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

December 29, 2015

SUBJECT: FAP Route 804 (US 45)
Project ACF-0804(196)
Section (24,23)RS-5
Champaign County
Contract No. 70785
Item No. 14, 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. Revised page ii of the Table of Contents to the Special Provisions
2. Revised pages 54, 57, and 68-77 of the Special Provisions
3. Deleted pages 55-56 of the Special Provisions
4. Added pages 112-128 to the Special Provisions

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: Kensil Garnett, Region 3, District 5; Justan Mann,Tim Kell; Estimates

JW/kf

Revised 12/29/15

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.

HOT MIX ASPHALT – PRIME COAT (BDE)
Effective: November 1, 2014

Revise Note 1 of Article 406.02 of the Standard Specifications to read:

"Note 1. The bituminous material used for prime coat shall be one of the types listed in the following table.

When emulsified asphalts are used, any dilution with water shall be performed by the emulsion producer. The emulsified asphalt shall be thoroughly agitated within 24 hours of application and show no separation of water and emulsion.

Application	Bituminous Material Types
Prime Coat on Brick, Concrete, or HMA Bases	SS-1, SS-1h, SS-1hP, SS-1vh, RS-1, RS-2, CSS-1, CSS-1h, CSS-1hp, CRS-1, CRS-2, HFE-90, RC-70
Prime Coat on Aggregate Bases	MC-30, PEP"

Revised 12/29/15

RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES (MODIFIED 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 produced by cold milling or crushing an existing hot-mix asphalt (HMA) pavement. The Contractor shall supply written documentation that the RAP originated from routes or airfields under federal, state, or local agency jurisdiction.

(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 93 percent passing the #4 (4.75 mm) sieve based on a dry shake gradation. RAS shall be uniform in gradation and asphalt binder content and 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. No additional RAP shall be added to the pile after the pile has been sealed. Stockpiles shall be sufficiently separated to prevent intermingling at the base. Stockpiles shall be identified by signs indicating the type as listed below (i.e. "Homogeneous Surface").

Prior to milling, the Contractor shall request the District provide documentation on the quality of the RAP to clarify the appropriate stockpile.

(1) Fractionated RAP (FRAP). FRAP shall consist of RAP from Class I, HMA (High and Low ESAL) 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 fractionated prior to testing by screening into a minimum of two size 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 shall pass the sieve size specified below for the mix into which the FRAP will be incorporated.

Mixture FRAP will be used in:	Sieve Size that 100% of FRAP Shall Pass
IL-19.0	1 1/2 in. (40 mm)
IL-9.5	3/4 in. (20 mm)
IL-4.75	1/2 in. (13 mm)

(2) Homogeneous. Homogeneous RAP stockpiles shall consist of RAP from Class I, HMA (High and Low ESAL) mixtures and represent: 1) the same aggregate quality, but shall be at least C quality; 2) the same type of crushed aggregate (either crushed natural aggregate, ACBF slag, or steel slag); 3) similar gradation; and 4) similar asphalt binder content. If approved by the Engineer, combined single pass surface/binder millings may be considered “homogenous” with a quality rating dictated by the lowest coarse aggregate quality present in the mixture.

(3) Conglomerate. Conglomerate RAP stockpiles shall consist of RAP from Class I, HMA (High and Low ESAL) 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 prior to testing by crushing to where all RAP shall pass the 5/8 in. (16 mm) or smaller screen. Conglomerate RAP stockpiles shall not contain steel slag.

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

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

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(b) RAS Stockpiles. Type 1 and Type 2 RAS shall be stockpiled separately and shall not be intermingled. Each stockpile shall be signed indicating what type of RAS is present.

Unless otherwise specified by the Engineer, mechanically blending manufactured sand (FM 20 or FM 22) up to an equal weight of RAS with the processed RAS will be permitted to improve workability. The sand shall be "B Quality" or better from an approved Aggregate Gradation Control System source. The sand shall be 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.

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

(a) RAP/FRAP Testing. When used in HMA, the RAP/FRAP shall be sampled and tested either during or after stockpiling.

(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) 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.

Each sample shall be split to obtain two equal 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 or RAS blended with manufactured sand shall be sampled and tested during stockpiling according to Illinois Department of Transportation Policy Memorandum, "Reclaimed Asphalt Shingle (RAS) Source".

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Samples shall be collected during stockpiling 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 250 tons (225 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 or RAS blended with manufactured sand shall be stockpiled 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.

