Long-Term Pavement Performance Warm-Mix Asphalt Study Final Report, Volume IV: SPS-10 Materials Sampling and Testing Requirements

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U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296

LTPP™

FOREWORD

Warm-mix asphalt (WMA), an innovative material that is part of the Federal Highway Administration Every Day Counts program, has been implemented by State highway agencies throughout the United States. WMA covers a variety of categories, each designed to allow for the production and compaction of asphalt concrete at temperatures lower than conventional hot-mix asphalt (HMA).

Recognizing that a knowledge gap exists in the comparison of WMA and HMA over the performance life of each type of pavement, the Long-Term Pavement Performance (LTPP) program initiated this research to design a national experiment to study the performance of WMA relative to HMA. New test sections were recruited into the LTPP program under the designation of the Specific Pavement Study (SPS)-10 experiment called "Warm Mix Asphalt Overlay of Asphalt Pavement Study."

The purpose of this volume of the report series is to document the materials sampling and testing guidelines for the SPS-10 experiment for the LTPP program. This experiment is designed to capture information on the short- and long-term performance of WMA relative to HMA. This experiment has been structured to ensure consistency and compatibility with the existing LTPP program objectives and database while addressing information gaps regarding WMA performance. The intent of the SPS-10 experiment is to capture not only field performance, but also laboratory test data that will allow both user-agencies and researchers a better understanding of the potential benefits of WMA. Collectively, this information could be used for performance prediction.

Mark Swanlund
Acting Director, Office of Infrastructure
Research and Development

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Guidelines for the development and implementation of a material-sampling and testing program for each test site included in the Specific Pavement Studies-10 (SPS-10) warm-mix asphalt study are presented in this report. These guidelines should be followed by a Federal Highway Administration Long-Term Pavement Performance (LTPP) regional support contractor to develop a material-sampling and testing plan tailored to each SPS-10 project. Field materials sampling and testing should be performed with the guidelines presented in this report and those contained in the SHRP-LTPP Guide for Field Material Sampling, Testing, and Handling. All laboratory testing should conform to the guidelines contained in the Long-Term Pavement Performance Project Laboratory Materials Testing and Handling Guide.</td></tr>
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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1,000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2,000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2,000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	2.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

LONG-TERM PAVEMENT PERFORMANCE WARM-MIX ASPHALT STUDY PROJECT REPORT SERIES

The following list contains all the volumes of this report series:

Volume	Title	Report Number
I	Long-Term Pavement Performance Warm-Mix Asphalt Study, Volume I: Final Report	FHWA-HRT-22-018
II	Long-Term Pavement Performance Warm-Mix Asphalt Study Final Report, Volume II: SPS-10 Experimental Matrix and Research Plan	FHWA-HRT-22-019
III	Long-Term Pavement Performance Warm-Mix Asphalt Study Final Report, Volume III: SPS-10 Nomination Guidelines	FHWA-HRT-22-020
IV	Long-Term Pavement Performance Warm-Mix Asphalt Study Final Report, Volume IV: SPS-10 Materials Sampling and Testing Requirements	FHWA-HRT-22-021
V	Long-Term Pavement Performance Warm-Mix Asphalt Study Final Report, Volume V: SPS-10 Performance Monitoring Guide	FHWA-HRT-22-022
VI	Long-Term Pavement Performance Warm-Mix Asphalt Study Final Report, Volume VI: SPS-10 Construction Documentation Guide	FHWA-HRT-22-023

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LIST OF ABBREVIATIONS

AASHTO	American Association of Highway and Transportation
AC	asphalt concrete
AMPT	asphalt mixture performance tester
BBR	bending beam rheometer
DCP	dynamic cone penetrometer
DSR	dynamic shear rheometer
FHWA	Federal Highway Administration
GPS	Global Positioning System
HMA	hot-mix asphalt
HWTD	Hamburg wheel-tracking device
ID	identification
ILE	inside lane edge
IWP	inside wheel path
LTPP	Long-Term Pavement Performance
LVDT	linear variable differential transformer
ML	midlane
MRL	Materials Reference Library
MSCR	multiple stress creep recovery
MSDS	materials safety data sheet
MTS	materials tracking system
NCHRP	National Cooperative Highway Research Program
OLE	outside lane edge
OWP	outside wheel path
PAV	pressure aging vessel
PPA	polyphosphoric acid
RAP	recycled asphalt pavement
RAS	recycled asphalt shingles
REOB	recycled engine oil bottoms
RSC	regional support contractor
RTFO	rolling thin film oven
SHRP	Strategic Highway Research Program
SPS	Specific Pavement Studies
TFHRC	Turner-Fairbank Highway Research Center
WGS	World Geodetic System
WMA	warm-mix asphalt

CHAPTER 1. INTRODUCTION

Guidelines for development and implementation of a material-sampling and testing program for each test site included in the Specific Pavement Study (SPS)-10 warm-mix asphalt (WMA) study are presented in this document. These guidelines should be followed by the Federal Highway Administration (FHWA) Long-Term Pavement Performance (LTPP) program regional support contractor (RSC) to develop a material-sampling and testing plan tailored to each SPS-10 project. The plan should be presented in a bound document prepared by the LTPP RSC before the start of construction of each SPS-10 project. The FHWA LTPP RSC office must coordinate with the participating State highway agency and central laboratory contractor to ensure that sampling and testing activities are conducted in accordance with the plan and that the resulting data are properly stored.

Field materials sampling and testing should be performed in accordance with the guidelines presented in this report and those contained in the Strategic Highway Research Program's (SHRP) *SHRP-LTPP Guide for Field Material Sampling, Testing, and Handling* (SHRP 1991). All laboratory testing should conform to the guidelines contained in the *Long-Term Pavement Performance Project Laboratory Materials Testing and Handling Guide* (Simpson et al. 2007).

SPS-10 EXPERIMENT

The objectives of the SPS-10 experiment are to:

- Evaluate and improve implementation of the WMA system through a hands-on field trial conducted by interested highway agencies.
- Compare the performance of WMA technologies against mixtures designed with current highway agencies' asphalt specifications, asphalt-aggregate specifications, and mixture design procedures.
- Provide long-term performance data for evaluating and refining WMA technologies, mixture design procedures, and models.
- Test the sensitivity of the WMA technology relative to low-temperature cracking, fatigue, or permanent deformation distress factors.
- Provide highway agencies the opportunity to evaluate the performance of other experimental features through the construction of supplemental sections.

The SPS-10 experiment requires the construction of a minimum of three test sections at each project site. Construction should consist of an overlay of an existing flexible pavement. The minimum three test sections are as follows:

- Section 01—Highway agencies' standard mixture (control section).
- Section 02—Mixture with WMA foaming process.
- Section 03—Mixture with WMA chemical additive.

Since this is a materials comparison study, the pavement structure and thicknesses of the layers containing the experimental mixtures should be the same on all test sections. Agencies are encouraged to take the opportunity afforded by the construction of these experimental test sections to construct supplemental sections, investigating experimental factors of specific agency interest.

MATERIALS SAMPLING AND TESTING OVERVIEW

A materials sampling and testing plan must be developed for each project to characterize the unique engineering properties of the paving materials and the pavement structure on all experimental test sections constructed. The materials sampling and testing plan must be designed to quantify material variations between test sections. The criteria for selecting test section locations requires that all test sections at each site have the same structural cross section and be constructed of the same materials under the same contract. To accommodate likely deviations from this and other established criteria, the test plan must be devised so that all known or suspected variations can be characterized. Generally, variability of the subgrade will be determined during the site selection process and should be a prime consideration in development of the final sampling and testing plan for the site. Plan and profile sheets as well as other soil information can help determine the location of cut/fill sections and possible variations in subgrade materials.

The following general process is used to obtain and report the necessary materials information from SPS-10 projects:

1. Review of project site layout and soil profile logs. Variations in the subgrade material, embankments, or other materials-related pavement features should be identified.

2. Formulation of a field materials sampling and test plan. This plan should consider site conditions and the laboratory material testing requirements. An adequate number of samples must be obtained to ensure that all laboratory material characterization tests can be performed. Additional samples for storage in the Materials Reference Library (MRL) must also be provided.

3. Development of a field sampling plan report. This report should specify sampling-area locations as well as the type, and number of material samples from each location. It should also include a tracking table that specifies all tests and testing sequence to be performed on each sample. This report should be submitted to FHWA for review before implementation.

4. Standardization of field sampling and materials testing. All field tests and sampling must be performed in accordance with LTPP standard protocols and reported on standard LTPP data forms. Adjustments to the sampling and testing plan made in the field must be recorded. A modified sampling and testing report must be produced and entered into the materials tracking system (MTS).

5. Testing of material samples in the laboratory. All tests must be performed according to LTPP test protocols and reported on standard LTPP data forms.

6. Compilation and storage of data. The compilation and storage of data includes the compilation of field sampling, field testing, and laboratory material test data as well as entry of these data into the pavement performance database (Elkins et al. 2017).

CHAPTER 2. MATERIAL-SAMPLING AND TESTING REQUIREMENTS

The material-sampling and testing guidelines presented in this document are based on the minimum three test sections specified in the experimental design. As shown in figure 1, these sections include a design based on the highway agency's standard hot-mix asphalt (HMA) mixture design, WMA foaming process design, and WMA chemical additive design. If additional or supplemental test sections are constructed, the tests performed on these samples must be made to provide equivalent information as appropriate.

Test sections will consist of overlay projects on existing flexible pavements. Coring and auguring must be used to obtain samples of the existing materials. Sampling of the existing pavement materials can be performed before placement of the overlay. However, fewer core holes are required if existing layers are sampled along with newly constructed layers after placement of the overlay.

The scope of the field material sampling and testing to be performed on SPS-10 projects include:

- Subgrade:
  - Bulk sampling of the subgrade for material classification tests.
  - Dynamic cone penetrometer (DCP) testing.

- Base layers:
  - Visual material classification.
  - Bulk sampling for material classification tests.
  - Layer thickness measurements (from cores of bound base and from auger holes in unbound base).
  - DCP testing.

- Existing asphalt concrete (AC) layers (coring for thickness measurements and laboratory testing).

- New AC surface layer:
  - Bulk samples of the AC mix.
  - Bulk samples of the recycled asphalt pavement (RAP) and/or recycled asphalt shingles (RAS) before mixing with virgin material.
  - Bulk samples of the virgin AC binder.
  - Coring of the AC layer for laboratory testing.
  - Before and after elevation measurements to determine layer thickness.
  - In situ density measurements.

The specifics of the location and number of samples, field tests, and laboratory tests to be performed are presented in the remaining portion of this document.

FIELD-SAMPLING AND TESTING PLAN

When developing the field-sampling plan for an SPS-10 site, obtaining a sufficient type and number of samples is imperative to ensure completion of all test procedures as well as to provide additional samples for storage in the MRL. Therefore, a laboratory-testing plan must always be developed in conjunction with the field material-drilling and sampling plan. The plan must list the tests to be performed and the samples to be used for each test. In addition to the laboratory tests required to characterize the materials used in the SPS test sections, other tests may be required to characterize the properties of materials used on the supplemental test sections constructed at the test site. The laboratory- and field-testing plan should address the testing requirements for both the primary SPS-10 experiment test sections and the supplemental test sections.

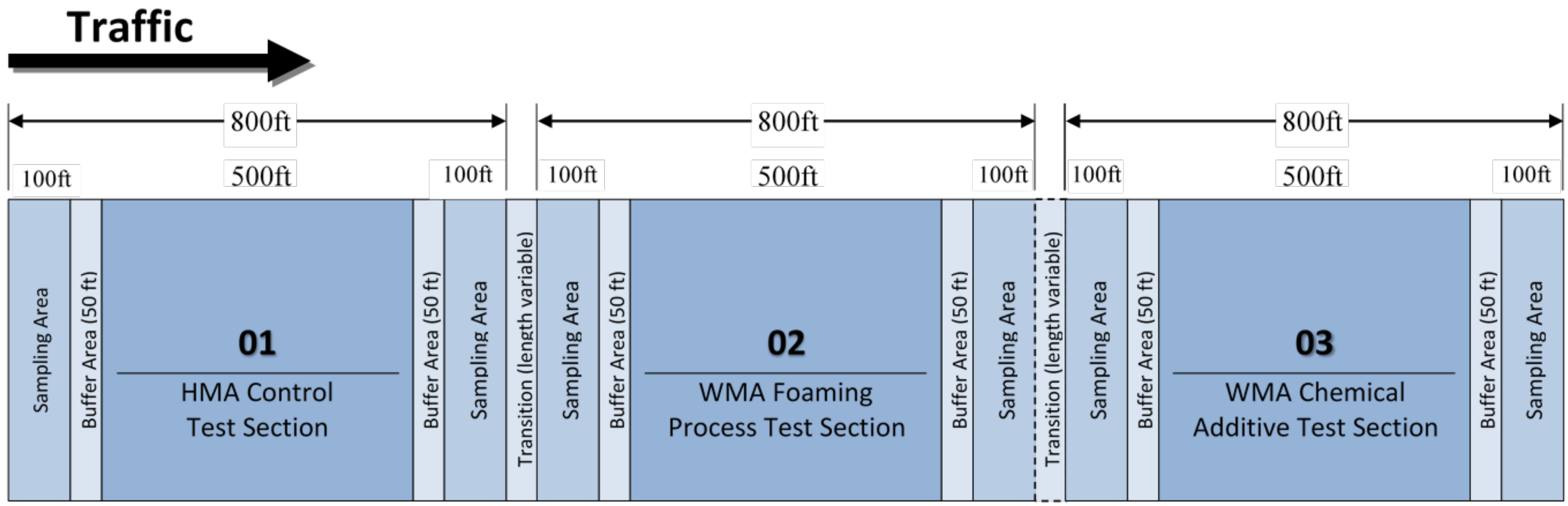
The site-specific field material-sampling, field-testing, and laboratory-testing plan for each SPS-10 site should include the following elements:

- Project layout plan.
- Detailed sampling layout.
- Detailed field-testing layout.
- Laboratory-testing plan.
- Sample tracking tables specifying the sequence of tests to be performed on each material sample.

Other items that may be included with the plan are soil profile logs, plan and profile sheets, and other project-specific information that are pertinent to the plans. The recommended plan should be reviewed and approved by the FHWA LTPP team before implementation.

The plan is used to identify the location of testing and sampling areas relative to the test sections for each sampling and testing activity. Since sampling and testing are required for each material layer, layouts must be developed for each layer (i.e., prepared subgrade, base course, surface course, and/or overlay). The approximate transition lengths between test sections should be indicated on the plan (figure 1).

To ensure consistency in data reporting, a detailed pavement layer structure should be developed before sampling and testing for the entire SPS-10 project (termed “project level”) and for each individual pavement section (termed “section level”). In the project-level scheme, each unique layer is designated by a letter of the alphabet. These layer structures may need to be revised based on information gained through sampling and testing. The RSC must have personnel onsite during the sampling activities who are familiar with the development of the plan and can make changes to the plan based on their observations. This requirement will limit the need to resample any materials. An example project level layer structure is shown in table 1 for a newly constructed SPS-10 project.



Source: FHWA.
1 ft = 0.3048 m.

Figure 1. Diagram. Typical SPS-10 site layout.

Table 1. Example project layer numbering scheme.

Project Material Code	Layer Code	Material Description
A	104	Natural soil
B	107	Embankment
C	303	Dense-graded, aggregate base
D	319	Dense-graded, asphalt-treated base
E	01	HMA binder course
F	01	HMA surface course

The first issue in developing a layer numbering scheme is the designation of subgrade and embankment material. If a project or test section is located on fill material, then the project layer numbering must contain an embankment layer.

If a fill (embankment) layer is present and is greater than 4 ft in thickness, the natural subgrade will not be sampled or tested. Only the fill (embankment) layer will be sampled and tested as if it were the natural subgrade.

The layering for the bound and unbound bases and subbases is rather straightforward. However, any test section located on a treated subgrade layer is considered a treated subbase layer in the project layering table.

The AC surface course may contain two (or more) layers. If the entire surface course comprises the same mixture design, then only one layer code is needed to represent the layer. However, if the AC layer comprises a surface and binder course that have different mixture composition (i.e., asphalt content and aggregate gradation), then the AC must be treated as two separate layers and coded and sampled accordingly. Multiple lifts of the same material in AC layers must not be identified as separate layers.

After the project level layering is completed, each individual test section will use appropriate project layer codes to designate their layer structure. Table 2 contains an example pavement layer structure.

Table 2. Example test section layer numbering scheme.

Layer No.	Project Material Code	Layer Thickness (inches)	Layer Code	Material Description
1	A	N/A	104	Natural soil
2	B	24	107	Embankment
3	C	4	303	Dense-graded, aggregate base
4	D	8	319	Dense-graded, asphalt-treated base
5	E	4	01	HMA binder course
6	F	3	01	HMA surface course

N/A = not applicable.

The establishment of this project- and test-section-level layer structure is essential to maintain consistency within the project. These layer numbers will follow the project and each test section throughout the field-sampling and laboratory-testing programs. Details of the proper procedures to be used to perform this layering activity can be found in the latest version of the *Long-Term Pavement Performance Project Laboratory Materials Testing and Handling Guide* (Simpson et al. 2007).

AC EXPERIMENT LAYER

The experiment layer on an SPS-10 is the final surface layer, which includes 2 to 4 inches (51 to 102 mm) of compacted WMA or HMA control mix. Variations in the use of warm-mix additives or production processes used in the experiment layers should be the only difference between the core sections at a project. If the project includes supplemental sections with additional differences within the experiment layer, the sampling and testing plan will need to be modified.

Bulk Samples of Uncompacted AC Mix

Bulk samples of the experiment layer mixture placed on each section as part of the construction of the SPS-10 project must be obtained and shipped to the MRL. The mixture must be uncompacted and sampled onsite, if possible. Eight 5-gal buckets of material must be obtained per section. Sampling must be conducted according to AASHTO T168-03 (AASHTO 2003).

Bulk Samples of WMA Additives

A sample of each WMA additive must also be obtained from the mixture production plant. The sample must be accompanied by the corresponding materials safety data sheet (MSDS). The sample container used must be in accordance with the recommendations of the additive manufacturer to prevent corrosion and contamination issues. These materials will be shipped to the MRL.

Bulk Samples of Combined Aggregate

A sample of combined aggregate must also be obtained from the mixture production plant. Five 5-gal buckets of material must be obtained per mix. These materials will be shipped to the MRL. Sampling must be conducted according to AASHTO T2-91 (AASHTO 1991).

Bulk Virgin AC Binder

The virgin asphalt cement must be sampled from the plant following AASHTO T40-02 after the asphalt has been heated for mixing (AASHTO 2002). Only one sample, to be placed in seven 1-gal cans, is required to represent all three core sections. If the supplemental sections include different virgin binders, samples of these binders must be obtained also.

Two of the 1-gal cans of bulk virgin AC binder collected from the plant are for laboratory testing; one must be sent to the laboratory contractor, and one must be sent to the Turner-Fairbank Highway Research Center (TFHRC) for recycled engine oil bottoms (REOB) AE11 testing. The remaining five must be sent to the MRL. Tests to be performed on the virgin AC binder are shown in table 3.

Table 3. Virgin AC binder tests.

Sample Type	Sample Code	Test Condition	Test Procedure	Test Designation	Minimum No. of Tests
1-gal can	BC01001	Original	Specific gravity	AE03	1
1-gal can	BC01001	Original	DSR	AE07	1
1-gal can	BC01001	Original + RTFO	DSR	AE07	1
1-gal can	BC01001	Original + RTFO	MSCR	AE10	1
1-gal can	BC01001	Original + RTFO + PAV	DSR	AE07	1
1-gal can	BC01001	Original + RTFO + PAV	BBR	AE08	1
1-gal can	BC01002	Original	Recycled engine oil (by FHWA)	AE11	1

BBR = bending beam rheometer; DSR = dynamic shear rheometer; MSCR = multiple stress creep recovery; PAV = pressure aging vessel; RTFO = rolling thin film oven.

