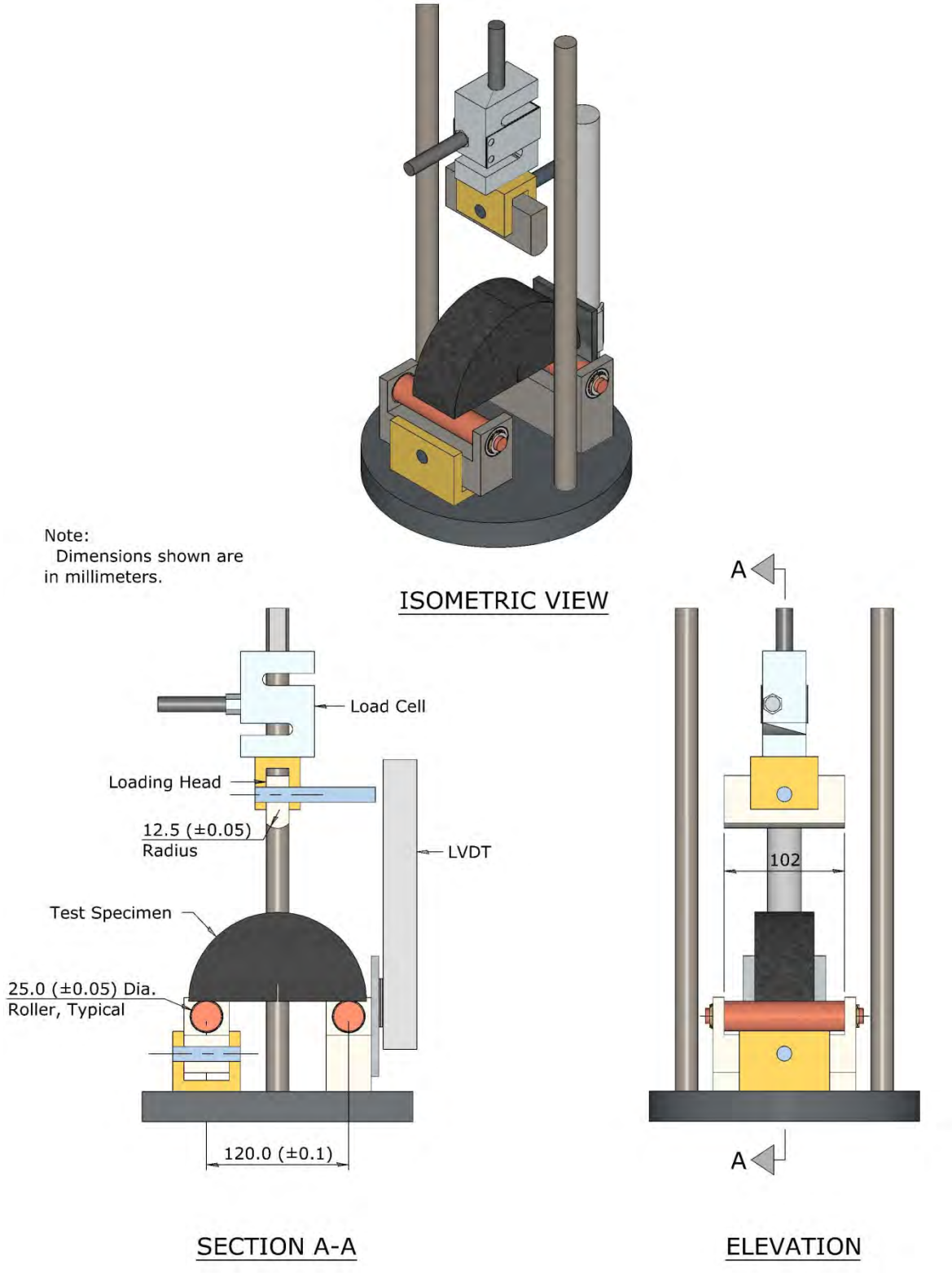


Figure 2— Method A

Added 1/6/16

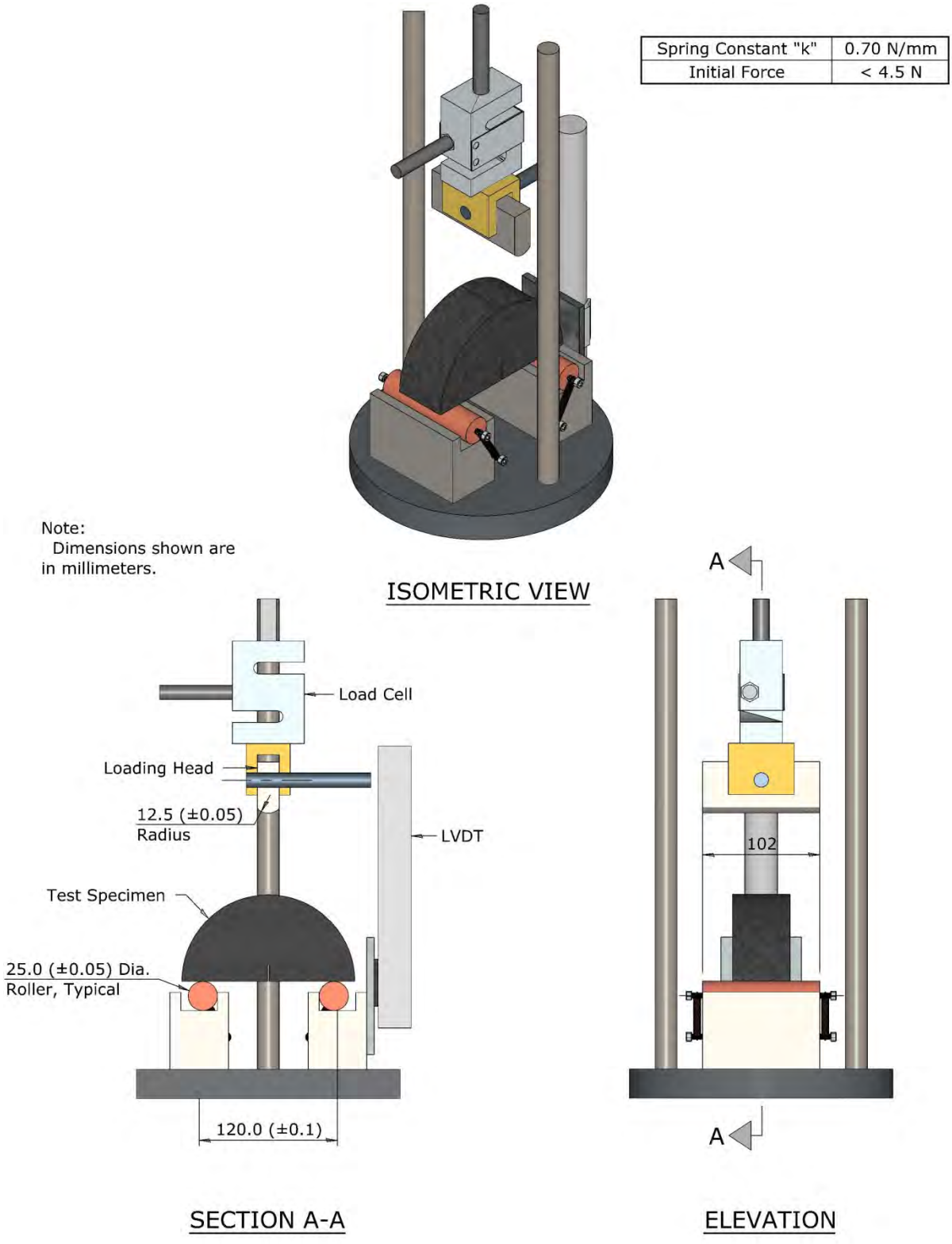


Figure 3—Method B

Added 1/6/16

Control and Data Acquisition System—Time and load, and LLD (using external and / or internal displacement measurement device) is recorded. The control data acquisition system is required to apply a constant LLD rate at a precision of 50 ± 1 mm/min and collect data at a minimum sampling frequency of 20 Hz in order to obtain a smooth load-load line displacement curve.

HAZARDS

Standard laboratory caution should be used in handling, compacting and fabricating asphalt mixtures test specimens in accordance with AASHTO T 312 and when using a saw for cutting specimens.

CALIBRATION AND STANDARDIZATION

A water bath as used in AASHTO T 283 will be used to maintain the specimen at a constant and uniform temperature. An environmental chamber may be used in lieu of a water bath.

Note 2— Caution should be used if an oven is selected for conditioning samples as this may result in variable sample conditioning and affect the test results.

Verify the calibration of all measurement components (such as load cells and LVDTs) of the testing system.

If any of the verifications yield data that does not comply with the accuracy specified, correct the problem prior to proceeding with testing. Appropriate action may include maintenance of system components, calibration of system components (using an independent calibration agency, service by the manufacturer, or in-house resources), or replacement of the system components.