Before testing, each sample shall be split to obtain two test samples. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall perform a washed extraction and test for unacceptable materials on 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.

If the sampling and testing was performed at the shingle processing facility in accordance with the QC Plan, the Contractor shall obtain and make available all of the test results from start of the initial stockpile.

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

(a) Evaluation of RAP/FRAP Test Results. All of the extraction results shall be compiled and averaged for asphalt binder content and gradation and, when applicable G_{mm}. Individual extraction test results, when compared to the averages, will be accepted if within the tolerances listed below.

Parameter	FRAP/Homogeneous/ Conglomerate
1 in. (25 mm)	
1/2 in. (12.5 mm)	± 8 %
No. 4 (4.75 mm)	± 6 %
No. 8 (2.36 mm)	± 5 %
No. 16 (1.18 mm)	
No. 30 (600 µm)	± 5 %
No. 200 (75 µm)	± 2.0 %
Asphalt Binder	± 0.4 % [1/]
G_{mm}	± 0.03

1/ The tolerance for FRAP shall be ± 0.3 %.

If more than 20 percent of the individual sieves and/or asphalt binder content tests are out of the above tolerances, the RAP/FRAP shall not be used in HMA unless the RAP/FRAP representing the failing tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

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)”.

(b) Evaluation of RAS and RAS Blended with Manufactured Sand 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. Individual test results, when compared to the averages, 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)	± 2.0 %
Asphalt Binder Content	± 1.5 %

If more than 20 percent of the individual sieves and/or asphalt binder content tests are out of the above tolerances, or if the percent unacceptable material exceeds 0.5 percent by weight of material retained on the # 4 (4.75 mm) sieve, the RAS or RAS blend shall not be used in Department projects. All test data and acceptance ranges shall be sent to the District for evaluation.

1031.05 Quality Designation of Aggregate in RAP/FRAP.

(a) RAP. The aggregate quality of the RAP for homogenous and conglomerate 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 C 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.

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(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. Coarse and fine FRAP stockpiles containing plus #4 (4.75 mm) sieve coarse aggregate shall have a maximum tonnage of 5000 tons (4500 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.

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

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

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

(2) Steel Slag Stockpiles. Homogeneous RAP stockpiles containing steel slag will be approved for use in all HMA (High ESAL and Low ESAL) Surface and Binder Mixture applications.

(3) Use in HMA Surface Mixtures (High and Low ESAL). RAP/FRAP stockpiles for use in HMA surface mixtures (High and Low ESAL) shall be FRAP or homogeneous in which the coarse aggregate is Class B quality or better. RAP/FRAP from Conglomerate stockpiles shall be considered equivalent to limestone for frictional considerations. Known frictional contributions from plus #4 (4.75 mm) homogeneous RAP and FRAP stockpiles will be accounted for in meeting frictional requirements in the specified mixture.

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

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

(6) When the Contractor chooses the RAP option, the percentage of RAP shall not exceed the amounts indicated in Article 1031.06(c)(1) below for a given Ndesign.

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

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

(1) RAP/RAS. When RAP is used alone or RAP is used in conjunction with RAS, the percentage of virgin asphalt binder replacement shall not exceed the amounts listed in the Max RAP/RAS ABR table listed below for the given Ndesign.

RAP/RAS Maximum Asphalt Binder Replacement (ABR) Percentage

HMA Mixtures 1/, 2/	RAP/RAS Maximum ABR %		
Ndesign	Binder/Leveling Binder	Surface	Polymer Modified
30	30	30	10
50	25	15	10
70	15	10	10
90	10	10	10

1/ For Low ESAL HMA shoulder and stabilized subbase, the RAP/RAS ABR shall not exceed 50 percent of the mixture.

2/ When RAP/RAS ABR exceeds 20 percent, the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28). If warm mix asphalt (WMA) technology is utilized, and production temperatures do not exceed 275 °F (135 °C) the high and low virgin asphalt binder grades shall each be reduced by one grade when RAP/RAS ABR exceeds 25 percent (i.e. 26 percent RAP/RAS ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28).

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(2) FRAP/RAS. When FRAP is used alone or FRAP is used in conjunction with RAS, the percentage of virgin asphalt binder replacement shall not exceed the amounts listed in the FRAP/RAS table listed below for the given Ndesign.