Bulk RAP

For all projects, one 50-lb bulk sample of RAP stockpile material must be obtained from the plant in accordance with AASHTO T2-91 and sent to the laboratory for testing (AASHTO 1991). An additional five 5-gal buckets of RAP stockpile material must be shipped to the MRL. Extra care should be taken in sampling this material to ensure uniformity. Tests to be performed on the RAP/RAS stockpile material are shown in table 4.

Table 4. RAP/RAS stockpile material tests.

Sample Type	Sample Code	Test Type	LTPP Designation	Minimum No. of Tests
50-lb sample	BR01001	Extraction	AC04	1
50-lb sample	BR01001	Binder specific gravity	AE03	1
50-lb sample	BR01001	DSR	AE07	1
50-lb sample	BR01001	BBR	AE08	1
50-lb sample	BR01001	MSCR	AE10	1
50-lb sample	BR01001	Gradation	AG04	1

BBR = bending beam rheometer; DSR = dynamic shear rheometer; MSCR = multiple stress creep recovery.

Cores of AC Surface Layer

Cores from each AC surface layer mixture used on the SPS-10 projects will be needed for volumetric testing, extracted binder testing, extracted aggregate testing, and mixture performance testing. These cores will be identified using the designations specified in table 5 and collected based on the time intervals identified in table 6 so that aging characteristics can be assessed. Coring must be performed within 30 d of the listed time interval. All cores obtained should be 4, 6, or 12 inches (102, 152, or 305 mm) in diameter.

Table 5. Numerical designations for months after paving.

Months After Paving	0	3–6	12	18
Numerical Designation	0	1	2	3

Table 6. Number of cores and coring time intervals for SPS-10 test sections.

Core Sizes	0 Mo After Paving	3–6 Mo After Paving	12 Mo After Paving	18 Mo After Paving
6 inches (152-mm)	14	6	6	6
12 inches (or 4 inches (102 mm) by 6 inches (152 mm)	2	1	1	1

All cores must be obtained outside the monitoring portion of each test section. The designated coring areas are made up of 100-ft-long zones on each end of a test section, as shown in figure 2. Each of these zones is further subdivided into 20-ft-long subareas corresponding to the sampling time intervals occurring after construction. Ten sampling areas have been defined; areas beyond the four required for the four sampling intervals described in table 5 are reserved for future use. Sequential numerical designations are used for each sampling time interval, specified in months after completion of paving (table 7). At each designated coring time interval, cores will be obtained from the coring zone subsection, corresponding to that interval.

Table 7. Stationing of sampling intervals at each test section.

Interval Identifier, t_m	Start Station	End Station
t_0	0-70	0-50
t_1	5+50	5+70
t_2	0-90	0-70
t_3	5+70	5+90
t_4	0-110	0-90
t_5	5+90	5+110
t_6	0-130	0-110
t_7	5+110	5+130
t_8	0-150	0-130

The core locations for all sections is shown in figure 2. In practice, the core location numbers will be used in a section-specific sample identification (ID) scheme, incorporating information regarding the sampling interval, test section sampled, and the number assigned in the core layout plan. A unique sample ID will exist for each sample collected at the project.

In all sections, coring is required for mixture-performance testing, and asphalt binder will also be extracted from some of the cores for asphalt content determination, binder characterization, and aggregate properties.

The coring operations must be carried out in accordance with AASHTO T24-07 (AASHTO 2007). Carbide or diamond bit drilling is to be performed. Mist or air-cooled drilling is preferred as the best method to minimize water contamination of the underlying layers. The coring may be performed by a truck-mounted drill rig or other coring equipment approved by the participating highway agency. The cores must be dried before packaging. The pavement may be cooled by dry ice or other means before coring if needed to obtain cores of suitable quality. Full-depth cores may be broken in the field to retrieve only the layer of interest as long as the sample is not unduly disturbed. Otherwise, cores of multiple layers must be wrapped and shipped as a single core.

Indicating the direction of traffic on the test cores is essential for laboratory material testing. Therefore, all cores of pavement surfaces must be marked on the top with an arrow to show the direction of traffic. This marking should be made before the removal of the cores from the pavement using a waterproof marking material and in a manner that will ensure visibility after coring operations. Plugs must not be inserted in cores intended for laboratory testing. Suction cups or wire pulls have been successfully used for core extraction.

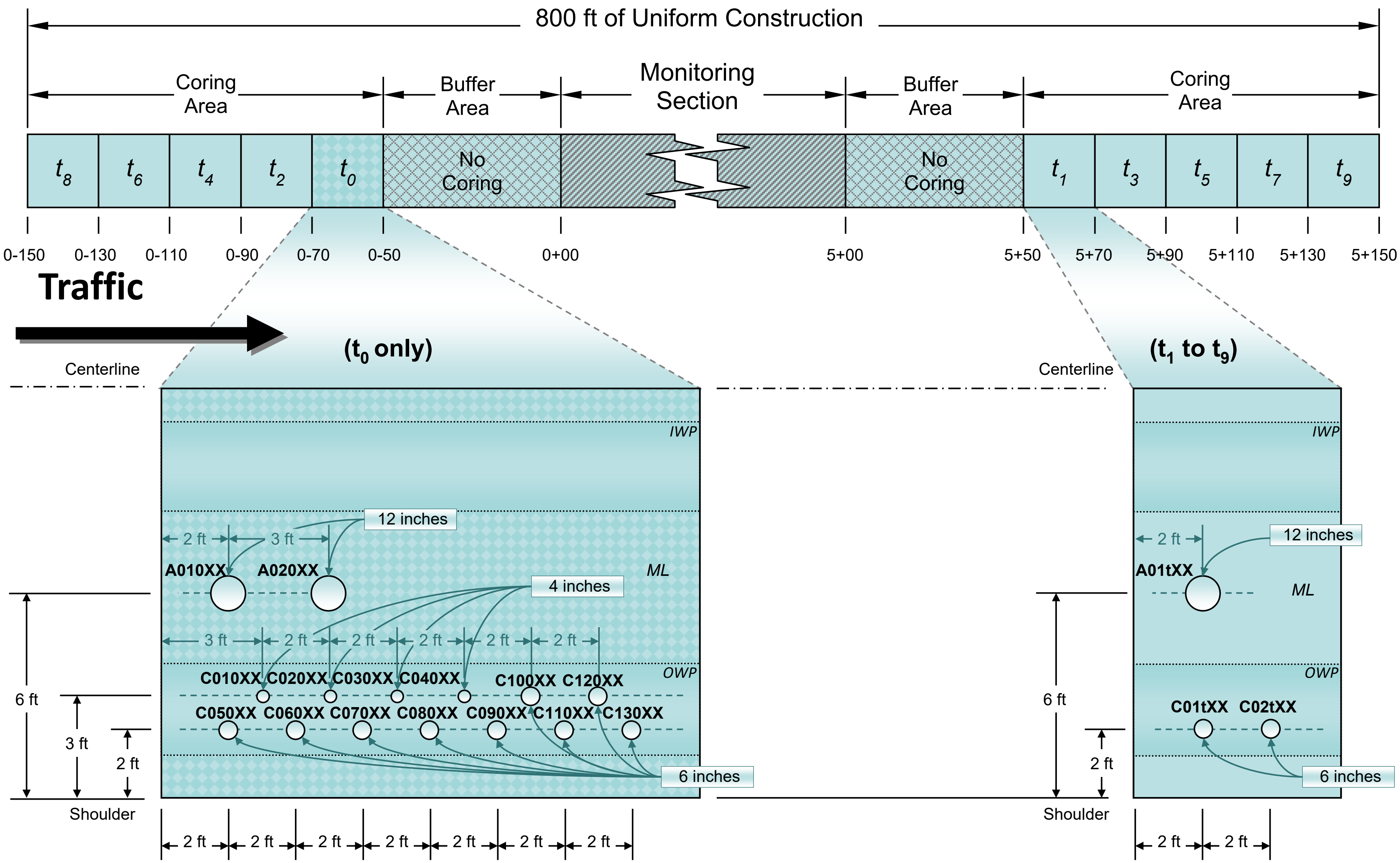
Core locations must be as shown on the sampling plan figures developed for the test site. Taking the cores perpendicular to the pavement surface (i.e., at a 90-degree angle to the surface) is important to ensure the recovery of straight, intact, and smooth-surfaced specimens suitable for laboratory testing.

The quality of the AC cores must be checked in the field to ensure suitability for laboratory testing. The suitability of the cores with respect to projections and depressions is as follows:

- Excellent—The projections/depressions along the sides of the core are less than 0.01 inches (0.3 mm) in height/depth. Ship these cores to the appropriate laboratory.

- Good—The projections/depressions along the sides of the core are between 0.01 to 0.1 inches (0.3 to 3 mm) in height/depth. These cores are considered marginal and should be shipped to the appropriate laboratory only if cores rated “excellent” cannot be obtained.

- Poor—The projections/depressions along the sides of the core are more than 0.1 inches (3 mm) in height/depth. These cores are not acceptable and should not be shipped to the laboratory unless no other suitable cores can be obtained. Another core should be drilled to replace cores rated as “poor.” After two attempts to obtain a satisfactory core have been unsuccessful, the core to be shipped to the laboratory must be selected from the better of the two drilled cores. The worse core of the two should be discarded. If a multitude of cores are retrieved in the “poor” condition, the onsite inspector should determine whether the drilling and sampling personnel are using the proper equipment and that the proper procedures are being followed.



4 inches = 102 mm, 6 inches = 152 mm, 12 inches = 305 mm

Source: FHWA.
IWP = inside wheel path; ML = midlane; OWP = outer wheel path.

Figure 2. Diagram. Coring area for SPS-10 test sections.

The following are criteria for evaluating the surface AC cores in terms of the skew of each end of the core. The suitability of the cores with respect to skewness is as follows:

- Good—The specimen departs from perpendicularity to the vertical axis by less than 0.5 degrees. (For 4-inch (102-mm) cores, the specimen can depart from perpendicularity by a maximum of 0.035 inch (0.889 mm); for 6-inch (152-mm) cores, the specimen can depart from perpendicularity by a maximum of 0.052 inch (1.32 mm).) The specimen is suitable for shipment to the laboratory.

- Poor—The specimen departs from perpendicularity to the vertical axis by more than 0.5 degrees. These cores are not acceptable and should not be shipped to the laboratory unless no other suitable cores can be obtained. Another core should be drilled to replace cores rated as “poor.” If after two tries a suitable core cannot be obtained, select the “better” core from the two and ship it to the appropriate laboratory. The “worse” core of the two must be discarded.

Additional cores should be drilled in the outer wheel path at an offset of 2 ft longitudinally from other cores.

Laboratory tests to be performed on cores obtained immediately after construction (t_0) are shown in table 8. Laboratory tests to be performed on cores obtained at 3–6, 12, and 18 mo after construction (t_1 to t_3) are shown in table 9.

An additional four 6-ft cores must be obtained and sent to the MRL at t_0.

Table 8. Experiment layer t_0 core tests.

Sample Type	No. of Samples	Sample Code	Material Type	Test Type	Minimum No. of Tests
6-inch (152-mm) core	4	CA110XX, CA120XX, CA130XX, CA140XX	Core	Core exam and thickness, bulk specific gravity, and Fenix fracture energy (requires 3 cores + 1 spare).	4 for all tests.
6-inch (152-mm) core	3	CA040XX, CA050XX, CA060XX	Core	Core exam and thickness, bulk specific gravity, AMPT dynamic modulus (requires 1 core + 2 spare).	3 for core exam and bulk specific gravity, 2 for AMPT dynamic modulus.
6-inch (152-mm) core	3	CA070XX, CA080XX, CA090XX	Core	Core exam and thickness, bulk specific gravity, and Hamburg wheel-track testing (requires 2 cores + 1 spare).	3 for core exam and bulk specific gravity, 2 for Hamburg wheel-track testing.
12-inch (305-mm) cores (or 6-inch (152-mm) cores)	2 (or 8)	BA02tXX	Mix	Core exam and thickness, maximum specific gravity, and extraction.	2 for core exam and thickness, 1 for maximum specific gravity, 1 for extraction.
12-inch (305-mm) cores (or 6-inch (152-mm) cores)	2 (or 8)	BA02tXX	Extracted binder	Specific gravity, DSR, MSCR.	1 for all tests.
12-inch (305-mm) cores (or 6-inch (152-mm) cores)	2 (or 8)	BA02tXX	Extracted binder + PAV	DSR and BBR.	1 for all tests.
12-inch (305-mm) cores (or 6-inch (152-mm) cores)	2 (or 8)	BA02tXX	Extracted aggregate	Gradation.	1 for all tests.

AMPT = asphalt mixture performance tester.
Note: The minimum number of tests is per section experiment layer.

Table 9. Experiment layer t_1–t_3 core tests.

Sample Type	No. of Samples	Sample Code	Material Type	Test Type	Minimum No. of Tests
6-inch (152-mm) core	3	CA01tXX, CA02tXX, CA03tXX,	Core	Core exam and thickness, bulk specific gravity, and AMPT dynamic modulus (requires 1 core + 2 spare).	3 for core exam and bulk specific gravity, 2 for AMPT dynamic modulus.
12-inch (305-mm) cores (or 6-inch (152-mm) cores)	1 (or 4)	BA01tXX	Mix	Core exam and thickness, extraction.	1 for all tests.
12-inch (305-mm) cores (or 6-inch (152-mm) cores)	1 (or 4)	BA01tXX	Extracted binder	DSR, BBR, and MSCR.	1 for all tests.

BBR = bending beam rheometer; DSR = dynamic shear rheometer; MSCR = multiple stress creep recovery.
Note: The minimum number of tests is per section experiment layer and per time interval.

An additional three 6-inch (152-mm) cores must be obtained and sent to the MRL during the t_1 to t_3 time intervals.

Elevation Surveys

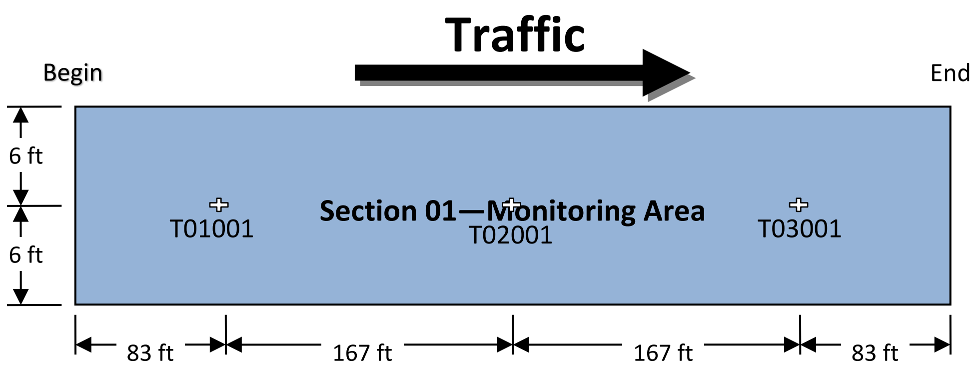
On all projects, elevation surveys should be performed to determine the thickness of each pavement layer placed as part of the construction. This surveying includes the existing surface layer elevation and the overlay layer(s). For mill and overlay projects, measurements are performed on the existing surface layer after milling and the overlay layer(s) after placement and compaction. Measurements should be performed at stations spaced on 50-ft intervals from the start to the end of the monitoring portion of the test section. At each elevation survey station, measurements should be performed at offsets of 0, 3, 6, 9, and 12 ft from the planned outside pavement edge at the location where the outside lane stripe will be placed. These offset locations roughly correspond to the outer lane edge, outer wheel path, lane center, inside wheel path (IWP), and inside lane edge (ILE) of a 3.6-m-wide lane. If the lane is greater than 12-ft wide, the five offsets should be adjusted so that measurements are performed in the wheel path locations.

The offsets should be specified in the material-sampling plan document relative to a convenient reference that will be marked or staked in the field. Many highway agencies use either the pavement centerline or project centerline on divided highway facilities to reference offsets for surveying measurements.

A reproducible location referencing system must be established in the field so that once the elevation survey locations are established, they can be relocated for subsequent measurements on the surface of each new pavement layer placed.

In Situ Density Measurements

In situ density testing will be conducted on the finished bituminous surface layer. This testing must be performed at the specified locations, as shown in figure 3, using the AASHTO T310-11 backscatter method. Each testing location must have four readings with the density instrument rotated 90 degrees between each reading. Test results must be recorded on sampling data sheet 8 shown in appendix A.



Source: FHWA.

Figure 3. Diagram. In situ density/moisture measurements using nuclear density/moisture gauge for a typical section.

Having two nuclear gauges available at the test site is recommended. One gauge will serve as a standby in the event the primary test gauge becomes inoperative or is of questionable accuracy. Nuclear equipment and testing must be conducted in full compliance with all Federal, State, and local regulations. Any special regulations for the use of nuclear density devices in any State must be followed.

CHAPTER 3. SUBSURFACE LAYERS

Subsurface layers are all layers in the pavement structure beneath the experiment layer. Subsurface layers must be sampled and tested according to their material type.

SUBGRADE

The subgrade is the natural soil under the pavement structure, designated as "layer 1." An embankment is fill material placed on top of the naturally occurring subgrade. If the embankment layer is greater than 4 ft thick, the embankment material should be sampled and tested in accordance with the instructions contained in this document for subgrade. In this situation, samples or tests are not required to be performed on the subgrade beneath the embankment layer. If the thickness of the embankment varies beneath the test section, engineering judgment must be used to decide if samples material classification tests should be performed on samples from both the subgrade and embankment layers. Treated subgrade should be classified and treated as a subbase layer for materials sampling and testing purposes.

Bulk Samples

Two bulk samples should be obtained for each project subgrade layer; however, no more than one bulk subgrade sample is required per section. If the subgrade layer is uniform throughout the project, only two subgrade samples are required. If the subgrade layer is found to be different for each section, a number of subgrade samples equal to the number of sections is required.

Bulk samples of the subgrade should be obtained by augering through the 12-inch (305-mm) core holes shown in figure 2. If these locations are impractical, an alternate location within the sampling area should be selected, taking care not to disturb areas designated for subsequent sampling. The depth of augering should be 4 ft below the top of the natural subgrade or fill embankment material directly beneath the base and/or subbase layers. If rocks, boulders, or other forms of dense material are encountered within 4 ft of the top of natural subgrade or fill, another attempt for sampling the subgrade must be made at a different location with a longitudinal offset of 2 ft. If rocks, boulders, or refusal is encountered at the second location, sampling must be terminated. The sampling operation should be performed following the procedures contained in section 3.5 of the *SHRP-LTPP Guide for Field Materials Sampling, Handling, and Testing* (SHRP 1991).

Each subgrade bulk sample sent to the laboratory should contain a minimum of 150 lb of material. The bag must include a jar sample of the material for moisture content measurements. The jar sample must be placed in the bulk sample bag before tying the bag shut.

Laboratory Testing

Laboratory tests to be performed on subgrade materials are shown in table 10.

Table 10. Subgrade testing.

Sample Type	Sample Code	Test Type	LTPP Designation	Minimum No. of Tests
150-lb sample	BS010XX	Sieve analysis	SS01	2
150-lb sample	BS010XX	Atterberg limits	SS03	2
150-lb sample	BS010XX	Classification	SS04	2
150-lb sample	BS010XX	Standard proctor	SS05	2
150-lb sample	BS010XX	Resilient modulus	SS07	2
one mason jar	MS020XX	Natural moisture content	SS09	2

Note: The minimum number of tests is per project layer. The maximum number of tests per section layer is 1.

DCP

DCP testing must be performed on the unbound layers of each test section. DCP testing is to be performed starting on the surface of the uppermost unbound layer. DCP testing is to be performed at one location per test section, using one of the cores in the outer wheel path. Testing is performed in accordance with LTPP protocol P72 of the *Long-Term Pavement Performance Project Laboratory Materials Testing and Handling Guide* (Simpson et al. 2007).