PREPARATION OF TEST SPECIMENS AND PRELIMINARY DETERMINATIONS

Specimen Size—For mixtures with nominal maximum aggregate size of 19 mm or less, prepare the test specimens from a lab compacted SGC cylinder or from pavement cores. The final I-FIT test cylinders shall have smooth parallel faces with a thickness of 50 ± 1 mm and a diameter of 150 ± 1 mm (see Figure 4). If field specimens are used, the final test specimen dimensions shall be 150 ± 8 mm in diameter with smooth parallel faces 25 to 50 mm thick depending on available layer thickness.

Note 3—A typical laboratory saw for mixture specimen preparation can be used to obtain cylindrical discs with smooth parallel surfaces. A tile saw is recommended for cutting the 15 mm notch in the individual I-FIT test specimens. Diamond-impregnated cutting faces and water cooling are recommended to minimize damage to the specimen. When cutting the I-FIT specimens, it is recommended not to push the two halves against each other because it may create an uneven base surface of the test specimen that can affect the results.

Added 1/6/16

SGC Specimens—Prepare a minimum of one laboratory SGC specimen according to T 312 in the SGC with a compaction height a minimum of 160 mm ± 1 mm. From the middle of each 160 mm ± 1 mm-tall specimen, obtain two cylindrical 50 ± 1 mm thick discs (see Figure 4). Cut each disc into two identical "halves" resulting in four individual I-FIT test specimens. A minimum of three individual I-FIT specimens is defined as one I-FIT test.

Note 4—It is recommended that a greater number of SGC specimens (and therefore a greater number of individual test specimens) be fabricated and tested to reduce the risk of a FI that is not representative of the mixture. This is especially important for marginal mixtures that have test results near the established pass/fail criteria.

Note 5—For laboratory compacted specimens, the air voids shall be determined for each of the two circular discs. The air voids for each disc shall be 7.0 +/- 0.5%. It is suggested that the minimum height of the gyratory compacted specimens shall be a minimum 160 ± 1 mm height to achieve the target 7.0 +/- 0.5% air voids in each of the top and bottom discs (see Figure 4). If target air voids cannot be achieved for each disc with 160 ± 1 mm height of the compacted specimens, then the specimen height can be increased. If specimen height cannot be increased or if a SGC has difficulty in compacting 160 mm tall specimens, then two SGC specimens, each at least 115 mm tall, may be compacted and used instead. A 50 mm thick disc will be cut from the middle of each gyratory specimen which will result in four individual I-FIT test specimens.