FRAP/RAS Maximum Asphalt Binder Replacement (ABR) Percentage

HMA Mixtures 1/, 2/	FRAP/RAS Maximum ABR %		
Ndesign	Binder/Leveling Binder	Surface	Polymer Modified 3/, 4/
30	55	45	15
50	45	40	15
70	45	35	15
90	45	35	15

1/ For Low ESAL HMA shoulder and stabilized subbase, the FRAP/RAS ABR shall not exceed 50 percent of the mixture.

2/ When FRAP/RAS ABR exceeds 20 percent for all mixes the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28). If warm mix asphalt (WMA) technology is utilized, and production temperatures do not exceed 275 °F (135 °C) the high and low virgin asphalt binder grades shall each be reduced by one grade when FRAP/RAS ABR exceeds 25 percent (i.e. 26 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28).

3/ For SMA the FRAP/RAS ABR shall not exceed 25 percent.

4/ For IL-4.75 mix the FRAP/RAS ABR shall not exceed 35 percent.

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) RAP/FRAP and/or RAS. RAP/FRAP and/or RAS mix designs shall be submitted for verification. If additional RAP/FRAP stockpiles are tested and found that no more than 20 percent of the results, as defined under “Testing” herein, are outside of the control tolerances set for the original RAP/FRAP stockpile and HMA mix design, and meets all of the requirements herein, the additional RAP/FRAP stockpiles may be used in the original mix 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 RAP/FRAP and/or RAS shall be as follows.

(a) RAP/FRAP. The coarse aggregate in all RAP/FRAP used shall be equal to or less than the nominal maximum size requirement for the HMA mixture being produced.

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 RAP 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 the RAP/FRAP control tolerances or QC/QA test results require corrective action, the Contractor shall cease production of the mixture containing RAP/FRAP and either switch to the virgin aggregate design or submit a new RAP/FRAP design.

(b) 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.

(c) RAP/FRAP and/or RAS. HMA plants utilizing RAP/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 RAP/FRAP/RAS 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.

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

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

(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).

e. RAP/FRAP/RAS weight to the nearest pound (kilogram).

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

g. Residual asphalt binder in the RAP/FRAP/RAS 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 in aggregate surface course (temporary access entrances only) and aggregate wedge shoulders, Type B 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. One hundred percent of the RAP material shall pass the 1 1/2 in. (37.5 mm) sieve. The RAP material shall be reasonably well graded from coarse to fine. RAP material that is gap-graded or single sized will not be accepted.”

Revised 12/29/15

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

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.”

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.

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."

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."

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

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.

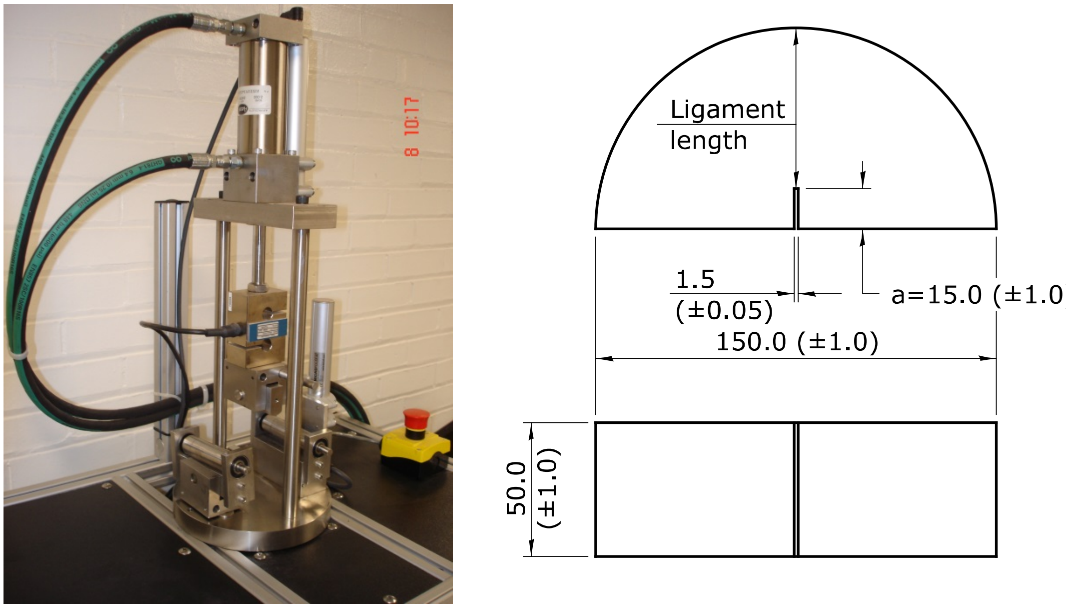
load line displacement, LLD—the displacement measured in the direction of the load application.