UNBOUND BASE LAYERS

Base and subbase layers that are composed of unbound materials should be sampled and tested following the same guidelines. The only tests on these materials are classification and layer thickness measurement.

Bulk Samples

Two bulk samples should be obtained for each project base and/or subbase layer; however, no more than one bulk sample is required per section layer. If the layer is uniform throughout the project, only two samples are required. If the layer composition is found to be different for each section, a number of samples equal to the number of sections is required.

Samples must be obtained by augering through the 12-inch (305-mm) core holes. Each bulk sample should consist of a minimum of 150 lb of material.

Laboratory Testing

Laboratory testing to be performed on unbound base/subbase layers is shown in table 11.

Table 11. Base/subbase testing.

Sample Type	Sample Code	Test Type	LTPP Designation	Minimum No. of Tests
150-lb sample	BS010XX	Sieve analysis	UG03	2
150-lb sample	BS010XX	Classification	UG08	2
150-lb sample	BS010XX	Atterberg limits	UG04	2
150-lb sample	BS010XX	Standard proctor	UG05	2
150-lb sample	BS010XX	Resilient modulus	UG07	2

Note: The minimum number of tests is per project layer. The maximum number of tests per section layer is 1.

Thickness Measurement

The thickness of base layers must be obtained from inspection and measurement of the auger borings from A-type auger sampling locations (figure 2).

BOUND (TREATED) BASE LAYERS

Cores of bound base layers should be obtained from the locations indicated in figure 2 and sent to the laboratory for measurement and inspection. The laboratory test will either be AC01 for high-quality AC base material or TB01 for other types of bound bases, depending on the type of bound material. At least two tests should be performed per project layer. Laboratory-testing requirements are shown in table 12.

Table 12. Bound base testing.

Sample Type	No. of Samples per Test	Sample Code	Test Type	Minimum No. of Tests
6-inch (152-mm) core	1	CT010XX	Examination and classification	6 cores

Note: The minimum number of tests is per project layer. Maximum number of tests per section layer is 1.

SUBSURFACE AC LAYERS

The subsurface AC layers are the existing AC layers after any milling. In general, samples of the subsurface AC layers can be obtained from the same cores used to obtain samples of the experiment layer, as shown in figure 2. If additional cores are necessary to obtain samples of the subsurface AC layers, these should be located so as not to interfere with future sampling. The required laboratory testing is shown in table 13.

Table 13. Subsurface ac layer testing.

Sample Type	No. of Samples/ Test	Sample Code	Material Type	Test Type	Minimum No. of Tests
6-inch (152-mm) core	3	CA010XX, CA020XX, CA030XX	Core	Core exam and thickness, bulk specific gravity, and AMPT dynamic modulus (requires 1 core + 2 spare)	6 for core exam and bulk specific gravity, 4 for AMPT dynamic modulus
12-inch (305-mm) core (or 6-inch (152-mm) cores)	1 (or 4)	BA010XX, BA020XX (or BA010XX, BA020XX, BA030XX, BA040XX)	Mix	Core exam and thickness, maximum specific gravity, and extraction	2 for all tests
12-inch (305-mm) core (or 6-inch (152-mm) cores)	1 (or 4)	BA010XX, BA020XX (or BA010XX, BA020XX, BA030XX, BA040XX)	Extracted binder	DSR, BBR, and MSCR	2 for all tests
12-inch (305-mm) core (or 6-inch (152-mm) cores)	1 (or 4)	BA010XX, BA020XX (or BA010XX, BA020XX, BA030XX, BA040XX)	Extracted aggregate	Gradation	2

BBR = bending beam rheometer; DSR = dynamic shear rheometer; MSCR = multiple stress creep recovery.
Note: Minimum number of tests per project layer. The maximum number of tests per section layer is 1. The minimum number of tests is based on all performing core exam as well as the thickness and bulk specific gravity on all three cores sampled. Two tests are performed per batch of three cores. Two batches of three cores are required for the four tests indicated.

CHAPTER 4. MRL SPECIMENS

Scheduling information should be furnished to the LTPP MRL contractor as soon as this information is available. This information should include, at a minimum, the sampling date, highway agency contact name, shipping address, and telephone number. The contact information for the MRL is located on the LTPP InfoPave™ website (FHWA n.d.-a).

Shipping the samples to the MRL must be done through a common carrier, and FHWA will cover the cost. The RSC should contact the MRL office for coordination and sample shipping details.

Before shipping the samples to the MRL, the specimens must be logged into the MTS along with the appropriate shipment information. If the LTPP testing contractor is not yet able to test or store the sample material, cores for SPS-10 projects can also be shipped and stored at the MRL. The MRL should be contacted for shipping containers and instructions.

Samples required for the MRL are shown in table 14, including two levels of MRL sampling recommendations: the minimum quantity and the National Cooperative Highway Research Program (NCHRP) 9-57 recommended quantity (Zhou et al. 2016).

Table 14. Material samples to be shipped to the LTPP MRL.

Specimen Type	Minimum Quantity	NCHRP Quantity
Asphalt cement collected from the plant in 1-gal cans.	Five for each type of binder	10 for each type of binder
Bulk asphalt mixture collected onsite in 5-gal buckets.	Eight for each section	15 for each section
Bulk combined aggregate collected from the mixture production plant in 5-gal buckets.	Five for each mix	20 for each mix
Bulk RAP material collected from the plant in 5-gal buckets.	Five for each mix	10 for each mix
WMA additive collected from the mixture production plant in 1-gal cans.	One for each type of additive	Three for each type of additive
6-inch (152-mm) cores at time interval, t_0.	Four per test section	Four per test section
6-inch (152-mm) cores at time intervals, t_1 to t_3.	Three per test section at each time interval	Three per test section at each time interval
Bulk unbound material in bags.	Three per test section at each time interval	Three per test section at each time interval

Contact the MRL before construction of the project sections to make arrangements for sample containers and to receive specific shipping instructions.

Only one sample of each unique asphalt binder used in the SPS-10 mixes is needed. If the same binder is used in more than one mix, then only one sample of that binder should be obtained.

CHAPTER 5. FIELD MATERIALS SAMPLING

This section describes the procedures and guidelines for field sampling and testing as well as the handling of cores and other material samples in the field and while transferring to the laboratory. These procedures should be followed as closely as possible to minimize the variability of material properties attributable to differences in sampling and handling techniques.

PERSONNEL REQUIREMENTS

Because of the scope, intensity, and time constraints imposed on the field coring and sampling for this SPS experiment, having additional field personnel, beyond those needed for routine construction-acceptance testing, present onsite is recommended. These individuals should have sole responsibility for obtaining the necessary material samples, completing the necessary data sheets and forms, as well as performing the necessary testing. A field crew that includes a qualified onsite project supervisor experienced with LTPP sampling procedures, data collection, and reporting requirements is recommended. This supervisor should be a senior technician, geologist, or engineer with experience in subsurface explorations and pavement field sampling and testing. This person must be familiar with all aspects of the LTPP drilling and sampling program, including the field coring and sampling techniques as well as the timing of all field activities.

FIELD OPERATIONS

Field operations at each SPS-10 project site will include the following activities:

1. Establish a joint field team: Before construction of project sections, the LTPP RSC should establish a joint field team with the participating highway agency to coordinate the conduct of the activities involved in the coring and sampling operations. RSC personnel must be assigned to assist the participating highway agency and contractors. Such personnel must ensure that the field operations are performed in accordance with the sampling and testing plan, utilize proper procedures, and perform all necessary written documentation.

2. Establish a project site: The joint field team must lay out the project site, mark initial sample locations, and perform the sampling and testing operations. Following the sequence of boring as specified in the sampling plan is important to reduce the risk of mixing samples at the site. Core or auger locations that are considered unacceptable should be replaced with alternate locations and marked on an as-sampled layout plan.

3. Document problems in the field: The LTPP field representative must record, report, and resolve problems encountered during the field operations.

4. Prepare test samples: Test samples, along with complete logs and other records, must be prepared for shipping.

COLLECTION OF SAMPLES, MARKING, PACKAGING, AND SHIPPING

Due to the nature of this research project and the long-distance delivery of samples, carefully packaging samples is extremely important. The samples must be packaged and preserved in accordance with group B of ASTM D4220-95 (ASTM 1995). Extreme care must be taken in the packaging and shipping test samples to prevent damage to the samples or modification of their properties.

General requirements for marking and packaging individual samples are as follows:

- Systems for sample numbering are needed (as provided in the following section of this report).
- Indelible ink pens (black or other suitable color) must be used for marking labels.
- Labels and tags must be of high-quality, moisture-resistant material. Color-coded labels to indicate the destination of the sample (e.g., contract lab, FHWA lab, and MRL) are recommended.
- Bags for small portions of auger and bulk samples of materials to be used for laboratory moisture content determination must be cloth or heavy plastic and sealable against moisture loss or gain by wire ties. Mason jars adequately sealed against moisture loss or gain may also be used.
- Bags for large bulk samples must be plastic-lined, heavy cloth bags that have wire ties for closing.
- Resealable storage bags or other suitable material (e.g., heavy duty plastic wrap or bubble wrap) must be used for cores to ensure that they are sealed from moisture and then wrapped for their entire length with tape (e.g., plastic transparent mailing tape 2-inches (51-mm) wide).

Sampling Location Designations

Sample locations for every sample taken must be unique throughout project. Sampling locations are designated on the LTPP forms and materials sampling plans with the following six-digit code format: S-LL-t-XX.

Where:

S = sample location type:

- A = bound, compacted bulk sample (12-inch- (305-mm) diameter core).
- F = bound bulk sample (uncompacted bulk mixture obtained onsite).
- U = combined aggregate used in AC mixes.
- C = 4- (102 mm) or 6-inch- (152-mm) diameter core.
- T = nuclear density/moisture gauge.
- H = samples obtained from the HMA plant.

LL = sample location number: up to a two-digit sample number assigned sequentially to each sample with the same sample type designation.
t = sampling time interval: time interval used for samples taken at specified time intervals referenced to the construction date.

The single number designating the time after paving is as follows:

0 = prior, during, or immediately after construction.
1 = 3–6 mo.
2 = 12 mo.
3 = 18 mo.
XX = section number: two-digit designation for test section number (e.g., 01, 02, and 03). This numbering makes the sample location unique to that test section.

Table 15 provides some examples of how this location designation is implemented.

Table 15. Examples of valid sample location numbers.

Code	Detail
A02003	Auger location 02 at sampling time interval t_0 (immediately after paving) from test section 03.
C04103	Core location 04 at sampling time interval t_1 (6 mo after paving) from test section 03.

The samples from each sample location are assigned a sample number as described in the next section.

Sample Code Number

Each sample (core, bulk, moisture, and compacted) must be assigned a seven-digit designation that must be recorded on the appropriate data forms. Sample numbers for every sample taken must be unique throughout the project. The sample number is based on the following format: S-M-##-t-XX

Where:
S = sample type:

- C = core sample.
- B = bulk sample.
- M = moisture sample.

M = material type:

- A = AC.
- C = asphalt cement.
- R = RAP.
- W = WMA additive.
- T = treated, bound, or stabilized base/subbase.

- G = untreated, unbound granular base/subbase.
- S = subgrade soil or fill material.

= sample number: up to a two-digit sample number assigned sequentially to each sample with the same sample type and material type.
t = sampling time interval: time interval used for samples taken at specified time intervals referenced to the construction date.

The single number designating the time after paving is as follows:

0 = prior, during, or immediately after construction.
1 = 3–6 mo.
2 = 12 mo.
3 = 18 mo.
XX = section number: two-digit designation for test section number (e.g., 01, 02, and 03). This numbering makes the sample location unique to that test section.

Table 16 provides some examples of how the sample code number is implemented.

Table 16. Examples of valid samples code numbers.

Code	Detail
CA24002	AC core number 24 obtained at time interval t_0, immediately following paving, from test section 02.
CA01301	AC core number 01 taken from test section 01 during interval t_3 (18 mo after construction).
CT02003	Treated base core number 02 from test section 03 at time interval t_0.
BG01001	Bulk sample number 01 of granular base from test section 01. Assign numbers consecutively as samples are obtained from each test section, such as BG01001, BG02001, etc..
BA01002	Bulk sample number 01 of uncompacted AC from test section 02. Assign numbers consecutively as samples are obtained from each test section, such as BA01002, BA02002, etc..
BS01002	Bulk subgrade sample of material from test section 02. Assign sample numbers consecutively for multiple samples from the same test section.
BC01001	Bulk asphalt cement sample number 01 obtained at time of construction.
MS01002	Subgrade moisture content sample number 01 obtained from bulk sampling location on test section 02.
BW01001	Bulk WMA additive sample number 01 obtained at time of construction.
BR01001	Bulk asphalt cement sample number 01 obtained from mixture production plant at time of construction.

MTS—Hole ID and Specimen ID

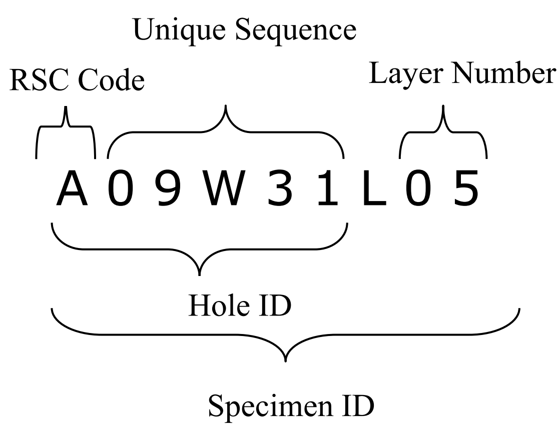
The LTPP MTS is based on the use of a single, unique specimen ID number for each test specimen. This ID must be directly written on the specimen (in the case of cores) or the specimen's container, in the case of bulk samples. While other identifying information (i.e., State code, SHRP ID, and layer number) may be transmitted along with the specimen, the specimen ID is intended to be the primary means of identifying the specimen in communications between the RSC, lab, and other stakeholders.

The RSC must assign the specimen ID. The first character of the specimen ID must indicate the RSC that assigned the specimen ID in accordance with table 17.

Table 17. Specimen ID RSC codes.

Code	Detail
A	North Atlantic
C	North central
S	Southern
W	Western

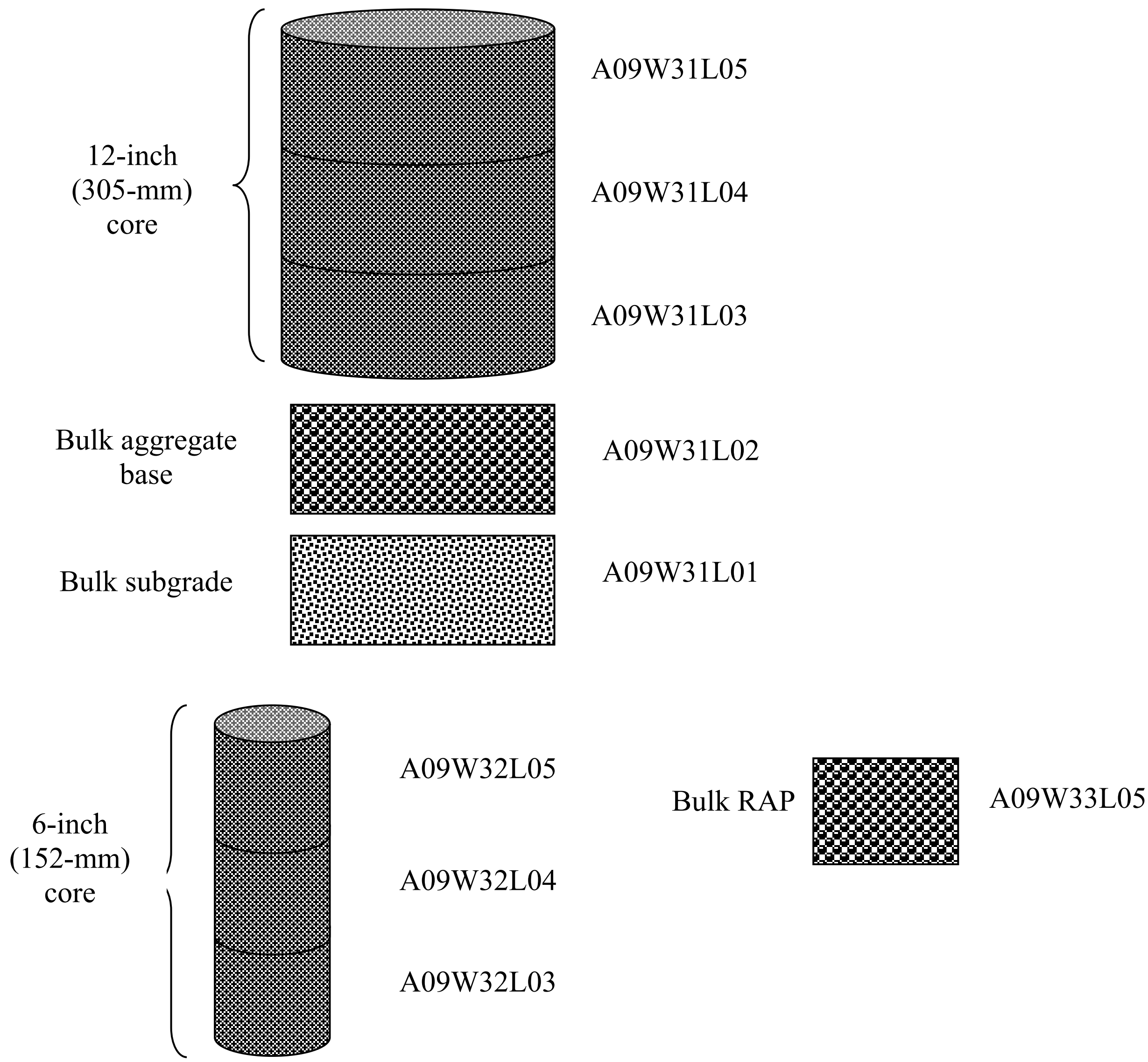
This RSC identifier must be followed by five alphanumeric characters that form a unique sequence for the sampling location. Using this sequence to encode any specific information is not required, and the RSC can decide to develop a system that ensures that this sequence is unique. This combination of the RSC code and a five-character unique sequence is called the hole ID for specimens obtained by coring/boring. The final three characters of the specimen ID must be "L" and the layer number corresponding to the specimen. An example is shown in figure 4.



Source: FHWA.

Figure 4. Illustration. Specimen ID diagram.

Mixture production plant specimens such as RAP stockpile materials or bulk asphalt cement may represent more than one test section, and it is possible that the layer numbering for these sections may be different. However, the sampling information must be connected to a single test section, and the layer number encoded in the specimen ID must be the layer number appropriate for that test section. An example "A" type core/boring location, "C" type core and bulk RAP sample from the same hypothetical test section, and the example specimen IDs are shown in figure 5.



Source: FHWA.

Figure 5. Illustration. Example specimen IDs.

Labels and Tags

Each sample must be labeled before packing in boxes and cartons. At a minimum, the following information must be included on a tag or label attached to the specimen:

- Specimen ID.
- State code.
- SHRP ID.
- Location designation.
- Sample number.
- Date (month, day, and year of sampling date).

- Field-set number (a one-digit number that will be 1 for the first round of sampling, 2 for the next round of sampling, etc.).

For cores, the hole ID must be written directly on the core. If the core contains more than one layer, layer boundaries must be clearly marked and each layer numbered. For bulk samples, the specimen ID must be written directly on the sample container.

Packaging

Suggestions for labeling and combining the samples for shipment are as follows:

1. All samples of like material (e.g., asphaltic concrete surface and binder) must be placed in separate boxes or separate compartments of one box.
2. Each sample must have a label or tag attached that clearly identifies the material. Color coding the label by destination (e.g., contract lab, FHWA lab, and MRL) is recommended.
3. Each core must be surrounded with bubble wrap or other acceptable cushioning material on all sides within the shipping box.
4. All bulk samples must be marked with two labels or tags. One must be placed inside the bag, and one attached to the outside. A jar sample for moisture testing of each bulk sample must be placed inside the bulk sample bag.
5. All shipping boxes should be made of sturdy wood able to withstand the shipping and moving process without falling apart or damaging the samples.
6. All boxes should be adequately secured by nails or screws before shipping.
7. Field operations information sheets 1 and 2 must be sent with each shipment of materials samples.