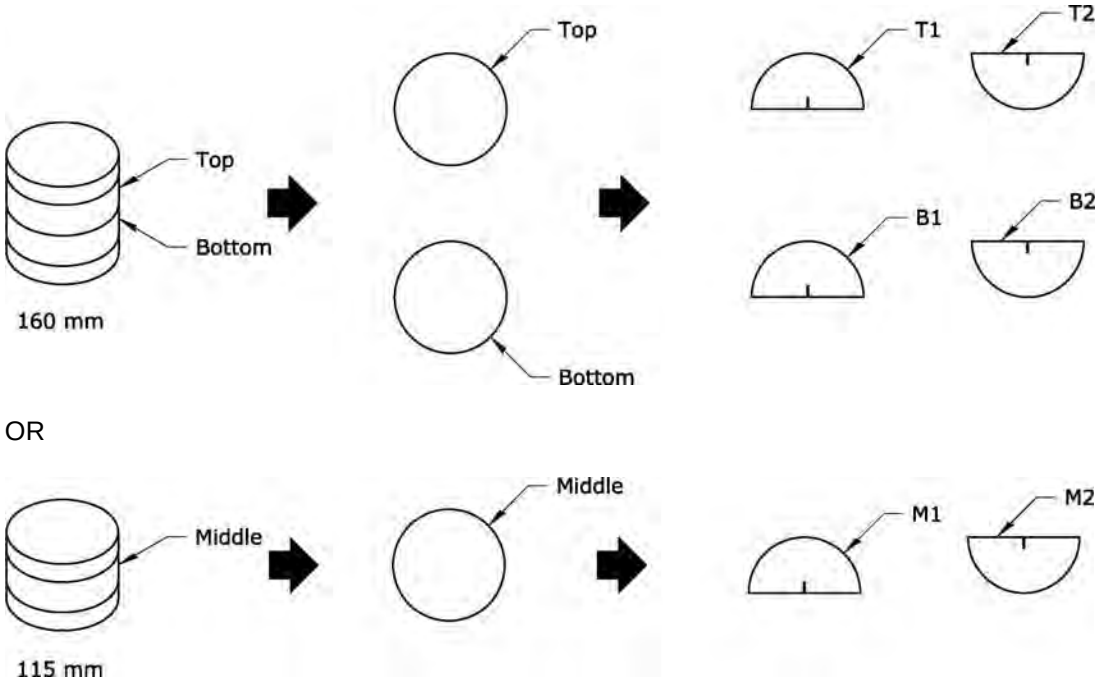


Figure 4— Specimen preparation from 160 mm or 115 mm SGC specimens

Field Cores—Obtain field cores from the pavement in accordance with ASTM D 5361. Obtain one 150 mm diameter pavement cores if the lift thickness is greater than 75 mm or two 150 mm diameter cores if the lift thickness is less than 75 mm.

Added 1/6/16

Field Specimens—From the pavement cores, prepare four replicate I-FIT test specimens with smooth, parallel surfaces that conform to the height and diameter requirements specified herein. The thickness of test specimens in most cases for field cores may vary from 25 to 50 mm. If the lift thickness is less than 50 mm, test specimens should be prepared as thick as possible but in no case be less than two times the nominal maximum aggregate size of the mixture or 25 mm whichever is greater. If lift thickness is greater than 50 mm, a 50 mm slice shall be prepared. Cores from pavements with lifts greater than 75 mm may be sliced to provide two cylindrical specimens of equal thickness. Cut each cylindrical specimen exactly in half to produce two identical, semicircular I-FIT specimens. Each slice of the field core shall have parallel, smooth faces.

Notch Cutting— Cut a notch along the axis of symmetry of each individual I-FIT specimen to a depth of 15 ± 1 mm and 1.5 ± 0.1 mm (0.06 in.) in width (see Figure 1).

Note 6—If the notch terminates in an aggregate particle 9.5 mm or larger on both faces of the specimen, the specimen shall be discarded.

Determining Specimen Dimensions— Measure the notch depth on both faces of the specimen and record the average value to the nearest 0.5 mm. Measure and record the ligament length (see Figure 1) and thickness of each specimen. The ligament length may be measured *directly* on both faces of the specimen with the average value recorded or the ligament length may be measured *indirectly* by subtracting the notch depth from the entire width (radius) of the specimen on both faces of the specimen and averaging the two measurements. Measure the specimen thickness approximately 19.0 mm (0.75 in.) on either side of the notch and on the curved edge directly across from the notch. Average the three measurements and record as the average thickness to the nearest 0.1 mm.

Determining the Bulk Specific Gravity—Determine the bulk specific gravity on the discs obtained from SGC cylinders or field cores according to AASHTO T 166.

TEST PROCEDURE

Conditioning—Test specimens shall be conditioned in a water bath or an environmental chamber at 25 ± 0.5 °C for 2 ± 0.5 h.

Temperature Control —The temperature of the specimen shall be maintained within 0.5 °C of the desired 25 ± 0.5 °C test temperature throughout the conditioning and testing periods. Testing shall be completed within 5 ± 1 minutes after removal from the water bath or environmental chamber. The temperature of the test specimen shall be within 0.5 °C of the desired test temperature (25 °C).

Position Specimen— Position the test specimen in the test fixture on the rollers so that it is centered in both the “x” and the “y” directions and so that the vertical axis of loading is aligned to pass from the center of the top radius of the specimen through the middle of the notch.

Contact Load— First, impose a small contact load of 0.1 ± 0.01 kN in stroke control with a loading rate of 0.05 kN/s.

Record Contact Load— Record the contact load to ensure it is achieved.

Loading—After the contact load of 0.1 kN is reached, the test is conducted using LLD control at a rate of 50 mm/min. The test stops when the load drops below 0.1 kN.

Added 1/6/16

PARAMETERS

Determining Work of Fracture (W_f)—The work of fracture is calculated as the area under the load vs. load line displacement curve (see Figure 5).