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.



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).

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.

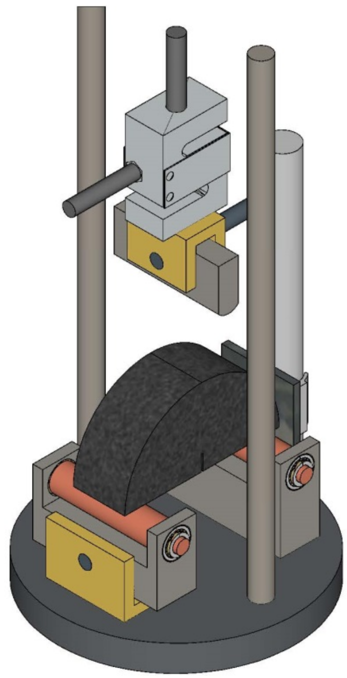
Bend Test Fixture—The fixture is composed of a loading head, a steel base plate, and two steel rollers with a diameter (D) of 25 mm. The tip of the loading head has a contact curvature with a radius of 12.5 mm. The horizontal loading head shall pivot relative to the vertical loading axis to conform to 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.

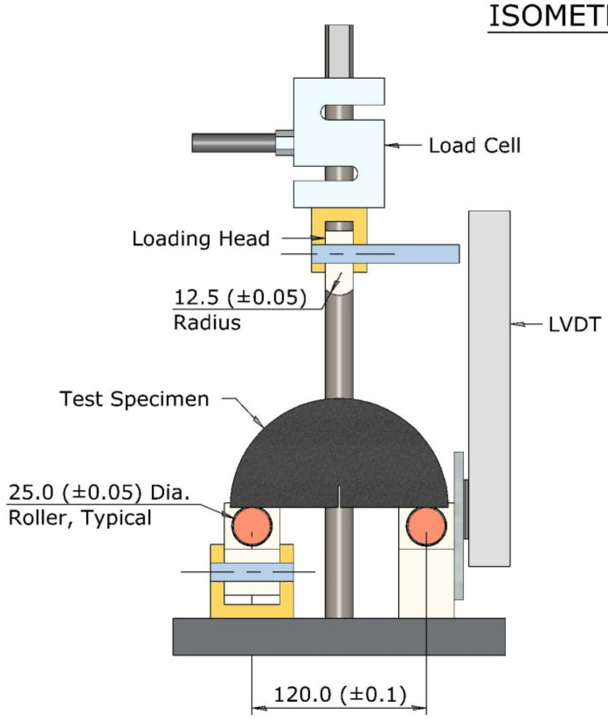
Internal Displacement Measuring Device— The displacement measurement can be performed using the machine's stroke (position) transducer if the resolution of the stroke is sufficient (0.01 mm or lower). The fracture test displacement data may be corrected for system compliance, loading-pin penetration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

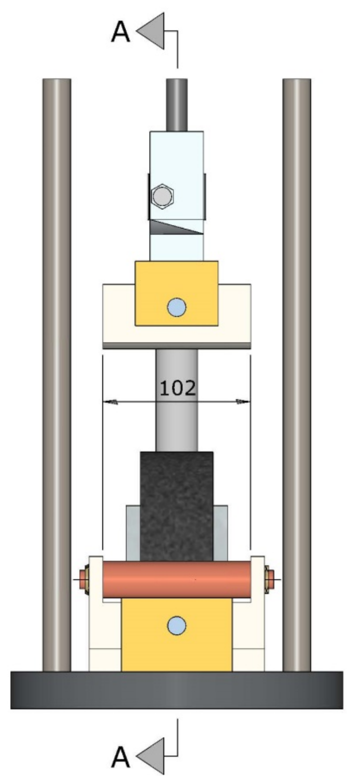


Note:
Dimensions shown are in millimeters.