Shipping

All samples should be shipped within 5 d of sampling to the FHWA-designated laboratory. Each box must be labeled to include the State code, SHRP ID, type(s) of samples, and box number (for each series of boxes for the specific project to each delivery point). The boxes should be labeled "handle with care" or with similar wording. Samples must be protected against freezing and overheating.

A copy of the bill of lading clearly showing the boxes being shipped and a receipt signed by the shipping organization must be sent to the appropriate RSC.

All of the discussed guidelines are economically feasible measures to protect the integrity of the material samples as much as possible. These materials are very important to the success of the LTPP program and should be treated with as much care as possible. Cooperation from all participants is needed to ensure that these specimens arrive at the laboratory with minimal damage.

Patching and Cleanup

After completing the sampling and testing of each layer, the sampling personnel must be especially careful to remove all debris created by the operations. Field sampling and testing personnel must also repair and restore all bulk sampling, auger probe, or coring locations by replacing all material and compacting the layer as per the participating agency's practice. The repair method of each sampling area type must be outlined in the materials sampling plan.

LOGS AND REPORTS

Accurate and detailed record keeping is essential for the materials sampling and testing program. All forms and paperwork are to be compiled by LTPP RSC personnel. During the field sampling operations, two types of forms must be completed: the field operations information forms and the sampling data sheets. Field operations information forms are used to record general information concerning the pavement test sections and the materials samples. Sampling data sheets are used to record the actual information for each sampling area or sampling location. A person should be designated to record data at each site on the appropriate data sheets to ensure the accuracy and integrity of the collected data and to forward the data sheets to the appropriate personnel. This person must thoroughly understand the content of the data sheets and the procedures for completing the sheets. If these forms are completed by a person other than the LTPP representative, the data sheets must be reviewed by the LTPP representative before forwarding the sheets to the appropriate personnel.

Global Positioning System Coordinates

A Global Positioning System (GPS) measurement must be taken at each sampling location. Such GPS measurement includes cores, bulk samples of uncompacted mixture, bulk samples of asphalt cement, and in situ density measurements. Sampling data sheets 2, 4, 8, 10, and 10-A (as shown in this report) include fields for recording GPS measurements. The GPS measurement must be taken using a receiver that meets all the following requirements:

1. Has Wide Area Augmentation System capability or a potential location accuracy of less than 3 m.
2. Displays measured latitude and longitude coordinates to a resolution of 0.00001 degree.
3. Provides an estimate of measurement accuracy in meters.
4. Has 12-parallel-channel tracking capability.

All GPS measurements must be obtained using the World Geodetic System 84 (WGS 84) datum.

Field-Set Number

The field-set number is a sequentially assigned number used to indicate the different periods in which the material sampling and field testing were conducted during the project. A field-set number can apply to more than one d since sampling of SPS-10 test sections may require more than one d.

All sampling that occurs during or immediately after construction of the overlay should be designated field-set number one. All sampling performed 3–6 mo after construction must be designated field-set number two.

Cores

A separate log must be completed for each core hole. The depth of penetration of each coring operation and the average length of the recovered core must be recorded to the nearest 0.1 inch (3 mm). Data sheets for these logs are included in appendix A of this document. Sampling data sheet 2 in this report must be used to record pavement cores from C-type sampling areas. These logs must show the general type of material. The general code 1 must be used to identify dense graded HMA, and 91 must be used to identify dense graded WMA. Remarks must include the type of cooling medium, difficulties encountered in coring, defects observed in the core (i.e., cracks, voids, and disintegration), and other pertinent observations.

A-Type Sampling

Data for each A-type sampling hole must be recorded on sampling data sheet 4 in this report. These sampling holes include auguring to obtain subgrade bulk samples as well as perform material classification and layer thickness measurements on base and subbase layers. These data should include descriptions of the subgrade layers, depth of samples, and other related data. Data to be recorded on this form should include the following:

1. Material type and description for each layer of untreated materials and soils in accordance with table C.2. of the *SHRP-LTPP Guide for Field Materials Sampling, Handling, and Testing* (SHRP 1991).
2. Thickness of each layer encountered in the hole to the nearest 0.1 inch (3 mm).
3. Presence and levels of any water encountered.
4. Sample numbers.

Bulk Sampling of Subgrade

Observations and measurements performed during subgrade sampling must be logged as the excavation progresses and must be reported on sampling data sheet 4 in this report. The record must include a description of the exposed subgrade and thickness measurement of any layers, sample numbers and number of bags per sample, test numbers, any water seepage, sloughing, voids, and other pertinent items.

ASSEMBLY OF DATA SHEETS AND TRANSMITTAL

The following is a description of the format that should be used for the assembly of the data sheets from each SPS-10 test site. The forms will appear in the final assembled data packet in the order provided in appendix A of this document. The title page will always be the first (top) sheet of the data packet and include the following information:

1. State.
2. State code.
3. SHRP ID.
4. Date(s) of field materials sampling and field testing.
5. Submitting contractor/agency.
6. Total sheets, including the title page.

To determine the number of sheets (item number six in the list above) all of the pages in the packet should be counted. The pages should then be numbered, starting with the title page. For example, if there are 100 pages in the packet, the title page would be "page 1 of 100" followed by "page 2 of 100" and so forth until the last page would read "page 100 of 100." This page numbering format will ensure that any lost sheets can be quickly identified.

After the packet has been assembled and numbered, an appropriate number of duplicates should be made. The original must be stored at the RSC office.

CHAPTER 6. LABORATORY MATERIALS TESTING

This chapter contains general guidelines to be used by laboratories participating in the SPS-10 laboratory materials testing program. Many of the protocols, test data reporting sheets, and definitions referenced in this document can be found in the document *LTPP Project Laboratory Material Testing and Handling Guide (*Simpson et al. 2007). The purpose of the protocols and the materials testing guide is to minimize the variability of materials test data attributable to laboratory material testing and handling techniques by standardizing these techniques as much as possible. They also provide a common format for reporting test results so they can be stored in the LTPP Information Management System for dissemination (Elkins et al. 2017). The general instructions included in this document are to be used as general guidelines by the laboratory. However, the laboratory chief/manager must exercise judgment when using these guidelines. If problems or discrepancies are found, the RSC should be contacted.

The standard method for transmitting sampling- and testing-related information between the RSC and lab is through the MTS. Responsibilities for each entity are as follows:

- RSC:
  - Enter sampling information.
  - Assign tests to samples.
  - Notify lab of sample shipment.
  - Acknowledge receipt of test results.
  - Acknowledge upload of test results.

- Lab:
  - Acknowledge receipt of test samples.
  - Update testing status.
  - Notify RSC of test results shipment.

LABORATORY TESTING OF SUBGRADE MATERIALS

The LTPP central laboratory contractor will be responsible for performing the sieve analysis, Atterberg limits, material classification, and natural moisture content tests on the subgrade materials obtained from the SPS-10 test sections. The LTPP protocols containing the test procedure, reporting requirements, and data forms for these tests are as follows:

- Sieve analysis, protocol P51 (Simpson et al. 2007).
- Atterberg limits, protocol P43 (Simpson et al. 2007).
- Material classification, protocol P52 (Simpson et al. 2007).
- Natural moisture content, protocol P49 (Simpson et al. 2007).
- Resilient modulus, protocol P46 (Simpson et al. 2007).

The following general procedures must be used to perform the testing on the subgrade soils:

- Perform moisture content testing (protocol P49) on all jar samples provided with the bulk samples.

- Combine the bulk samples with the same sample number if contained in more than one bag or container. Do not combine bulk samples of materials obtained from different locations on the SPS-10 project.

- Thoroughly mix the combined bulk sample and then dry the sample in accordance with the procedure described in section 4.1 of AASHTO R58-11 (AASHTO 2011).

- Reduce the mixed and dried sample to the appropriate test size using the procedures described in AASHTO T248-11. The test samples must be representative of the total bulk sample (AASHTO 2011).

- Perform all other tests in accordance with the appropriate protocols.

Having a substantial amount of leftover material after testing the subgrade soil is likely. This extra material ensures that an adequate amount of sample is available to run all of the required characterization tests. The extra material can be disposed of after all the testing has been completed and the RSC has received all of the quality-control-approved results.

LABORATORY TESTING OF EMBANKMENT MATERIALS

Materials from embankment layers greater than or equal to 4-ft thick must be treated as subgrade materials and tested in accordance with the subgrade soil laboratory-testing protocols described in this report. Materials from embankment layers less than 4-ft thick must be considered as a subbase but tested as a subgrade material.

LABORATORY TESTING OF UNBOUND GRANULAR BASE/SUBBASE MATERIAL

All testing must be performed by the LTPP central laboratory contractor. These tests must be conducted in the following order:

1. Particle size analysis, protocol P41 (Simpson et al. 2007).
2. Atterberg limits, protocol P43 (Simpson et al. 2007).
3. Classification of granular base/subbase materials, protocol P47 (Simpson et al. 2007).
4. Resilient modulus, protocol P46 (Simpson et al. 2007).

The following general procedures must be used to perform the testing on the unbound granular base/subbase:

- Combine the bulk samples with the same sample number if contained in more than one bag or container. Do not combine bulk samples of materials obtained from different locations on the SPS-10 project.

- Thoroughly mix the combined bulk sample and then dry the sample in accordance with the procedure described in section 4.1 of AASHTO R58-11 (AASHTO 2011).

- Reduce the mixed and dried sample to the appropriate test size using the procedures described in AASHTO T248-11 (AASHTO 2011). The test samples must be representative of the total bulk sample.

- Perform all other tests in accordance with the appropriate protocols.

Before the extra material can be disposed of, all the testing must be completed and the RSC must receive all of the quality-control-approved results.

LABORATORY TESTING OF HMA MATERIALS

The following sections are to be used as a guide for the completion of the laboratory material testing program for HMA materials, including asphalt cement, RAP stockpile material, and HMA cores. All tests must be performed by the LTPP central laboratory contractor except:

- Protocol P01 must be performed by the RSCs (Simpson et al. 2007). Each RSC is responsible for performing AC01 on every core drilled within its region. This protocol should be completed and the results verified before the core is shipped to the LTPP central laboratory contractor.

- Protocol P76 will be performed by FHWA TFHRC (Simpson et al. 2007).

Bulk Samples of AC Binder

The following tests must be performed on each asphalt cement used in the SPS-10 experiment HMA mixtures. Normally this testing will only be for the unmodified binder used in the control section; however, these tests will apply to binder used in the supplemental sections if the binder specification is different than for the core sections. Two separate samples of each binder must be obtained. One sample must be shipped to the central laboratory contractor, and one must be shipped to FHWA.

The central laboratory contractor must perform the following tests in the following order:

1. Binder specific gravity, protocol P23 (Simpson et al. 2007).
2. Dynamic shear rheometer (DSR), unaged, protocol P27 (Simpson et al. 2007).
3. DSR, RTFO, protocol P27 (Simpson et al. 2007).
4. Multiple stress creep recovery (MSCR), RTFO, protocol P73 (Simpson et al. 2007).
5. DSR, RTFO+PAV, protocol P27 (Simpson et al. 2007).
6. Bending beam rheometer (BBR), RTFO+PAV, protocol P28 (Simpson et al. 2007).

FHWA TFHRC will perform the polyphosphoric acid (PPA) and used motor oil test, protocol P76.

Bulk Samples of RAP

The following tests must be performed on RAP material used in the SPS-10 experiment AC mixtures. All testing must be performed by the central laboratory contractor.

The tests must be performed in the following order:

1. DSR, RTFO, protocol P27 (Simpson et al. 2007).
1. BBR, RTFO, protocol P28 (Simpson et al. 2007).

2. MSCR, RTFO, protocol P73 (Simpson et al. 2007).

AC Layers Other Than Surface Layer

The following tests must be performed on each nonsurface AC layer. For overlay projects, these tests correspond to the existing AC layers. These tests must only be done for cores sampled at the time of construction. All testing must be performed by the central laboratory contractor, except for AC01, which must be performed by the RSC.

- Mixture stiffness—Three 6-inch (152-mm) cores/section required, except for supplemental sections:

    1. Examination and thickness, performed on each core, protocol P01 (Simpson et al. 2007).
    2. Bulk specific gravity, performed on each core, protocol P02. (Simpson et al. 2007).
    3. Dynamic modulus, performed on specimens prepared from one of the three cores protocol P74.

- Maximum specific gravity and component properties—Two 12-inch (305-mm) core/section required, except for supplemental sections. Multiple smaller cores may be substituted to achieve same volume of material:

    1. Examination and thickness, protocol P01 (Simpson et al. 2007).
    2. Maximum specific gravity, protocol P03 (Simpson et al. 2007).
    3. Extraction, asphalt content, protocol P04 (Simpson et al. 2007).
    4. DSR, unaged, protocol P27 (Simpson et al. 2007).
    5. BBR, unaged, protocol P28 (Simpson et al. 2007) .
    6. MSCR, unaged, protocol P73.
    7. Aggregate gradation, protocol P14 (Simpson et al. 2007).

Surface AC Layers

The following tests must be performed on each surface AC layer. These layers correspond to the WMA- or HMA-control layers placed as part of this experiment. All testing must be performed by the central laboratory contractor, except for protocol P01, which must be performed by the RSC.

The following tests are performed for t_0 (immediately after construction):

- Mixture stiffness—Three 6-inch (152-mm) cores/section required, including supplemental sections:

    1. Examination and thickness, performed on each core, protocol P01 (Simpson et al. 2007).
    2. Bulk specific gravity, performed on each core, protocol P02 (Simpson et al. 2007).
    3. Two dynamic modulus tests, performed on different specimens prepared from the three cores, protocol P74.

- Rut resistance—Three 6-inch (152-mm) cores/section required, including supplemental sections:

  1. Examination and thickness, performed on each core, protocol P01 (Simpson et al. 2007).
  2. Bulk specific gravity, performed on each core, protocol P02 (Simpson et al. 2007).
  3. Hamburg wheel-track testing, performed on two of the three cores, protocol P75.

- Fracture energy—Four 6-inch (152-mm) cores/section required, including supplemental sections:

  1. Examination and thickness, performed on each core, protocol P01 (Simpson et al. 2007).
  2. Bulk specific gravity, performed on each core, protocol P02 (Simpson et al. 2007).
  3. Fenix, performed on three of the four cores, protocol P79.

- Maximum specific gravity and component properties—One 12-inch (305-mm) core/section required, including supplemental sections. Multiple smaller cores may be substituted to achieve same volume of material:

  1. Examination and thickness, protocol P01 (Simpson et al. 2007).
  2. Maximum specific gravity, protocol P03 (Simpson et al. 2007).
  3. Extraction, asphalt content, protocol P04 (Simpson et al. 2007).
  4. Binder specific gravity, protocol P23 (Simpson et al. 2007).
  5. DSR, unaged, protocol P27 (Simpson et al. 2007).
  6. MSCR, unaged, protocol P73.
  7. DSR, PAV, protocol P27 (Simpson et al. 2007).
  8. BBR, PAV, protocol P28 (Simpson et al. 2007).
  9. Aggregate gradation, protocol P14 (Simpson et al. 2007).

The following tests are performed for each sampling interval after construction (t_1–t_3):

- Mixture stiffness—Three 6-inch (152-mm) cores/section required, including supplemental sections:

  1. Examination and thickness, performed on each core, protocol P01 (Simpson et al. 2007).
  2. Bulk specific gravity, performed on each core, protocol P02 (Simpson et al. 2007).
  3. Two dynamic modulus tests, performed on different specimens prepared from the three cores, protocol P74.

- Binder properties—One 12-inch (305-mm) core/section required, including supplemental sections. Multiple smaller cores may be substituted to achieve the same volume of material:

  1. Examination and thickness, protocol P01 (Simpson et al. 2007).
  2. Extraction, asphalt content, protocol P04 (Simpson et al. 2007).

3. DSR, unaged, protocol P27 (Simpson et al. 2007).
4. BBR, unaged, protocol P28 (Simpson et al. 2007).
5. MSCR, unaged, protocol P73.

Treated Base/Subbase/Subgrade Materials

If a treated base, subbase, or subgrade is present, protocol P31 must be used to examine it. This examination can be performed on a core with a 4 inch (102 mm) or greater diameter. One test must be performed for each section. Testing must be performed by the RSCs.

SAMPLE ID AND MARKING

Maintaining strict adherence to field-based sample ID and marking procedures is imperative. The specimen ID must follow each sample throughout the laboratory materials testing process. Also keeping tags and labels on samples during storage is extremely important.

SAMPLE RECORD KEEPING

The laboratories conducting SPS-10 project testing are required to keep in close contact with the RSC from the time of receiving the samples from the field to the disposal of the material samples. Timely transmission of information between the laboratory and the RSC should be maintained using the MTS.

Sample Receipt Procedures

Upon receipt of the samples, the samples must be inspected by the laboratory manager (or their designee) for the following:

- Completeness of the shipment (as compared to the MTS).
- Condition of samples (e.g., damage, contamination).
- Quantity of samples.
- Proper ID.

Regardless of the condition and size of the samples, they must be logged in using the MTS. If testing cannot be performed on a given specimen, the reason must be entered in the MTS.

Test Data Reporting

The participating laboratory is required to use electronic data formats for recording test results. FHWA must verify and agree to the electronic data formats before testing is performed. At a minimum, the electronic record must contain the specimen ID of the sample and all data fields included on the paper data reporting forms contained in chapter 3.1 of the *Long-Term Pavement Performance Project Laboratory Materials Testing and Handling Guide* (Simpson et al. 2007). For each test performed, the lab must update the MTS with the name of the electronic data file containing the test results. Data file shipments must also be tracked using the MTS.

SAMPLE STORAGE

Due to the volume of work and the likelihood of delays in testing, proper storage conditions must be maintained for all specimens obtained from SPS-10 projects. The storage requirements presented herein are critical to ensuring the integrity of the sample/specimen for future testing and materials characterization. Specifically, requirements for adequate storage and temperature conditions have been detailed for the specimens to ensure that the samples are not compromised without making the storage requirements overly burdensome. ID assigned to the materials must be retained on tested samples, untested samples, and extra samples at all times.

The term "environmentally protected storage" as used in this document means that the storage area must be fully enclosed and not subjected to the natural elements. This type of area must provide protection against contact with water (rain or wet floor) and exposure to direct sunlight. Also, the storage area must be capable of maintaining each sample in the required temperature range. Samples must be marked to indicate their status, such as "hold material—do not use."

The following four sections illustrate the guidelines that must be followed for storage of materials from the LTPP experiments.

AC Materials

Asphalt materials must be stored between 5 °C (40 °F) and 27 °C (80 °F) in an environmentally protected storeroom. Cores should be stored flat side down, fully supported.

Asphalt-Treated Materials

Asphalt-treated base/subbase and treated subgrade cores and materials should be stored flat side down, fully supported at a temperature between 5 °C (40 °F) and 27 °C (80 °F) in an environmentally protected storeroom.

Nonasphalt-Treated Materials

Nonasphalt-treated base/subbase as well as nonasphalt-treated subbase cores and materials should be kept in an environmentally protected (i.e., indoors, not subject to rain, sleet, snow, etc.) storage area at a temperature between 5 °C (40 °F) and 38 °C (100 °F).

Bulk/Moisture Samples

Bulk and moisture samples of base, subbase, and subgrade material should be kept in an environmentally protected storage area at a temperature between 5 °C (40 °F) and 38 °C (100 °F).

SAMPLE HANDLING AND SHIPPING

All samples sent to other laboratories for testing must, at a minimum, be prepared and shipped using the following guidelines.

Packaging

The following list provides the instructions for packaging samples prior to shipping.

1. Each sample must have a label or tag attached that clearly identifies the material, the project number/test section that it was recovered from, and the sample number.