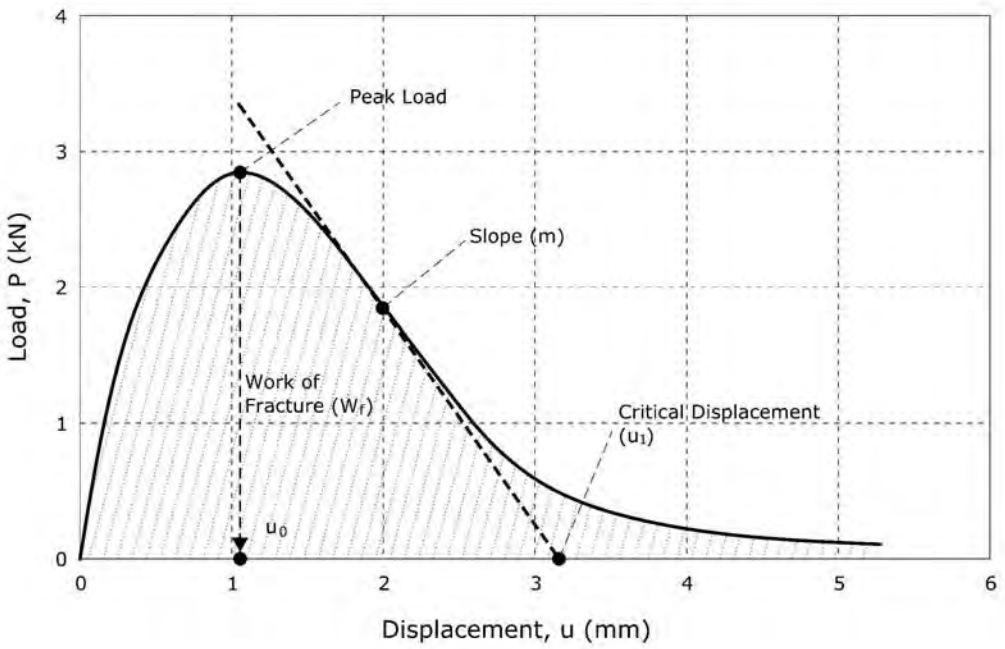


Figure 5—Recorded load (P) versus load line displacement (u) curve

Added 1/6/16

Fracture Energy (G_F)— G_F is calculated by dividing the work of fracture (W_f) by the ligament area (the product of the ligament length and the thickness of the specimen) of the specimen measured prior to testing:

$$G_f = \frac{W_f}{Area_{lig}} \qquad \text{Equation 1}$$

where:

G_f = fracture energy (Joules/m^2);

W_f = work of fracture (Joules)

P = load (kN);

u = displacement (mm);

$Area_{lig}$ = ligament area = (r – a) *x* t, (mm^2)

r = specimen radius (mm);

a = notch length (mm);

t = specimen thickness (mm)

m = post-peak slope (kN/mm)

Note 7—G_f is a size dependent property. This specification does not aim at calculating size independent G_f. Therefore, cracking resistance of asphalt mixes quantified with G_f may vary when the notch length to radius ratio changes.

Determining post-peak slope (m) — The inflection point is determined on the load-displacement curve (Figure 5) after the peak load. The slope of the tangential curve drawn at the inflection point represents post-peak slope.

Determining displacement at peak load (u_o) — Find the displacement when peak load is reached.

Determining critical displacement (u_1) — Intersection of the tangential slope with the displacement axis yields the critical displacement value. A straight line is drawn connecting the inflection point and displacement axis with a slope m.

Flexibility Index (FI) — Flexibility Index can be calculated (by the software) from the parameters obtained using the load displacement curve. The factor A is used for unit conversion and scaling. “A” is equal to 0.01.

$$FI = \frac{G_f}{|m|} \times A \qquad \text{Equation 2}$$

where:

$|m|$= absolute value of m.

Note 8—When four individual I-FIT specimens are tested, the FI value that is farthest from the average of the four may be discarded as an outlier to lower the variability of the average FI value that is reported. When eight or more individual I-FIT specimens are tested, the highest and lowest FI values may be discarded as outliers to lower the variability of the average FI value that is reported.

Added 1/6/16

CORRECTION FACTORS

Shift factor from lab to field specimens — Apply a shift factor between SGC and pavement core specimens based on the age of field specimens, different criteria based on design, plant mix, and aged for different times. This shift factor still needs to be determined.

REPORT

Report the following information:

Bulk specific gravity of each specimen tested, to the nearest 0.001;

Average air void content of each disc, to the nearest 0.1;

Thickness t and ligament length of each specimen tested, to the nearest 0.1 mm;

Initial notch length a, to the nearest 0.5 mm;

Peak load and coefficient of variation (COV) of peak load, to the nearest 0.1 kN;

Post-peak slope and COV of post-peak slope (m), to the nearest 0.1 kN/mm

G_f and COV of G_f to the nearest 1 J/m^2.

FI and COV of FI to the nearest 0.1.

PRECISION AND BIAS

Precision— The research required to develop precision estimates has not been conducted.

Bias— The research required to establish the bias of this method has not been conducted.

KEYWORDS

Fracture energy; asphalt mixture; Illinois flexibility index test (I-FIT); stiffness; work of fracture; flexibility index.

Added 1/6/16