ISOMETRIC VIEW

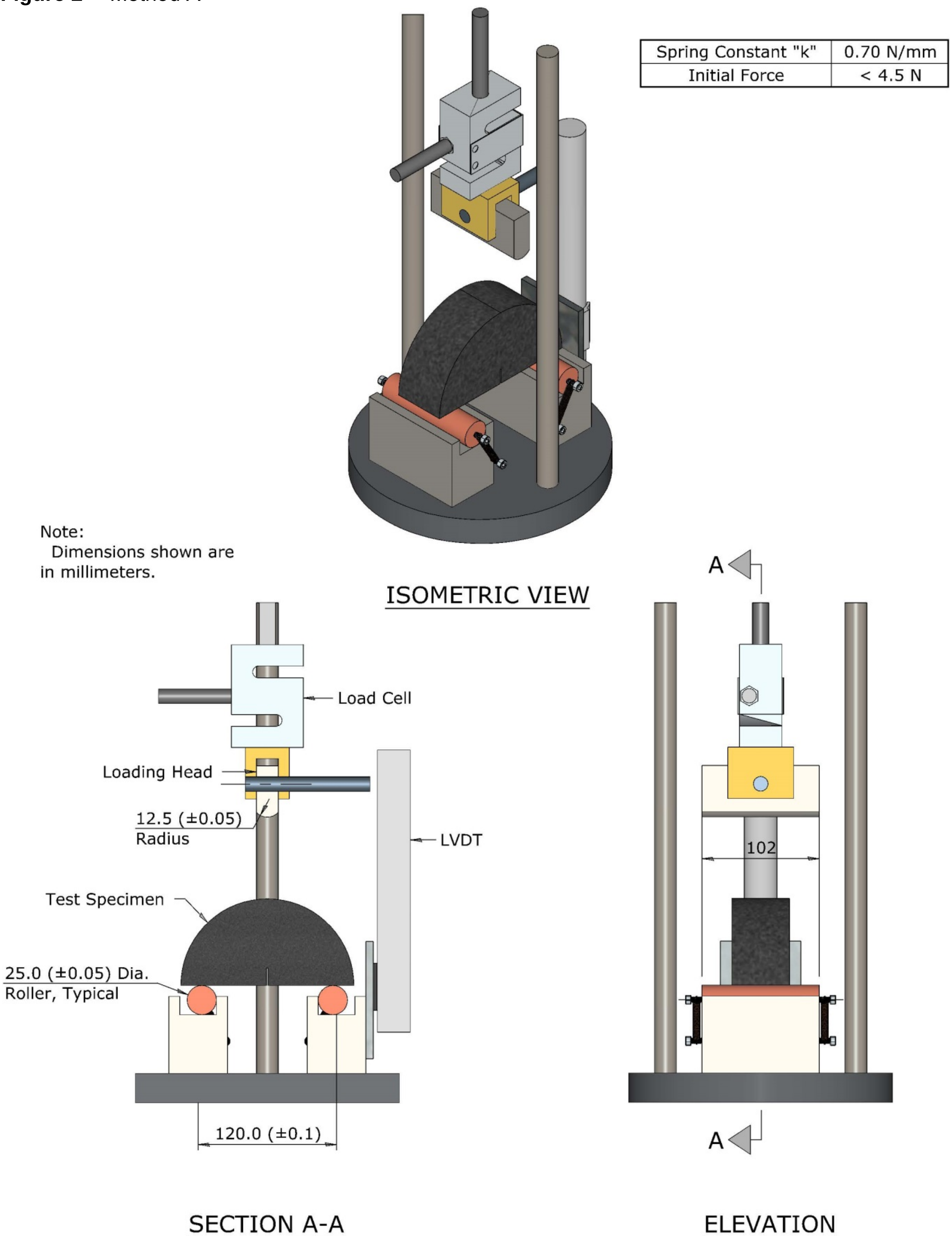


SECTION A-A



ELEVATION

Figure 2— Method A



Spring Constant "k"	0.70 N/mm
Initial Force	< 4.5 N

Added 12/29/15

Figure 3—Method B

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.

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.