2. Each core must be wrapped in bubble wrap or other acceptable cushioning material on all sides within the shipping box.

3. Bulk samples must be marked with two labels or tags. One must be placed inside the bag and one attached to the outside. Pieces from treated layers not suitable for testing as cores must be packaged and shipped as bulk samples.

4. Shipping boxes must be made of wood of suitable grade and construction to withstand shipping and subsequent moving without breakage of the box or damaging of the samples.

5. All boxes must be adequately secured by nails or screws before shipping.

6. All necessary documentation related to the samples being shipped must also be included in the shipment. A duplicate set of all necessary documentation must be sent in a separate package to the laboratory to confirm the box inventory.

Shipping

Each box must be labeled to include the project ID number, type(s) of samples, and the box number (for each series of boxes). The boxes must be labeled “handle with care” or similar wording as specified by the transporting organization to reasonably ensure careful handling and protection from freezing and overheating.

A copy of the bill of lading indicating the box’s shipment and a shipping company-signed receipt must be sent to the appropriate RSC.

Summary

The sample preparation and shipping guidelines provided in this report are designed to maintain the integrity of material samples to the highest degree possible in an economically feasible manner. These materials are very important to the success of the LTPP program and should be treated with as much care as possible. Cooperation from all participants is needed to ensure that these specimens are shipped between entities with minimal damage.

TESTING PROTOCOLS

A set of laboratory-testing protocols specifically developed for the SPS-10 experiment are included in appendix B of this report. These protocols were current at the time of development of this report. They may have been changed by directive in the interim. Please reference LTPP InfoPave materials directives for the most up-to-date protocols (FHWA n.d.-b).

The protocols included in this report are as follows:

- Protocol P27: Standard test method for determining the rheological properties of asphalt binder using a DSR (test designation AE07) (Simpson et al. 2007).
- Protocol P28: Standard test method for determining the flexural creep stiffness of asphalt binder using the BBR (test designation AE08) (Simpson et al. 2007).
- Protocol P73: Standard test method for the MSCR test (test designation AE10).
- Protocol P74: Using asphalt mixture performance tester (AMPT) to determine dynamic modulus for HMA (test designation AC08).
- Protocol P75: Standard test method for Hamburg wheel-track testing of AC (test designation AC09).
- Protocol P77: Standard test method for the RTFO test (test designation AE12).
- Protocol P78: Standard test method for PAV (test designation AE13).
- Protocol P79: Test method for determining fracture energy of asphalt materials at low and intermediate temperatures (Fenix fracture energy) (test designation AC10).

APPENDIX A—FIELD MATERIALS SAMPLING AND TESTING DATA FORMS

In general, the field materials sampling and testing should be performed following the guidelines in the *SHRP-LTPP Guide for Field Materials Sampling, Testing, and Handling (*SHRP 1991). However, field data forms have been revised, and data sheets have been included to report data for bulk sampling of subgrade, granular material, and AC materials performed during construction. These changes and/or additions have been made to accommodate the specific needs of the experiment.

LTPP-SPS-10 MATERIAL-SAMPLING AND FIELD-TESTING DATA SHEETS

Material-sampling and field-testing data sheets used in the SPS experiments include sampling data sheets and field operations information forms. The SPS-10 experiment requires completion of the following sheets and forms in table 18, table 19, and table 20:

Table 18. Sampling data sheets used in SPS-10 experiments.

Sampling Data Sheet No.	Description
2	Pavement core log at C-type core locations.
4	A-type bore hole log.
8	In situ density and moisture tests.
10	Sampling uncompacted bituminous paving mixtures.
10-A	Sampling asphalt cement.

Table 19. Field operations information sheets used in SPS-10 experiments.

Field Operations Information Form No.	Description
1	Laboratory shipment samples inventory.

Table 20. Elevation measurement sheets used in SPS-10 experiments.

Elevation Measurements Form No.	Description
1	Rod and level elevation survey.

Most of the LTPP-SPS material-sampling and field-testing data sheets (sampling data sheets and field operations information forms) use the same top block of information related to the test section and project:

- Sheet number: Since multiple data sheets will be required for the samples and tests from the multiple sampling areas on the project, room is provided on all data forms to sequentially order the data sheets. The first field is the sequential number of the data sheet, and the second field is the total number of data sheets submitted.

- State: Indicate the name of the U.S. territory, U.S. State, or Canadian Province in which the project is located.

- State code: Enter the two-digit numeric code corresponding to the U.S. State or Canadian Province.
- SHRP ID: Enter the four-digit SHRP ID assigned to the test section.
- Field-set number: The field-set number is a sequentially assigned number to indicate the different periods in which the material samples and field testing were conducted on the project. These periods usually refer to different stages in the pavement construction or life, such as before overlay construction and after overlay construction. A field-set number can apply to more than 1 d since sampling of SPS-10 test sections may require more than 1 d. In general, the same field-set number should be applied to all material samples and field tests conducted in a continuous 30-d period, unless a construction event occurs between the two sampling sessions. Enter 1 for the first time that the material sampling and field testing were conducted on the project. Enter 2, 3, etc. for second, third, and subsequent sampling and field testing on this project.
- Sample/test location: Check "before section" if the sampling location is before the beginning of the test section indicated under test section number on the form (station 0−). Check "after section" if the sampling location is after the end of the test section indicated on the form (station 5+).

SAMPLING DATA SHEET 2. PAVEMENT CORE LOG AT C-TYPE CORE LOCATIONS

This data sheet is used to log data from the 6-inch- (152-mm) diameter pavement cores extracted from C-type core locations. Each sheet can be used to record data for cores taken from three different core hole locations. Space is provided in each column to record data for up to four layers from one core hole. The pavement surface layer core should be recorded first, followed by other layers in the column. The first column from the left should always start with the lowest numbered core hole.

- Operator: Record the coring equipment operator's name.
- Equipment used: Indicate the generic type of the coring equipment used.
- Coring date: Record the month, day, and year the core was taken.
- Core barrel size: Record the rated inside diameter of the core barrel to the nearest 0.1 inch (3 mm).
- Cooling medium: Record the material used for cooling during the coring operation.
- Core hole ID: Enter the core hole ID as specified in the materials sampling plan developed for the project.
- Core hole number: Enter the core hole sample code number following the sample coding system as specified in the materials sampling plan developed for the project.

- Location—Station: This is the station number of the core relative to the test section specified under SHRP ID on the form. This number should be greater than 5+00 for sampling locations that occur after the test section specified, and less than 0+00 for sampling locations that occur before the test section specified.

- Location—Offset: This is the distance from the interface of the pavement lane and the outside shoulder to the core location (generally measured from the outside edge of the white pavement edge stripe). This distance should be indicated to the nearest 0.1 ft.

- Core recovered: Circle the appropriate response to indicate if an intact and suitable core was recovered from the indicated core hole.

- Replacement core hole number: Record the sample number of the core that will replace a core deemed unacceptable during field sampling operations. This entry should only be used when a “no” was recorded in the “core recovered” data entry space of this form.

- Core sample number: Record the core sample number for the recovered core. Separate sample numbers should be assigned to AC surface layers and bound base layers from the same core hole, even if the bound base adheres to the AC surface layer.

- Core layer number: Record the layer number for the layer identified in the core. Layer numbers are referenced to the materials sampling plan developed for the project and start at one for the subgrade and increase toward the surface.

- Depth: Depth should be measured from the pavement surface to the bottom of the material interface in the core and expressed to the nearest 0.1 inch (3 mm).

- Material description: Enter the appropriate material description based on the generic material type. These material descriptions are contained in table C.2 of appendix C in the *SHRP-LTPP Guide for Field Materials Sampling, Handling, and Testing* (SHRP 1991).

- Material code: Enter the appropriate material code number from table C.2 of appendix C in the *SHRP-LTPP Guide for Field Materials Sampling, Handling, and Testing*, corresponding to the described type of material (SHRP 1991).

SAMPLING DATA SHEET 4. A-TYPE BORE HOLE LOG

This data sheet is designed to record logs of A-type auger sampling. The following data are recorded on this form:

- Operator: Record the boring equipment operator’s name.

- Equipment used: Indicate the generic type of the drilling equipment used.

- Boring date: Record the month, day, and year the operation was performed.

- Location—Station: This is the station number of the bore relative to the test section specified under test section number on the form. This number should be greater than 5+00 for sampling locations that occur after the test section specified and less than 0+00 for sampling locations that occur before the test section specified.

- Location—Offset: This is the distance from the interface of the pavement lane and the outside shoulder to the bore location (generally measured from the outside edge of the white pavement edge stripe). This distance should be indicated to the nearest 0.1 ft.

- Bore hole number: Enter the core hole sample code number following the sample coding system specified in the material-sampling plan developed for the project.

- Bore hole ID: Enter the core hole ID as specified in the materials sampling plan developed for the project.

- Bore hole size: Record the borehole size (diameter) in inches to the nearest inch.

- Strata change: Record the depth of strata changes to the nearest 0.1 inch (3 mm). The depth of strata changes should always be measured from the top of the pavement surface. Draw a horizontal line across the form that indicates the depth of each strata change. Also, record the depth of sampling for each sample taken. For example, if a thin-walled tube sample was obtained at a depth of 18 to 36 inches (457–914 mm), a line should be drawn at the 18-inch (457-mm) mark and the 36-inch (914-mm) mark along with the appropriate sample code number and material description. See example data sheets in the *SHRP-LTPP Guide for Field Materials Sampling, Testing, and Handling* for further clarification (SHRP 1991).

- Sample number: Record the sample number for bulk samples obtained from the subgrade.

- Layer number: Record the layer number for the identified layer. Layer numbers are referenced to the materials sampling plan developed for the project and start at 1 for the subgrade and increase toward the surface.

- Moisture sample number: Record the sample number for moisture samples obtained from the unbound base or subgrade.

- Material description: Enter the appropriate material description for each strata, based on the generic material type. These material descriptions are contained in table C.2 of appendix C in the *SHRP-LTPP Guide for Field Materials Sampling, Testing, and Handling* (SHRP 1991).

- Material code: Enter the appropriate material code number for each strata from table C.2 of appendix C in the *SHRP-LTPP Guide for Field Materials Sampling, Testing and Handling,* corresponding to the described type of material (SHRP 1991).

SAMPLING DATA SHEET 8. IN SITU DENSITY AND MOISTURE TESTS

This sheet is designed to record data from the in situ density and moisture tests performed on all unbound layers and density tests performed on bound layers with a nuclear moisture and density gauge. The following data are recorded on this form:

- Operator: Record nuclear density gauge operator's name.
- Nuclear density gauge ID: Record the ID number of the nuclear density gauge.
- Test date: Record the month, day, and year the test was performed.
- Date of last major calibration: Record the date of the last major calibration of the nuclear density gauge. All dates should be recorded as month-day-year. A major calibration is defined as that calibration/verification performed as directed in section 4 of the *SHRP-LTPP Guide for Field Materials Sampling, Handling, and Testing (*SHRP 1991). Daily calibrations performed in the field do not constitute a major calibration.
- Location—Station: This is the station number of the sampling area relative to the test section specified under test section number on the form. This number should be greater than 5+00 for sampling locations that occur after the test section specified, and less than 0+00 for sampling locations that occur before the test section specified.
- Location—Offset: This is the distance from the edge of the pavement lane and the outside shoulder to the location the test was performed (generally measured from the edge of the white pavement edge stripe). This distance should be indicated to the nearest 0.1 ft.
- Sampling location number: Enter the sampling location number shown in the material-sampling plan developed for the project.
- Depth from surface to the top of the layer: This information is obtained from sampling data sheet 4 for each unbound granular layer. Record to the nearest 0.1 inch (3 mm) and measure from the top of the pavement surface for each test performed.
- Layer number: Write in the project specified layer number for the layer being tested.
- Material type: Report a "G" if the material is unbound (granular); record "T" if the material is other than unbound (treated). In practice, all entries should be a "G" since nuclear density testing is not required on bound materials.
- In situ density: For each unbound layer, record four nuclear density gauge results. These measurements should be taken at the top of each unbound layer using the direct transmission test method if possible. Record all values as rounded to one decimal place in pounds/foot^3.
- Average: Calculate and record the average in situ densities for each unbound layer. Record all values as rounded to one decimal place.

- Method (A, B, or C): Record the test method used to perform the in situ density test as per AASHTO T310-11, "A"—backscatter, "B"—direct transmission, or "C"—air gap (AASHTO 2011). The direct transmission method ("B") should almost always be used. However, there may be some extenuating circumstances necessitating the use of methods "A" or "C."

- Rod depth: Record the depth of the nuclear density gauge probe to the nearest inch.

- In situ moisture content: For each unbound layer, record four in situ moisture content test results. These tests should be conducted at the top of each layer. Record as a percentage moisture content rounded to one decimal place. The backscatter method should always be used for this measurement.

- Average: Calculate and record the average of the four in situ moisture content test results for each unbound layer. Round to one decimal place.

SAMPLING DATA SHEET 10. SAMPLING UNCOMPACTED BITUMINOUS PAVING MIXTURES

This data sheet is used to record information concerning sampling of uncompacted bituminous paving mixtures (AC and asphalt-treated materials) for LTPP material testing purposes.

- Person performing sampling: Record the name, title, and affiliation of the person performing the sampling.

- Plant name: Record the common name or operator of the mixture plant facility that produced the sampled material.

- Plant location: Record the location of the mixture production plant, including street address, town/city, and State.

- Plant type: Indicate the general type of mixture production plant used to produce the mix. If a plant other than a batch or drum plant was used, indicate "other" and provide a description of the plant on the next line.

- Description of mixture production plant: Provide a brief description of the type of mixture production plant, noting any special features of traditional types of batch or drum plants, or a description of other mixture production plant types.

- Manufacturer of mixture production plant: Enter the name of the mixture production plant manufacturer.

- Model number: Enter the model number or model designation of the mixture production plant.

- Batch size: Record the size of the batch from which the sample was obtained.

- Sampling location: Enter the code number shown on the data form, corresponding to the location from which the sample was taken. If the sample was taken from the roadway before compaction, indicate the station and offset of the sample and the respective test section number.

- Mixture type: Enter the code number corresponding to the generic type of material (virgin AC, recycled AC, asphalt dense graded, or permeable asphalt treated).

- Layer type: Enter the code number, as shown on the form, corresponding to the type of layer in which the material is used.

- Sample location designation: Enter the sample type designation for the sample. Sampling locations are designated on the LTPP forms and material-sampling plans with the following six-digit code format: S-LL-t-XX.

  Where:
  S = sample location type:

  - B = unbound bulk sample.
  - H = samples obtained from the HMA plant.

  LL = sample location number: up to a two-digit sample number assigned sequentially to each sample with the same sample type designation.
  t = sampling time interval: time interval used for samples taken at specified time intervals referenced to the construction date.

  The single number designating the time after paving is as follows:

  0 = prior, during, or immediately after construction.
  1 = 6 mo.
  2 = 12 mo.
  3 = 18 mo.
  XX = section number: two-digit designation for test section number (e.g., 01, 02, and 03). This numbering makes the sample location unique to that test section.

- Sample number: Each sample must be assigned a seven-digit designation that must be recorded on the appropriate data forms. The sample number will consist of the following format: S-M-##-t-XX

  Where:
  S = sample type: bulk sample (indicated as B).
  M = material type.
  A = AC.
  R = RAP/RAS.
  ## = sample number: up to a two-digit sample number assigned sequentially to each sample with the same sample type and material type.

t = sampling time interval: time interval used for samples taken at specified time intervals referenced to the construction date.

The single number designating the time after paving is as follows:

0 = prior, during, or immediately after construction.
1 = 6 mo.
2 = 12 mo.
3 = 18 mo.
XX = section number: two-digit designation for test section number (e.g., 01, 02, and 03). This numbering makes the sample location unique to that test section.

- Specimen ID: Enter the specimen ID as specified in the materials sampling plan developed for the project.

- Approximate sample size: Enter the approximate weight of the sample obtained, to the nearest pound.

- Date sampled: Enter the date the material sample was obtained.

- Location sample shipped to: Record the location the sample was shipped to from the field. In many cases this location should be the laboratory that will perform the testing.

- Date shipped: Enter the date the material was shipped to the location indicated on the form.

- General remarks: Provide any general remarks concerning the representativeness of the obtained sample, comments concerning the quality or uniformity of the mix, or any other pertinent miscellaneous comments.

SAMPLING DATA SHEET 10-A. SAMPLING ASPHALT CEMENT.

This data sheet is used to record information concerning sampling of asphalt cement for LTPP material testing purposes.

- Person performing sampling: Record the name, title, and affiliation of the person performing the sampling.

- Plant name: Record the common name or operator of the mixture production plant that produced the sampled material.

- Mixture production plant location: Record the location of the mixture production plant, including the street address, town/city, and State.

- Mixture production plant type: Indicate the general type of mixture production plant used to produce the mix. If a mixture production plant other than a batch or drum mixture production plant was used, indicate “other” and provide a description of the mixture production plant on the next line.

- Description of mixture production plant: Provide a brief description of the type of mixture production plant, noting any special features of traditional types of batch or drum plants or a description of other mixture production plant types.

- Manufacturer of mixture production plant: Enter the name of the mixture production plant manufacturer.

- Model number: Enter the model number or model designation of the mixture production plant.

- Batch size: Record the size of the batch from which the sample was obtained.

- Sampling location: Enter the code number shown on the data form corresponding to the location from which the sample was taken. If the sample was taken from the roadway before compaction, indicate the station and offset of the sample and the respective test section number.

- Mixture type: Enter the code number corresponding to the generic type of material (virgin AC, recycled AC, asphalt dense graded, or permeable asphalt treated).

- Sample location designation: Enter the sample type designation for the sample. Sampling locations are designated on the LTPP forms and material-sampling plans with the following six-digit code format: S-LL-t-XX.

  Where:
  S = sample location type: samples obtained from the HMA plant (indicated as "H").
  LL = sample location number: up to a two-digit sample number assigned sequentially to each sample with the same sample type designation.
  t = sampling time interval: time interval used for samples taken at specified time intervals referenced to the construction date.

  The single number designating the time after paving is as follows:

  0 = prior, during, or immediately after construction.
  1 = 6 mo.
  2 = 12 mo.
  3 = 18 mo.
  XX = section number: two-digit designation for test section number (e.g., 01, 02, and 03). This numbering makes the sample location unique to that test section.

  - Sample number: Each sample (core, bulk, moisture, and compacted) must be assigned a seven-digit designation that must be recorded on the appropriate data forms. The sample number will consist of the following format: S-M-##-t-XX.

    Where:
    S = sample type: bulk sample (indicated as "B").
    M = material type: asphalt cement (indicated as "C").

= sample number: up to a two-digit sample number assigned sequentially to each sample with the same sample type and material type.
t = sampling time interval: time interval used for samples taken at specified time intervals referenced to the construction date.

The single number designating the time after paving is as follows:

0 = prior, during, or immediately after construction.
1 = 3–6 mo.
2 = 12 mo.
3 = 18 mo.
XX = section number: two-digit designation for test section number (e.g., 01, 02, and 03). This numbering makes the sample location unique to that test section.

- Specimen ID: Enter the specimen ID as specified in the materials sampling plan developed for the project.

- Sample volume: Enter the approximate volume of the sample obtained, to the nearest gallon.

- Date sampled: Enter the date the material sample was obtained.

- Location sample shipped to: Record the location the sample was shipped to from the field. In many cases this location should be the laboratory that will perform the testing.

- Date shipped: Enter the date the material was shipped to the location indicated on the form.

- Comments: Provide any comments concerning the representativeness of the obtained sample, comments concerning the quality or uniformity of the mix, or any other pertinent miscellaneous comments that may be of use to the data users.

- General remarks: Provide any general remarks that may be of use to the office data handler or during the data entry and quality-control processes.

FIELD OPERATION INFORMATION FORM 1. LABORATORY SHIPMENT SAMPLES INVENTORY

This form is intended to provide a record of field activity and no information from this form will be included in the database. This form provides the necessary information for the RSC to perform test assignments. Also, it provides a detailed inventory of material samples shipped to each materials testing laboratory. The inventory should be made in the following sequence of sample location numbers, starting from the pavement surface layer in each case:

1. Samples from C-type locations starting from cores of pavement surface layers.
2. Samples from A-type bore holes and any additional similar bore holes.
3. Samples from shallow excavations.

Sample location numbers and sample numbers should be obtained from the appropriate sampling data sheets. “Sample size” should be used to record the number of bags of bulk samples or the number of jar samples bearing a single sample number in each case. The bulk sample from one layer can be placed in more than one bag, if necessary. However, the sample number should be the same on all of these bags with an indication of the number of bags on the labels and in the column of the “sample size.” For core samples, record only diameter of the core in the “sample size” column in inches.

Enter core, bulk, or moisture in the “sample type” column as appropriate. Enter AC, portland cement concrete, base, subbase, or subgrade in the “sample material” column as appropriate. The “sample condition” should indicate a brief description as to the overall quality of the sample cores (i.e., good, poor, or fractured) and bulk samples (i.e., satisfactory, wet, insufficient quantity, or contaminated).

Since more than one laboratory may be used to test samples in the SPS-10 experiment, room is provided on this form to indicate up to three laboratories to receive samples. As noted at the bottom of the form, enter the laboratory number and laboratory name each sample is sent to under the “lab” column.

Typically, samples will include all AC cores from A- and C-type locations. Samples will also include bulk samples and jar samples of granular (untreated) layers and subgrade from BA-type locations and test pits.

ELEVATION MEASUREMENTS FORM EM-1. ROD AND LEVEL ELEVATION SURVEY

This form is used to record the elevation data to determine the thickness of each pavement layer.

- Surveyor: Record the name of the person performing the rod and level survey.
- Survey date: Record the month, day, and year the survey was performed.
- Reference description: Describe the reference (marked or staked in the field) used for surveying measurements. Many highway agencies use either the pavement centerline or project centerline on divided highway facilities to reference offsets for surveying measurements.
- Reference elevation: Record the elevation of the reference.
- Layer number: Record the layer number for the surface layer at the time of survey. The layer numbers are referenced to the materials sampling plan developed for the project. The layer numbers start at one for the subgrade and increase toward the surface, including the existing surface layer (after milling) and the overlay layer(s) after placement and compaction. Use additional sheets for multiple layers.
- Station: Measurements should be taken at 50-ft intervals at five transverse offsets (locations) from the pavement edge.

- Transverse offset: Record the five offsets that correspond to the outside lane edge, outside wheel path (OWP), lane center, IWP, and ILE of the lane. For a nominal 12-ft-wide lane, the transverse offsets should be 0, 3, 6, 9, and 12 ft from the planned outside pavement edge at the location where the outside lane stripe will be placed. If the lane is greater than 12 ft wide, the five offsets should be adjusted so that measurements are performed in the wheel path locations.

- Elevation: Record the elevation of the layer surface at each location.

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING FOR EXPERIMENT SPS-10

PAVEMENT CORE LOG AT C-TYPE CORE LOCATIONS

SAMPLING DATA SHEET 2

SHEET NO. _____ OF _____

STATE ___________________

STATE CODE [ ][ ]

SHRP ID [ ][ ][ ][ ]

FIELD-SET NO. [ ][ ]

SAMPLE/TEST LOCATION:

☐ **Before Section** ☐ **After Section**

OPERATOR _______________________

CORING DATE ____-___-__________

(MM-DD-YYYY)

EQUIPMENT USED __________________________

CORE BARREL:

Tip Type __________________________

Cooling Medium __________________________

Note: Record information for all cores extracted from each core hole in one column in the table below. Use a separate sheet for each test section. Depth should be measured from the pavement surface to the bottom of the layer strata and recorded to the nearest tenth of an inch.

Core Hole ID			
Core Hole No.			
Station (feet)			
Offset (feet from outside shoulder)	__ __ . __	__ __ . __	__ __ . __
Latitude (degrees north)	__ __.__ __ __ __ __	__ __.__ __ __ __ __	__ __.__ __ __ __ __
Longitude (degrees west)	__ __ __.__ __ __ __ __	__ __ __.__ __ __ __ __	__ __ __.__ __ __ __ __
Core Size (diameter in inches)	4 inches (102 mm)/6 inch (152 mm)	4 inches (102 mm)/6 inches (152 mm)	4 inches (102 mm)/6 inches (152 mm)
Core Recovered?	Yes/No	Yes/No	Yes/No
Replacement Core Hole No.			
Core Sample No.			
Layer No.			
Depth (inches)	__ __ . __	__ __ . __	__ __ . __
Material Description			
Material Code			
Core Sample No.			
Layer No.			
Depth (inches)	__ __ . __	__ __ . __	__ __ . __
Material Description			
Material Code			
Core Sample No.			
Layer No.			
Depth (inches)	__ __ . __	__ __ . __	__ __ . __
Material Description			
Material Code			
Core Sample No.			
Layer No.			
Depth (inches)	__ __ . __	__ __ . __	__ __ . __
Material Description			
Material Code			

GENERAL REMARKS: ____

CERTIFIED

____

Field Crew Chief
Affiliation ________________________

VERIFIED AND APPROVED

____

RSC Personnel
Affiliation ________________________

DATE

_______–_______–_________

Month – Day – Year

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING FOR EXPERIMENT SPS-10

PAVEMENT BORE HOLE LOG AT A-TYPE AUGER LOCATIONS

SAMPLING DATA SHEET 4

SHEET NO. _____ OF _____

STATE ___________________

STATE CODE [ ][ ]

OPERATOR ________________________

EQUIPMENT USED ___________________________

SHRP ID [ ][ ][ ][ ]

BORING DATE ____-___-________

(MM-DD-YYYY)

BORE HOLE NO.: ___________________________

FIELD-SET NO. [ ][ ]

BORE HOLE ID: ____________________________

SAMPLE/TEST LOCATION:

☐ **Before Section**

☐ **After Section**

LOCATION:

STATION ____________________

OFFSET _________ ft from outside shoulder

BORE HOLE SIZE: _____________ inches diameter

LATITUDE: __ __ . __ __ __ __ __ degrees north

LONGITUDE: __ __ __ . __ __ __ __ __ degrees west

Scale (Inches)	Strata Change (Inches)	Layer No.	Sample No.	Moisture Sample No.	Material Description	Material Code
5.0___						
10.0___						
15.0___						
20.0___						
25.0___						
30.0___						
35.0___						
40.0___						
45.0___						
50.0___						
55.0___						
60.0___						

GENERAL REMARKS: ____

____

____

CERTIFIED	VERIFIED AND APPROVED	DATE
______________________	______________________	______–______–______
Field Crew Chief	RSC Personnel	Month – Day – Year
Affiliation ______________	Affiliation ______________	

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING FOR EXPERIMENT SPS-10

IN SITU DENSITY AND MOISTURE TEST

SAMPLING DATA SHEET 8

SHEET NO. _____ OF _____

STATE ________________

STATE CODE [ ] [ ]

SHRP ID [ ] [ ] [ ] [ ]

FIELD-SET NO. [ ] [ ]

SAMPLE/TEST LOCATION:

☐ **Before Section**

☐ **Within Section**

☐ **After Section**

OPERATOR ______________________

TEST DATE ___-___-_______ (MM-DD-YYYY)

NUCLEAR DENSITY GAUGE ID ____________________

DATE OF LAST MAJOR CALIBRATION ___-___-_______

LOCATION: (a) STATION				
(b) OFFSET(feet from outside shoulder)				
LATITUDE degrees north		__ __.__ __ __ __ __	__ __.__ __ __ __ __	__ __.__ __ __ __ __
LONGITUDE degrees west		__ __ __.__ __ __ __ __	__ __ __.__ __ __ __ __	__ __ __.__ __ __ __ __
DEPTH FROM SURFACE TO THE TOP OF THE LAYER (inches from plans)				
LAYER DESCRIPTION				
MATERIAL TYPE: (Unbound = G and Other = T)				
IN SITU DENSITY (pounds/ foot^3) (*AASHTO T310-11*)	1			
	2			
	3			
	4			
AVERAGE				
METHOD (A, B, or C)				
ROD DEPTH (inches)				
IN SITU MOISTURE CONTENT (percent) (*AASHTO T310-11*)	1			
	2			
	3			
	4			
AVERAGE				

Note: Use additional sheets if necessary.

GENERAL REMARKS: ____

____

____

CERTIFIED	VERIFIED AND APPROVED	DATE
______________________	______________________	______–______–______
Field Crew Chief	RSC Personnel	Month – Day – Year
Affiliation ______________	Affiliation ______________	

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING FOR EXPERIMENT SPS-10

SAMPLING UNCOMPACTED BITUMINOUS PAVING MIXTURES

SAMPLING DATA SHEET 10

SHEET NO. _____ OF _____

STATE ________________

STATE CODE [ ][ ]

SHRP ID [ ][ ][ ][ ]

FIELD-SET NO. [ ][ ]

PERSON PERFORMING SAMPLING

NAME ______________________________ AFFILIATION ____

MIXTURE PRODUCTION PLANT

PLANT NAME ____

PLANT LOCATION ____

PLANT TYPE ....[ ]

Batch = 1, Drum = 2, Other = 3 (Specify: ____)

DESCRIPTION OF MIXTURE PRODUCTION PLANT ____

MANUFACTURE OF ASPHALT PRODUCTION PLANT ____

MODEL NO. ____

BATCH SIZE ____

SAMPLING LOCATION..[ ]

Conveyor Belt = 1, Stockpile = 2, Haul Truck = 3, Funnel Device = 4,
Roadway Prior to Compaction = 5 (Specify: Station ____________________ Offset ____________ ft from outside shoulder),

Other = 6 (Specify: ____), Bins = 7,

Recycle Asphalt Pavement Stockpile = 8.

Latitude..[ ][ ].[ ][ ][ ][ ][ ] **degrees north**

Longitude..[ ][ ][ ].[ ][ ][ ][ ][ ] **degrees west**

MIXURE TYPE..[ ]

Virgin Asphalt Concrete (AC) = 1, Recycled AC = 2

LAYER TYPE ....[ ]

Rut Level-Up = 1, Mill Replacement = 2, Binder Course = 3, Surface Course = 4, Surface Friction Layer = 5

SAMPLE LOCATION DESIGNATION..[ ][ ][ ][ ][ ][ ]

SAMPLE NO. ....[ ][ ][ ][ ][ ][ ]

SPECIMEN ID..[ ][ ][ ][ ][ ][ ] **L** [ ][ ]

APPROXIMATE SAMPLE SIZE (pounds)..[ ][ ][ ]

DATE SAMPLED (MM-DD-YYYY) .... [ ] [ ]-[ ] [ ]-[ ] [ ] [ ] [ ]

LOCATION SAMPLE SHIPPED TO: ____

DATE SHIPPED (MM-DD-YYYY) .... [ ] [ ]-[ ] [ ]-[ ] [ ] [ ] [ ]

GENERAL REMARKS: ____

____

____

CERTIFIED	VERIFIED AND APPROVED	DATE
______________________	______________________	_______–_______–_________
Field Crew Chief	RSC Personnel	Month – Day – Year
Affiliation ______________	Affiliation ______________	

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING FOR EXPERIMENT SPS-10

SAMPLING ASPHALT CEMENT

SAMPLING DATA SHEET 10-A

SHEET NO. _____ OF _____

STATE __________________

STATE CODE [ ] [ ]

SHRP ID [ ] [ ] [ ] [ ]

FIELD-SET NO. [ ] [ ]

PERSON PERFORMING SAMPLING

NAME _________________________________ AFFILIATION ____

MIXTURE PRODUCTION PLANT

PLANT NAME ____

PLANT LOCATION ____

PLANT TYPE .... [ ]

Batch = 1, Drum = 2, Other = 3 (Specify: ____)

DESCRIPTION OF MIXTURE PRODUCTION PLANT ____

MANUFACTURE OF ASPHALT PRODUCTION PLANT ____

MODEL NO. ____

BATCH SIZE ____

SAMPLING LOCATION .... [ ]

Storage Tank = 1, Feedline = 2, Other = 3 (Specify: ______________________________________)

Latitude .... [ ] [ ].[ ] [ ] [ ] [ ] [ ] **degrees north**

Longitude .... [ ] [ ] [ ].[ ] [ ] [ ] [ ] [ ] **degrees west**

MIXTURE TYPE .... [ ]

Virgin Asphalt Concrete (AC) = 1, Recycled AC = 2

SAMPLE LOCATION DESIGNATION .... [ ] [ ] [ ] [ ] [ ] [ ]

SAMPLE NO. .... [ ] [ ] [ ] [ ] [ ] [ ] [ ]

SPECIMEN ID .... [ ] [ ] [ ] [ ] [ ] [ ] **L** [ ] [ ] [ ]

SAMPLE VOLUME (gallons) .... [ ] [ ]

DATE SAMPLED (MM-DD-YYYY) .... [ ] [ ]-[ ] [ ]-[ ] [ ] [ ] [ ]

LOCATION SAMPLE SHIPPED TO: ____

DATE SHIPPED (MM-DD-YYYY) .... [ ] [ ]-[ ] [ ]-[ ] [ ] [ ] [ ]

COMMENTS: ____

GENERAL REMARKS: ____

____

____

CERTIFIED	VERIFIED AND APPROVED	DATE
______________________	______________________	_____–_____–______
Field Crew Chief	RSC Personnel	Month – Day – Year
Affiliation ______________	Affiliation ______________	

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING FOR EXPERIMENT SPS-10

LABORATORY SHIPMENT SAMPLE INVENTORY

FIELD OPERATION INFORMATION FORM 1

SHEET NO. _____ OF _____

STATE __________________

STATE CODE [ ] [ ]

SHRP ID [ ] [ ] [ ] [ ]

FIELD-SET NO. [ ] [ ]

SAMPLE/TEST LOCATION:

☐ **Before Section**

☐ **Within Section**

☐ **After Section**

FIELD WORK COMPLETED ON: _____-_____-________ (MM-DD-YYYY)

Note: Use additional sheets if necessary. Include summary information (Field Operations Information Form 2) and as actual sampling location plan sheets with this material samples inventory.

Specimen ID	Sample Size	Sample Type	Sample Material	Sample Condition	Lab*

*Enter the number of the laboratory each sample was sent to:

Lab No. (1)____

Lab No. (2)____

Lab No. (3)____

GENERAL REMARKS: ____

CERTIFIED	VERIFIED AND APPROVED	DATE
______________________	______________________	_______–_______–_________
Field Crew Chief	RSC Personnel	Month – Day – Year
Affiliation ______________	Affiliation ______________	

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING FOR EXPERIMENT SPS-10

ROD AND LEVEL ELEVATION SURVEY

ELEVATION MEASUREMENTS FORM EM-1

SHEET NO. _____ OF _____

STATE ________________

STATE CODE [ ][ ]

SHRP ID [ ][ ][ ][ ]

OPERATOR ______________________

SURVEY DATE _____-_____-________ (MM-DD-YYYY)

REFERENCE DESCRIPTION ____ **REFERENCE ELEVATION __ __.__ __ __**

LAYER NO. (use additional sheets as necessary) ....[ ]

	STATION 0+00		**STATION 50+00**		**STATION 100+00**	
	TRANSVERSE OFFSET (feet)	ELEVATION (feet)	TRANSVERSE OFFSET (feet)	ELEVATION (feet)	TRANSVERSE OFFSET (feet)	ELEVATION (feet)
OLE	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
OWP	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
ML	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
IWP	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
ILE	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __

	STATION 150+00		**STATION 200+00**		**STATION 250+00**	
	TRANSVERSE OFFSET (feet)	ELEVATION (feet)	TRANSVERSE OFFSET (feet)	ELEVATION (feet)	TRANSVERSE OFFSET (feet)	ELEVATION (feet)
OLE	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
OWP	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
ML	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
IWP	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
ILE	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __

	STATION 300+00		**STATION 350+00**		**STATION 400+00**	
	TRANSVERSE OFFSET (feet)	ELEVATION (feet)	TRANSVERSE OFFSET (feet)	ELEVATION (feet)	TRANSVERSE OFFSET (feet)	ELEVATION (feet)
OLE	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
OWP	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
ML	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
IWP	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
ILE	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __

	STATION 450+00		**STATION 500+00**		**For nominal 12-ft lane use the following transverse offsets:**
	TRANSVERSE OFFSET (feet)	ELEVATION (feet)	TRANSVERSE OFFSET (feet)	ELEVATION (feet)	
OLE	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	**OLE = 0 ft**
OWP	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	**OWP = 3 ft**
ML	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	**ML = 6 ft**
IWP	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	**IWP = 9 ft**
ILE	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __	**ILE = 12 ft**

ILE = inside lane edge; IWP = inside wheel path; ML = midlane; OLE = outside lane edge

GENERAL REMARKS: ____

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CERTIFIED	VERIFIED AND APPROVED	DATE
______________________________	______________________________	______–______–________
Field Crew Chief	RSC Personnel	Month – Day – Year
Affiliation ______________________	Affiliation ______________________	

APPENDIX B—LTPP PROTOCOLS TO BE USED FOR SPS-10 TESTING

PROTOCOL P27 STANDARD TEST METHOD FOR DETERMINING THE RHEOLOGICAL PROPERTIES OF ASPHALT BINDER USING A DSR (AE07)

This LTPP protocol covers the procedures for determining the dynamic shear modulus and phase angle of asphalt binder. The test must be carried out in accordance with AASHTO T315-02, as described by the following sections (AASHTO 2002).

Summary and Test Method

The oscillatory loading frequency should be 10 rad/s using a sinusoidal waveform. The complex modulus (G^*) and phase angle (δ) are calculated automatically as part of the operation of the rheometer using equipment manufacturer-supplied proprietary computer software.

Preparation of Apparatus

Select the test temperature based upon the laboratory-testing plan and the information provided within the following items:

- First test temperature: Select the first test temperature based on the laboratory-testing plan designed for the individual SPS project. Allow the DSR to reach a stabilized temperature within ± 0.1 °C (± 0.2 °F) of test temperature (table 21).

- Second test temperature: Select the second test temperature based on the value of $G^*/sin\delta$ resulting from the first testing temperature. If the $G^*/sin\delta$ is higher than the target value, increase the second test temperature by 6 °C. Otherwise, if the $G^*/sin\delta$ is low, then decrease the second test temperature by 6 °C (table 22).

- Third test temperature: Select the third test temperature base on the complex modulus ($G^*/sin\delta$) resulting from the first and second testing temperature. If the $G^*/sin\delta$ from the first test is high and the $G^*/sin\delta$ from the second test is still high, increase the second test temperature by another 6 °C. Otherwise, if the $G^*/sin\delta$ is low, then decrease the second test temperature by 3 °C. If the $G^*/sin\delta$ from the first test is low and the $G^*/sin\delta$ from the second test is still low, decrease the second test temperature by another 6 °C. Otherwise, if $G^*/sin\delta$ is high, increase the second test temperature by 3 °C (table 23).

Table 21. Temperature information for first test.

Temperature	G^*
T_0	High
T_0	Low

T_0 = expected temperature for individual SPS project.

Table 22. Temperature information for second test.

Temperature	*G**
$T_0 + 6$ °C	High
$T_0 + 6$ °C	Low
$T_0 - 6$ °C	High
$T_0 - 6$ °C	Low

T_0 = expected temperature for individual SPS project.

Table 23. Temperature information for third test.

Desired Temperature
$T_0 + 12$ °C
$T_0 + 3$ °C
$T_0 - 3$ °C
$T_0 - 12$ °C

T_0 = expected temperature for individual SPS project.

Target values are based on the conditioning and aging of the specimen, as shown in table 24:

Table 24. Target values for each specimen type.