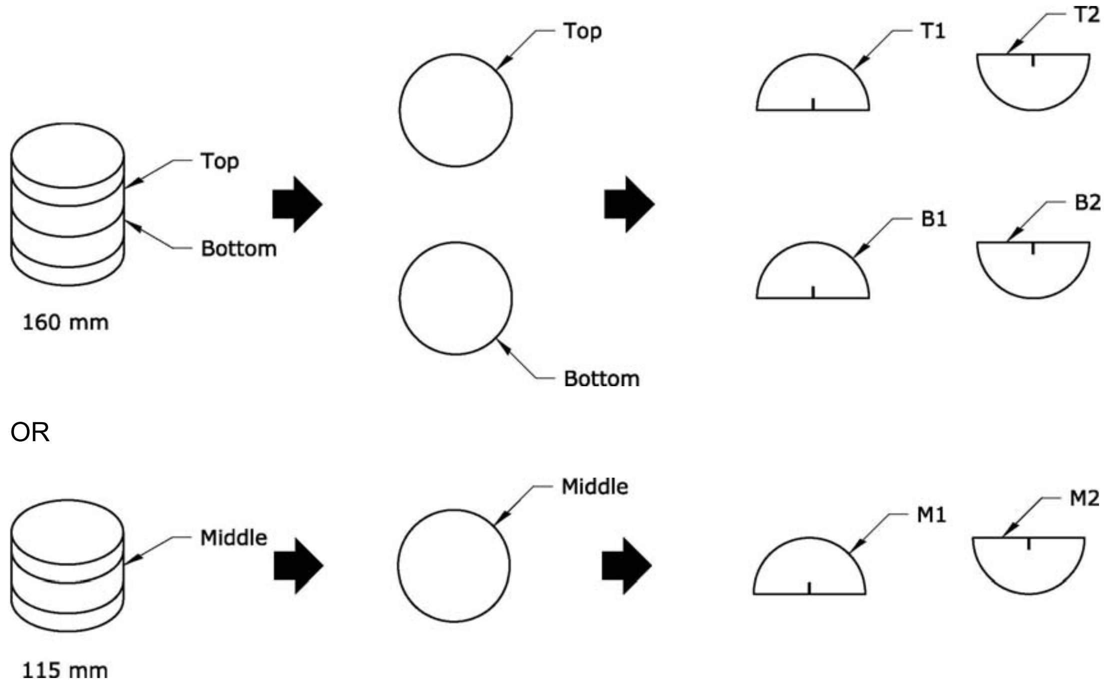


Figure 4— Specimen preparation from 160 mm or 115 mm SGC specimens

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.

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.

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).

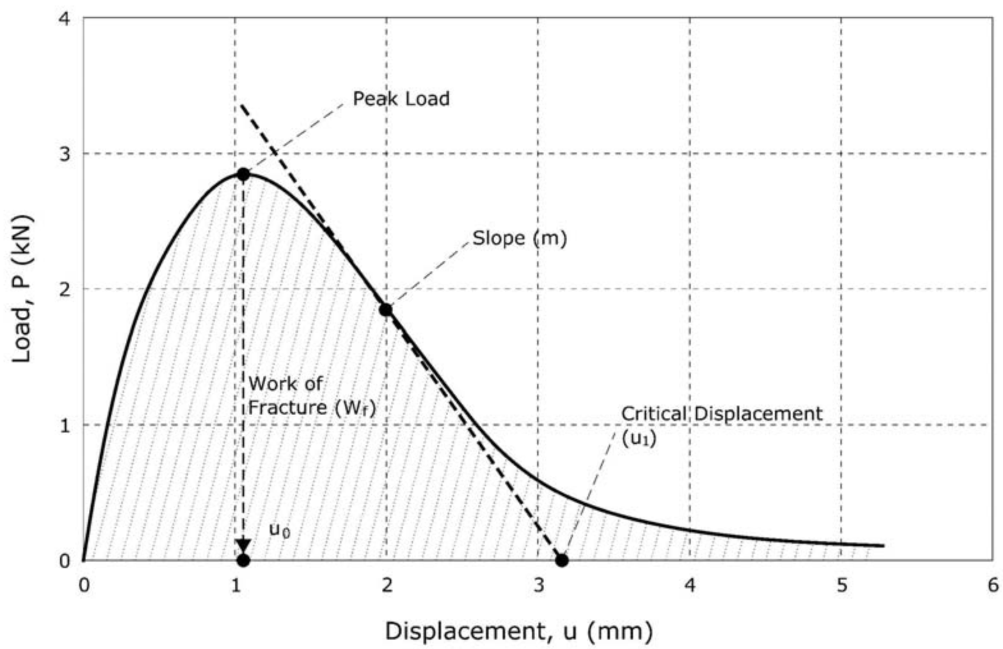


Figure 5—Recorded load (P) versus load line displacement (u) curve

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.

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.