Specimen Type	Target $G^*/\sin\delta$ Value (Kilopascals)
Tank binder	1.00
RTFO-aged or extracted from t_0 core	2.20
PAV-aged or extracted from t_{1+} core	5,000

t_0 = cores obtained 0 mo after paving. t_{1+} = cores taken 3 mo or more after paving as specified in table 6.

The following information must be recorded for each test temperature and reported using lab data sheet T27.

Sample ID must include laboratory ID code, State, State code, SHRP ID, layer number, field-set number, sample location number, LTPP sample number, and test run.

The general test and sample information include:

- Material type (stated as original, RTFO, PAV, or field aged).
- Time since construction for field-aged, specified in months.
- Test control mode (indicated as stress or strain).
- Test gap, in micrometers.
- Test plate diameter, in millimeters.
- Number of conditioning cycles.
- Conditioning frequency, in rad/second.
- Test frequency, in rad/second.
- Target strain amplitude, in percent.
- Target torque amplitude, in millinewton·meters.
- Test temperature as specified in in section 8.4 of AASHTO T315-02 (AASHTO 2002).

The different G^* and δ values obtained per cycle must be reported as well as their average and standard deviation.

Comments must include LTPP standard comment code(s) as shown in the *Long-Term Pavement Performance Project Laboratory Materials Testing and Handling Guide* and any other note as needed (Simpson et al. 2007).

LTPP-SPS LABORATORY MATERIAL HANDLING AND TESTING FOR EXPERIMENT SPS-10

LABORATORY MATERIAL TEST DATA

RHEOLOGICAL PROPERTIES OF ASPHALT BINDER

USING DYNAMIC SHEAR RHEOMETER (DSR)

LAB DATA SHEET T27

ASPHALT CONCRETE (AC) LAYER (AC PROPERTIES)

LTPP TEST DESIGNATION AE07 / LTPP PROTOCOL P27

SHEET NO. _____ **OF** _____

STATE ________________

STATE CODE [ ] [ ]

SHRP ID [ ] [ ] [ ] [ ]

FIELD-SET NO. [ ] [ ]

LABORATORY PERFORMING TEST: ________________________________ **LAB CODE** .... [ ] [ ] [ ] [ ]

SAMPLED BY: ________________________________ DATE SAMPLED: ____-____-______

LAYER NO. .... [ ] [ ]

SAMPLE LOCATION DESIGNATION .... [ ] [ ] [ ] [ ] [ ] [ ]

SAMPLE NO. .... [ ] [ ] [ ] [ ] [ ] [ ] [ ]

TEST RUN (1: first run, 2: second run, etc.) .... [ ]

NO. OF MONTHS AGED IN FIELD (leave blank if sample is from plant) .... [ ] [ ]

ACCELERATED AGING (check box if used)**:** ☐ **Rolling Thin Film Oven (RTFO)** ☐ **Pressure Aging Vessel (PAV)**

DSR MODEL: ________________________________

DSR SOFTWARE: ________________________________

TEST CONTROL .... [ ]

TEST GAP (millimeters) .... [ ] [ ].[ ] [ ] [ ]

PLATE DIAMETER (millimeters) .... [ ] [ ].[ ] [ ]

NO. OF CONDITIONING CYCLES .... [ ] [ ]

FREQUENCY OF CONDITIONING CYCLES (rad/second) .... [ ] [ ].[ ]

FREQUENCY OF TEST CYCLES (rad/second) .... [ ] [ ].[ ]

TARGET STRAIN AMPLITUDE (for strain control testing) (percent) .... [ ] [ ].[ ] [ ]

TARGET TORQUE AMPLITUDE (for stress control testing) (millinewton·meters) .... [ ] [ ] [ ] [ ]

TEST TEMPERATURE (Celsius)	COMPLEX MODULUS, G^* (kilopascals)	PHASE ANGLE, δ (degrees)
[ ][ ].[ ]	[ ][ ][ ][ ][ ][ ].[ ]	[ ][ ].[ ]
[ ][ ].[ ]	[ ][ ][ ][ ][ ][ ].[ ]	[ ][ ].[ ]
[ ][ ].[ ]	[ ][ ][ ][ ][ ][ ].[ ]	[ ][ ].[ ]

COMMENT CODES .... [ ] [ ], [ ] [ ], [ ] [ ], [ ] [ ]

COMMENT OTHER: ________________________________

TEST DATE (month-day-year) .... [ ] [ ]/[ ] [ ]/[ ] [ ]

GENERAL REMARKS: ____

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CERTIFIED	DATE	VERIFIED AND APPROVED	DATE
____________________	______–______–______	____________________	______–______–______
Laboratory Chief	Month – Day – Year		Month – Day – Year
Affiliation ____________		Affiliation ____________	

PROTOCOL P28 STANDARD TEST METHOD FOR DETERMINING THE FLEXURAL CREEP STIFFNESS OF ASPHALT BINDER USING THE BBR (AE08)

This LTPP protocol covers the procedures for determining the flexural creep stiffness of asphalt binders using a BBR. The test must be carried out in accordance with AASHTO T313-12 with the following modifications in the next five sections (AASHTO 2012).

Procedure

Select the test temperature based on the laboratory-testing plan designed for the individual SPS project. After demolding, immediately place the test specimen in the testing bath and condition it at the testing temperature for 60 ± 5 min.

Report

The following information must be recorded for each test temperature and reported using lab data sheet T28:

- Laboratory ID code.
- State.
- State code.
- SHRP ID.
- Layer number.
- Field-set number.
- Sample location number.
- LTPP sample number.

General test and sample information

In addition to the identification information provided above, the following general testing information are to be included:

- Minimum and maximum test temperature, in Celsius.
- Soak time, in meters.
- Beam width, in millimeters.
- Beam thickness, in millimeters.
- Preload, in millinewtons.
- Seating load, in millinewtons.
- Seating load time, in seconds.
- Recovery time, in seconds.
- AC performance grade.

Material type should be stated as original, RTFO, PAV, or field aged.

In case of a field-aged material type, specify the time the sample has aged since construction, in months.

Summary of results

For every loading time (8, 15, 30, 60, 120, and 240 s), report:

- Time, in seconds.
- Force, in newtons (record force at 0 and 5 s also).
- Deflection, in millimeters (record deflection at 0 and 5 s also).
- Stiffness, measured and estimated in megapascals.
- Percent of difference between measured and estimated stiffness values.
- Estimated *m* value. See section 3.2.4 of AASHTO TP1-98 for definition (AASHTO 1998).
- Regression coefficients:
  - Regression constant, *A*.
  - Regression constant, *B*.
  - Regression constant, *C*.
  - Correlation coefficient, R^2.

Comments must include LTPP standard comment code(s) as shown in the *Long-Term Pavement Performance Project Laboratory Materials Testing and Handling Guide* and any other note as needed (Simpson et al. 2007).

Raw data from the BBR device should be included.

LTPP-SPS LABORATORY MATERIAL HANDLING AND TESTING FOR EXPERIMENT SPS-10

SHEET NO. _____ OF _____

LABORATORY MATERIAL TEST DATA

FLEXURAL CREEP STIFFNESS OF ASPHALT BINDER

USING BENDING BEAM RHEOMETER (BBR)

LAB DATA SHEET T28

ASPHALT CONCRETE (AC) LAYER (AC PROPERTIES)

LTPP TEST DESIGNATION AE08 / LTPP PROTOCOL P28

STATE __________________

STATE CODE [ ] [ ]

SHRP ID [ ] [ ] [ ] [ ]

FIELD-SET NO. [ ] [ ]

LABORATORY PERFORMING TEST: ____ **LAB CODE** .... [ ] [ ] [ ] [ ]

SAMPLED BY: ____ DATE SAMPLED: ____-____-______

LAYER NO. .... [ ] [ ]

SAMPLE LOCATION DESIGNATION .... [ ] [ ] [ ] [ ] [ ] [ ]

SAMPLE NO. .... [ ] [ ] [ ] [ ] [ ] [ ] [ ]

NO. OF MONTHS AGED IN FIELD (leave blank if sample is from plant) .... [ ] [ ]

ACCELERATED AGING (check box if used)**:** ☐ **Rolling Thin Film Oven (RTFO)** ☐ **Pressure Aging Vessel (PAV)**

BBR MODEL: ____

BBR SOFTWARE: ____

SOAK TIME (minutes) .... [ ] [ ] [ ] [ ].[ ]

BEAM WIDTH (millimeters) .... [ ] [ ].[ ]

BEAM THICKNESS (millimeters) .... [ ] [ ].[ ]

TIME (seconds)	**FORCE** (newtons)	**DEFLECTION** (millimeters)	**STIFFNESS** (megapascals)			***M*-VALUE**
			MEASURED	**ESTIMATED**	**DIFFERENCE** (percent)	
8	[ ][ ].[ ][ ][ ][ ]	[ ].[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ].[ ][ ][ ][ ]	[ ].[ ][ ][ ]
15	[ ][ ].[ ][ ][ ][ ]	[ ].[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ].[ ][ ][ ][ ]	[ ].[ ][ ][ ]
30	[ ][ ].[ ][ ][ ][ ]	[ ].[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ].[ ][ ][ ][ ]	[ ].[ ][ ][ ]
60	[ ][ ].[ ][ ][ ][ ]	[ ].[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ].[ ][ ][ ][ ]	[ ].[ ][ ][ ]
120	[ ][ ].[ ][ ][ ][ ]	[ ].[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ].[ ][ ][ ][ ]	[ ].[ ][ ][ ]
240	[ ][ ].[ ][ ][ ][ ]	[ ].[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ].[ ][ ][ ][ ]	[ ].[ ][ ][ ]

REGRESSION COEFFICIENTS: A = [ ] [ ].[ ] [ ] [ ], **B =** [ ] [ ].[ ] [ ] [ ], **C =** [ ] [ ].[ ] [ ] [ ], **R^2 =** [ ] [ ].[ ] [ ] [ ]

COMMENT CODES .... [ ] [ ], [ ] [ ], [ ] [ ], [ ] [ ]

COMMENT OTHER: ____

TEST DATE (month-day-year) .... [ ] [ ]/[ ] [ ]/[ ] [ ]

Raw Data File Name

GENERAL REMARKS: ____

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CERTIFIED	DATE	VERIFIED AND APPROVED	DATE
______________________	______–______–______	______________________	______–______–______
Laboratory Chief	Month – Day – Year		Month – Day – Year
Affiliation ______________		Affiliation ______________	

PROTOCOL P73 STANDARD TEST METHOD FOR THE MSCR TEST (AE10)

This LTPP protocol covers the procedures for performing the MSCR test, using a DSR. The test must be carried out in accordance with AASHTO TP70-13 with the following modifications (AASHTO 2013).

Procedure

Tank binder specimens must be conditioned in accordance with protocol P77. Extracted binder specimens must not be conditioned.

Report

Report results using lab data sheets T73A and T73B. Include raw data from the DSR device.

LTPP-SPS LABORATORY MATERIAL HANDLING AND TESTING FOR EXPERIMENT SPS-10

SHEET NO. _____ OF _____

LABORATORY MATERIAL TEST DATA

STATE __________________

MULTIPLE STRESS CREEP RECOVERY (MSCR) TEST DATA

LAB DATA SHEET T73A

STATE CODE [ ] [ ]

SHRP ID [ ] [ ] [ ] [ ]

ASPHALT CONCRETE (AC) LAYER (AC PROPERTIES)

LTPP TEST DESIGNATION AE10 / LTPP PROTOCOL P73

FIELD-SET NO. [ ] [ ]

LABORATORY PERFORMING TEST: ____ **LAB CODE** .... [ ] [ ] [ ] [ ]

SAMPLED BY: ____ DATE SAMPLED: ____-____-______

LAYER NO. .... [ ] [ ]

SAMPLE LOCATION DESIGNATION .... [ ] [ ] [ ] [ ] [ ] [ ]

SAMPLE NO. .... [ ] [ ] [ ] [ ] [ ] [ ] [ ]

DSR MODEL: ____

DSR SOFTWARE: ____

TEST GAP (millimeters) .... [ ] [ ].[ ] [ ] [ ]

PLATE DIAMETER (millimeters) .... [ ] [ ].[ ] [ ]

TEST TEMPERATURE (Celsius) .... [ ] [ ].[ ]

AVERAGE RECOVERY AT 100 PA .... [ ] [ ].[ ]

AVERAGE RECOVERY AT 3200 PA .... [ ] [ ].[ ]

PERCENT DIFFERENCE IN RECOVERY .... [ ] [ ].[ ]

AVERAGE NONRECOVERABLE CREEP COMPLIANCE AT 100 PA .... [ ] [ ] [ ] [ ]

AVERAGE NONRECOVERABLE CREEP COMPLIANCE AT 3200 PA .... [ ] [ ] [ ] [ ]

PERCENT DIFFERENCE IN NONRECOVERABLE CREEP COMPLIANCE .... [ ] [ ] [ ] [ ]

RAW DATA FILE NAME: ____

COMMENT CODES .... [ ] [ ], [ ] [ ], [ ] [ ], [ ] [ ]

COMMENT OTHER: ____

TEST DATE (month-day-year) .... [ ] [ ]/[ ] [ ]/[ ] [ ]

LTPP-SPS LABORATORY MATERIAL HANDLING AND TESTING FOR EXPERIMENT SPS-10

LABORATORY MATERIAL TEST DATA

MULTIPLE STRESS CREEP RECOVERY (MSCR) TEST DATA

LAB DATA SHEET T73B

ASPHALT CONCRETE (AC) LAYER (AC PROPERTIES)

LTPP TEST DESIGNATION AE10 / LTPP PROTOCOL P73

SHEET NO. _____ **OF** _____

STATE __________________

STATE CODE [ ][ ]

SHRP ID [ ][ ][ ][ ]

FIELD-SET NO. [ ][ ]

LABORATORY PERFORMING TEST: ____ **LAB CODE** .... [ ][ ][ ][ ]

SAMPLED BY: ____ DATE SAMPLED: ____-____-______

LAYER NO. .... [ ][ ]

SAMPLE LOCATION DESIGNATION .... [ ][ ][ ][ ][ ][ ]

SAMPLE NO. .... [ ][ ][ ][ ][ ][ ]

STRESS LEVEL (pascals)	**CYCLE**	**INITIAL STRAIN,** $\in_0$ (percent)	**STRAIN CREEP,** $\in_c$ (percent)	**STRAIN RECOVERY,** $\in_r$ (percent)	**STRAIN CREEP ADJUSTED,** $\in_1$ (percent)	**STRAIN RECOVERY ADJUSTED,** $\in_{10}$ (percent)	**PERCENT RECOVERY** (percent)	**NONRECOVERABLE CREEP COMPLIANCE** (kilopascals^{-1})
100	**1**	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	2	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	3	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	4	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	5	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	6	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	7	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	8	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	9	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	10	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
3200	**1**	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	2	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	3	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	4	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	5	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	6	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	7	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	8	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	9	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]
	10	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ].[ ]

COMMENT CODES .... [ ][ ], [ ][ ], [ ][ ], [ ][ ]

COMMENT OTHER: ____

TEST DATE (month-day-year) .... [ ][ ]/[ ][ ]/[ ][ ]

PROTOCOL P74 USING AMPT TO DETERMINE DYNAMIC MODULUS FOR HMA (AC08)

This LTPP protocol covers the procedures for determining the dynamic modulus AC pavement cores, using the AMPT. The test must be carried out in accordance with AASHTO TP79-12 with the following modifications (AASHTO 2012).

Summary of Method

Follow procedure for measuring dynamic modulus only. Procedure for measuring flow number is disregarded.

- Test temperature—Procedure must be conducted at test temperatures of 5, 20, and 45 °C.
- Test frequency—Procedure must be conducted at test frequencies of 0.1, 1, 10, and 25 Hz for each test temperature.
- Flow number procedure—Delete.

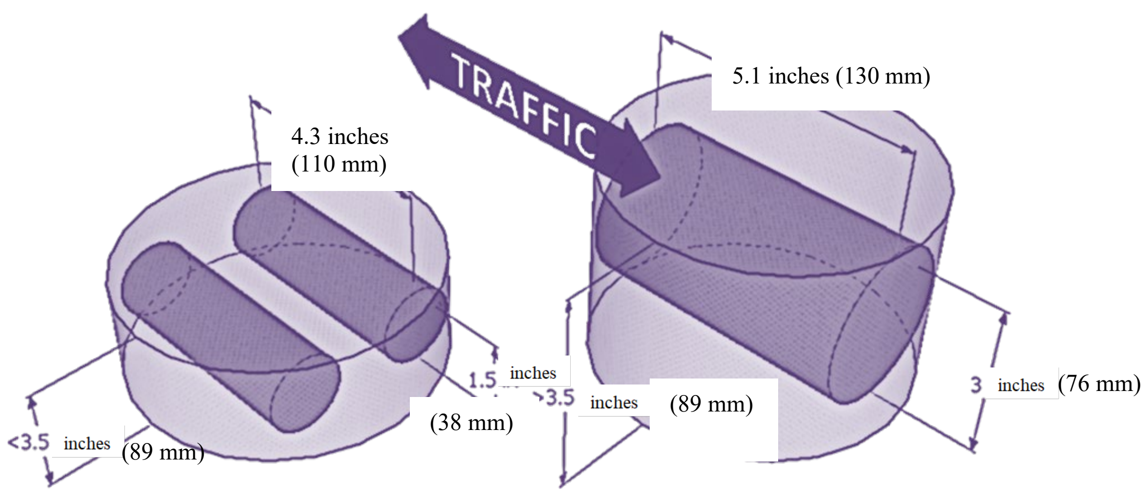
Procedure A—Dynamic Modulus Test

The procedure to perform the dynamic modulus test is as follows.

Test Specimen Fabrication

The requirements for the fabrication of the specimen for testing are identified in the following:

- Size of test specimens—The test specimens must be cored from 6-inch (152-mm) cores sampled from the field. The size of the test specimen will depend on the thickness of the layer to be tested in the field core. If the thickness of the layer is less than 3.5 inches (89 mm), then the test specimens must be 4.3-inches (110-mm) tall and have a 1.5-inch (38-mm) diameter (cored using a 1.5-inch- (38-mm) inside-diameter core barrel). If the thickness of the layer is more than 3.5 inches (89 mm), then the test specimens must be 5.1-inches (130-mm) tall and have a 2.9-inch (75-mm) diameter (cored using a 3-inch-inside-diameter core barrel). All specimens should be core in parallel to the direction of traffic as shown in the figure 6 diagram.



Source: FHWA.

Figure 6. Diagram. Size of specimen.

- Number of test specimens—The test must be performed on three specimens (one for each test temperature).

- Material—Use Teflon®-coated friction reducers.

- Test temperature—The three test specimens must be conditioned separately in the environmental chamber. Condition each specimen with an additional dummy specimen containing a temperature probe to the target test temperature. Repeat procedures for remaining test specimen at the corresponding temperature.

- Confined test—Delete.

Reporting

Following information must be recorded for each test specimen/temperature and reported using lab data sheet T74.

For each specimen tested, report the following:

- Laboratory ID code, State, State code, SHRP ID, field-set number, layer number, sample location designation, LTPP sample number, LTPP specimen number, specimen length, and specimen diameter.
- Test temperature.
- Test frequency.
- Confining stress level—Delete.
- Dynamic modulus.
- Phase angle.
- Data quality statistics—Deformation drift direction, peak-to-peak strain, load standard error, deformation standard error, and phase uniformity.

Comments must include LTPP standard comment code(s) as shown in the *Long-Term Pavement Performance Project Laboratory Materials Testing and Handling Guide* and any other note as needed (Simpson et al. 2007).

Procedure B—Flow Number Test

Procedure B, flow number test, is not used for LTPP purposes and is deleted in its entirely.

LTPP-SPS LABORATORY MATERIAL HANDLING AND TESTING FOR EXPERIMENT SPS-10

LABORATORY MATERIAL TEST DATA

TEST FOR DETERMINING THE DYNAMIC MODULUS

LAB DATA SHEET T74

ASPHALT CONCRETE (AC) LAYER (AC PROPERTIES)

LTPP TEST DESIGNATION AC08 / LTPP PROTOCOL P74

SHEET NO. _____ **OF** _____

STATE __________________

STATE CODE [ ] [ ]

SHRP ID [ ] [ ] [ ] [ ]

FIELD-SET NO. [ ] [ ]

LABORATORY PERFORMING TEST: ____ **LAB CODE** .... [ ] [ ] [ ] [ ]

SAMPLED BY: ____ DATE SAMPLED: ____-____-______

LAYER NO. .... [ ] [ ]

SAMPLE LOCATION DESIGNATION .... [ ] [ ] [ ] [ ] [ ] [ ]

SAMPLE NO. .... [ ] [ ] [ ] [ ] [ ] [ ] [ ]

SPECIMEN LENGTH (millimeters) .... [ ] [ ] [ ].[ ]

SPECIMEN DIAMETER (millimeters) .... [ ] [ ] [ ].[ ]

TEST TEMPERATURE (Celsius) .... [ ] [ ].[ ]

TEST FREQUENCY (hertz)	[ ][ ].[ ][ ]	[ ][ ].[ ][ ]	[ ][ ].[ ][ ]	[ ][ ].[ ][ ]
DYNAMIC MODULUS (kilopascals)	[ ][ ][ ][ ][ ][ ][ ]	[ ][ ][ ][ ][ ][ ][ ]	[ ][ ][ ][ ][ ][ ][ ]	[ ][ ][ ][ ][ ][ ][ ]
PHASE ANGLE (degrees)	[ ][ ].[ ]	[ ][ ].[ ]	[ ][ ].[ ]	[ ][ ].[ ]
DEFORMATION DRIFT DIRECTION (I = In Direction, N = Not In Direction)	[ ]	[ ]	[ ]	[ ]
PEAK TO PEAK STRAIN (microstrain)	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]	[ ][ ][ ][ ]
LOAD ERROR (percent)	[ ][ ]	[ ][ ]	[ ][ ]	[ ][ ]
DEFORMATION ERROR (percent)	[ ][ ]	[ ][ ]	[ ][ ]	[ ][ ]
DEFORMATION UNIFORMITY (percent)	[ ][ ]	[ ][ ]	[ ][ ]	[ ][ ]
PHASE UNIFORMITY (degrees)	[ ][ ]	[ ][ ]	[ ][ ]	[ ][ ]

COMMENT CODES .... [ ] [ ], [ ] [ ], [ ] [ ], [ ] [ ]

COMMENT OTHER: ____

TEST DATE (month-day-year) .... [ ] [ ]/[ ] [ ]/[ ] [ ]

Raw Data File Name

GENERAL REMARKS: ____

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CERTIFIED	DATE	VERIFIED AND APPROVED	DATE
____________________	_______–_______–________	____________________	_______–_______–________
Laboratory Chief	Month – Day – Year		Month – Day – Year
Affiliation ______________		Affiliation ______________	

PROTOCOL P75 STANDARD TEST METHOD FOR HAMBURG WHEEL-TRACK TESTING OF AC (AC09)

This LTPP protocol covers the procedures for determining the rutting and moisture susceptibility of AC pavement cores, using the Hamburg wheel-tracking device (HWTD). The test must be carried out in accordance with AASHTO T324-11 with the following modifications (AASHTO 2011).

Specimen Preparation

The specimens are to be prepared for testing in accordance with AASHTO T324-11 with the following notes:

- Number of test specimens—The test must be performed on two 6-inch- (152-mm) diameter cores, mounted in the system shown in figure 1 and figure 2 of AASHTO T324-11 (AASHTO 2011).

- Laboratory-produced HMA—Delete.

- Field-produced HMA—Delete.

- Cutting field cores or field slab specimens—Field cores must be 6 inches (152 mm) in diameter. The height of the field cores must be adjusted to 1.5 inches (38 mm) by wet saw cutting. If the layer from which the core was obtained is less than 1.5 inches (38 mm) in thickness, the sample must be shimmed up using plaster so that it is level to the surface of the mold. Field cores must also be cut according to section 6.4.2 of AASHTO T324-11 (AASHTO 2011). The surface of the core must be marked in the field with an arrow showing the direction of traffic. Cores must be arranged in the mold such that the operation of the HWTD is parallel to the direction of traffic.

Procedure

The test must be performed at 50 °C.

Report

Test results must be reported using lab data sheet T75.

Sample ID must include the laboratory ID code, State, State code, SHRP ID, layer number, field-set number, sample location number, and LTPP sample number.

Other items for reporting are noted in the following list:

- HMA production—Delete.
- Compaction method—Delete.
- Specimen(s) air void—Delete.
- Type and amount of antistripping additive used—Delete.
- Number of passes at stripping inflection point.

Comments must include LTPP standard comment code(s) as shown in the *Long-Term Pavement Performance Project Laboratory Materials Testing and Handling Guide* and any other note as needed (Simpson et al. 2007).

LTPP-SPS LABORATORY MATERIAL HANDLING AND TESTING FOR EXPERIMENT SPS-10

LABORATORY MATERIAL TEST DATA

HAMBURG WHEEL-TRACK TESTING

LAB DATA SHEET T75

ASPHALT CONCRETE (AC) LAYER (AC PROPERTIES)

LTPP TEST DESIGNATION AC09 / LTPP PROTOCOL P75

SHEET NO. _____ **OF** _____

STATE ________________

STATE CODE [ ] [ ]

SHRP ID [ ] [ ] [ ] [ ]

FIELD-SET NO. [ ] [ ]

LABORATORY PERFORMING TEST: ____ **LAB CODE** .... [ ] [ ] [ ] [ ]

SAMPLED BY: ____ DATE SAMPLED: ____-____-______

LAYER NO. .... [ ] [ ]

SPECIMEN 1

SAMPLE LOCATION DESIGNATION .... [ ] [ ] [ ] [ ] [ ] [ ]

SAMPLE NO. .... [ ] [ ] [ ] [ ] [ ] [ ] [ ]

SPECIMEN LENGTH (millimeters)............. [ ] [ ] [ ].[ ]

SPECIMEN DIAMETER (millimeters)........ [ ] [ ] [ ].[ ]

SPECIMEN 2

SAMPLE LOCATION DESIGNATION .... [ ] [ ] [ ] [ ] [ ] [ ]

SAMPLE NO. .... [ ] [ ] [ ] [ ] [ ] [ ] [ ]

SPECIMEN LENGTH (millimeters)............. [ ] [ ] [ ].[ ]

SPECIMEN DIAMETER (millimeters)........ [ ] [ ] [ ].[ ]

TEST TEMPERATURE (Celsius)..[ ] [ ].[ ]

NO. OF PASSES AT FAILURE POINT ....[ ] [ ] [ ] [ ] [ ]

DEPTH OF IMPRESSION AT FAILURE POINT (millimeters) ....[ ] [ ].[ ] [ ]

CREEP SLOPE (millimeters/pass)..[ ] [ ].[ ]

STRIP SLOPE (millimeters/pass)..[ ] [ ].[ ]

NO. OF PASSES AT STRIPPING INFLECTION POINT..[ ] [ ].[ ]

COMMENT CODES..[ ] [ ], [ ] [ ], [ ] [ ], [ ] [ ]

COMMENT OTHER: ____

TEST DATE (month-day-year)..[ ] [ ]/[ ] [ ]/[ ] [ ]

RAW DATA FILE NAME: ____

PROTOCOL P77 STANDARD TEST METHOD FOR THE RTFO TEST (AE12)

This LTPP protocol covers the procedures for simulating the aging of asphalt binder specimens, using the RTFO test. The test must be carried out in accordance with AASHTO T240-09 with no modifications (AASHTO 2009).

LTPP-SPS LABORATORY MATERIAL HANDLING AND TESTING FOR EXPERIMENT SPS-10

SHEET NO. _____ OF _____

LABORATORY MATERIAL TEST DATA

ROLLING THIN FILM OVEN TEST

LAB DATA SHEET T77

ASPHALT CONCRETE (AC) LAYER (AC PROPERTIES)

LTPP TEST DESIGNATION AE12 / LTPP PROTOCOL P77

STATE __________________

STATE CODE [ ][ ]

SHRP ID [ ][ ][ ][ ]

FIELD-SET NO. [ ][ ]

LABORATORY PERFORMING TEST: ____ **LAB CODE** .... [ ][ ][ ][ ]

SAMPLED BY: ____ DATE SAMPLED: ____-____-______

LAYER NO. .... [ ][ ]

SAMPLE LOCATION DESIGNATION .... [ ][ ][ ][ ][ ][ ]

INITIAL SAMPLE NO. .... [ ][ ][ ][ ][ ][ ][ ]

POSTTEST SAMPLE NO. .... [ ][ ][ ][ ][ ][ ][ ]

MASS CHANGE (percent) .... [ ][ ]

COMMENT CODES .... [ ][ ], [ ][ ], [ ][ ], [ ][ ]

COMMENT OTHER: ____

TEST DATE (month-day-year) .... [ ][ ]/[ ][ ]/[ ][ ]

RAW DATA FILE NAME: ____

GENERAL REMARKS: ____

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CERTIFIED	DATE	VERIFIED AND APPROVED	DATE
____________________	______–______–______	____________________	______–______–______
Laboratory Chief	Month – Day – Year		Month – Day – Year
Affiliation ______________		Affiliation ______________	

PROTOCOL P78 STANDARD TEST METHOD FOR PAV (AE13)

This LTPP protocol covers the procedures for simulating the aging of asphalt binder specimens, using the PAV method. The test must be carried out in accordance with AASHTO R28-12 with no modifications (AASHTO 2012).

LTPP-SPS LABORATORY MATERIAL HANDLING AND TESTING FOR EXPERIMENT SPS-10

SHEET NO. _____ OF _____

LABORATORY MATERIAL TEST DATA

PRESSURE AGING VESSEL

LAB DATA SHEET T78

ASPHALT CONCRETE (AC) LAYER (AC PROPERTIES)

LTPP TEST DESIGNATION AE13 / LTPP PROTOCOL P78

STATE ___________________

STATE CODE [ ] [ ]

SHRP ID [ ] [ ] [ ] [ ]

FIELD-SET NO. [ ] [ ]

LABORATORY PERFORMING TEST: ____ **LAB CODE** .... [ ] [ ] [ ] [ ]

SAMPLED BY: ____ DATE SAMPLED: ____-____-______

LAYER NO. .... [ ] [ ]

SAMPLE LOCATION DESIGNATION .... [ ] [ ] [ ] [ ] [ ] [ ]

INITIAL SAMPLE NO. .... [ ] [ ] [ ] [ ] [ ] [ ] [ ]

POSTTEST SAMPLE NO. .... [ ] [ ] [ ] [ ] [ ] [ ] [ ]

TEST TEMPERATURE (Celsius) .... [ ] [ ].[ ]

COMMENT CODES .... [ ] [ ], [ ] [ ], [ ] [ ], [ ] [ ]

COMMENT OTHER: ____

TEST DATE (month-day-year) .... [ ] [ ]/[ ] [ ]/[ ] [ ]

RAW DATA FILE NAME: ____

GENERAL REMARKS: ____

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CERTIFIED	DATE	VERIFIED AND APPROVED	DATE
______________________	______–______–______	______________________	______–______–______
Laboratory Chief	Month – Day – Year		Month – Day – Year
Affiliation ______________		Affiliation ______________	

PROTOCOL P79 TEST METHOD FOR DETERMINING FRACTURE ENERGY OF ASPHALT MATERIALS AT LOW AND INTERMEDIATE TEMPERATURES (FENIX FRACTURE ENERGY) (AC10)

Scope

This LTPP protocol describes procedures for the determination of the fracture energy of asphalt materials at temperatures ranging from −10 °C to 20 °C. This protocol is applicable to 6-inch- (152-mm) diameter cores that are at least 1.5 inch (38 mm) in height. The core is sawn in half along the diametral axis. The specimen is then notched, and the steel loading plates are glued to the sawn face of the specimen. The specimen is loaded in tension through the steel plates at a constant rate of displacement of 0.04 inch (1 mm)/min. The loading is continued past the peak load until a residual load value of 0.1 kN is reached.

Data collected during this testing are used to determine fracture energy; maximum load and corresponding displacement; displacement at 50 percent of the peak load; and displacement at the residual load value.

Apparatus

The following subheadings identify each part of the apparatus to be used in performing this testing.

Loading Device and Transducers

The testing machine must be capable of applying a load of at least 10 kN with a constant rate of ram displacement of 1 ± 0.004 inch (0.1 mm)/min. The testing machine must have a transducer such as a linear variable differential transformer (LVDT) capable of measuring ram displacement with a range of at least 0.4 inch (10 mm) and an accuracy of at least 0.0004 inch (0.01 mm). It must have a transducer, such as a load cell, capable of measuring applied load with a maximum load of at least 10 kN and an accuracy of at least 5 N.

Data Acquisition System

The data acquisition system must be capable of electronically recording simultaneous measurements from the load and displacement transducers at a rate of at least 500 samples/s.

Loading Plates

Two loading plates are required.

Alignment Plates

One alignment plate is required.

Clevis Pins

Two clevis pins are required.

Environmental Chamber

The environmental chamber temperature control system must be capable of maintaining temperature control within ± 0.2 °C at settings ranging from −10 to 20 °C.

Test Specimen

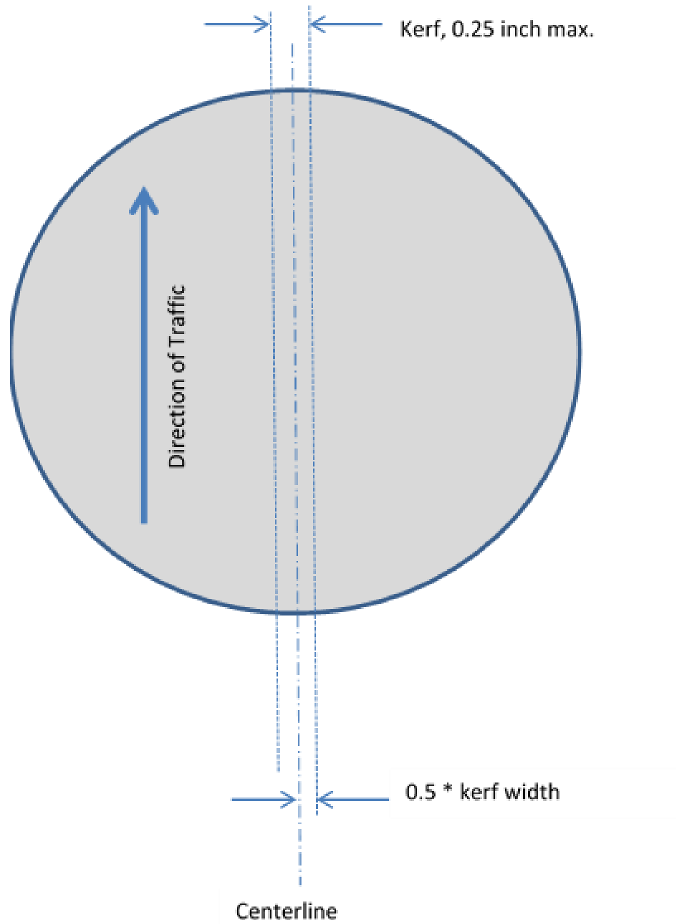
The following subheadings provide the details for the test specimens to be used to complete this testing.

Specimen Requirements

For all LTPP testing, the specimen must be a 6-inch- (152-mm) diameter core. Cores cut using a 6-inch- (152-mm) outside-diameter core barrel are not acceptable. Cores must have smooth and uniform vertical (curved) surfaces. Cores that are obviously deformed or have any visible cracks must be rejected. Irregular top and bottom surfaces must be trued up as necessary. The surface of the core must be marked in the field with the direction of traffic.

Specimen Preparation

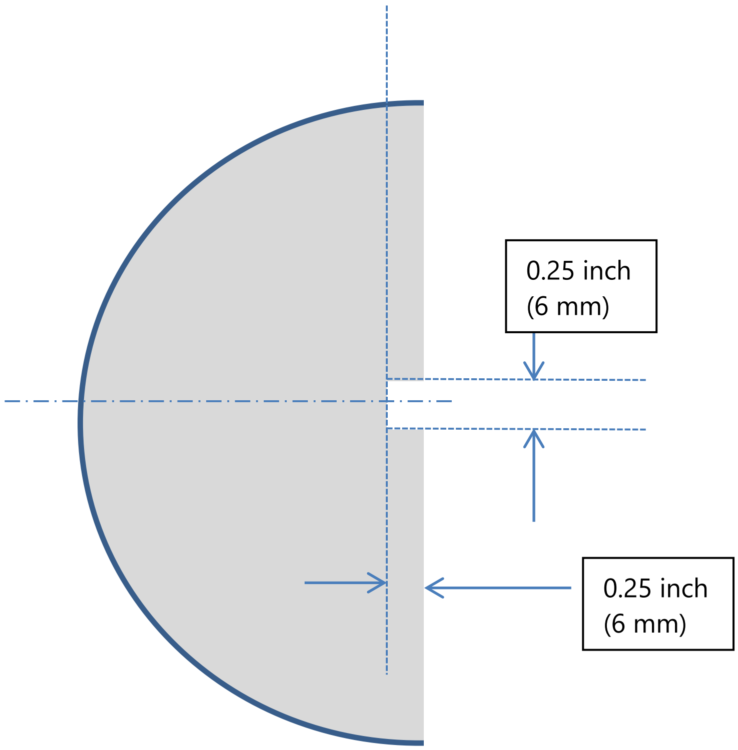
Each specimen must represent a single layer, as defined by LTPP. If the field core includes two or more different AC layers, the layers must be separated at the layer interface by sawing. After any necessary sawing, truing, or trimming, the core must have a minimum height of 1.5 inches (38 mm) and a maximum height of 2.5 inches (64 mm). If the core must be further trimmed to meet the maximum height requirement, an equal thickness must be trimmed from the top and bottom of the core. Care must be taken to maintain the direction of traffic reference through any sawing or trimming activities. The trimmed core must be cut along the diametral axis parallel to the direction of traffic as shown in figure 7. The maximum kerf width must be 0.25 inch (6 mm). The kerf must be evenly divided across the center of the core, yielding two symmetrical specimens.



Source: FHWA.

Figure 7. Diagram. Specimen sawing.

The cut specimen must then be notched across the full height of the vertical axis, as shown in figure 8. The notch must be 0.25-inch (6-mm) deep by 0.25-inch (6-mm) wide.

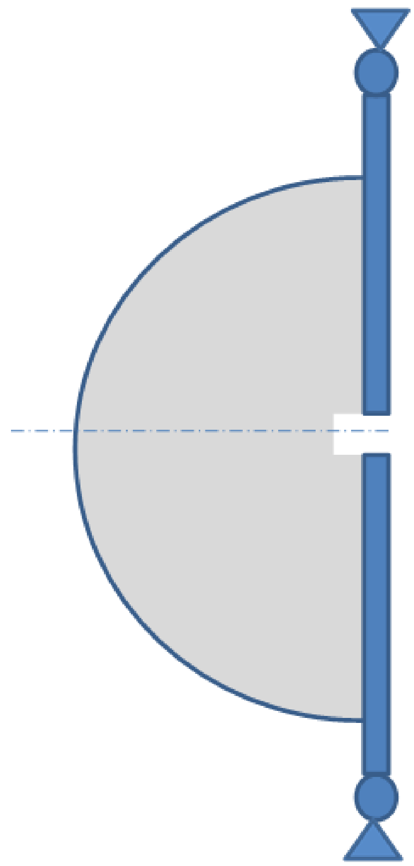


Source: FHWA.

Figure 8. Diagram. Specimen notching.

Loading Plate Mounting

The loading plates must be glued to the specimen using thixotropic adhesive mortar containing epoxy resins as shown in figure 9, using the alignment plate to ensure that the loading plates are in alignment. If the loading plates are wider than the specimen, the specimen must be centered in the load plates.



Source: FHWA.

Figure 9. Diagram. Specimen with attached load plates.

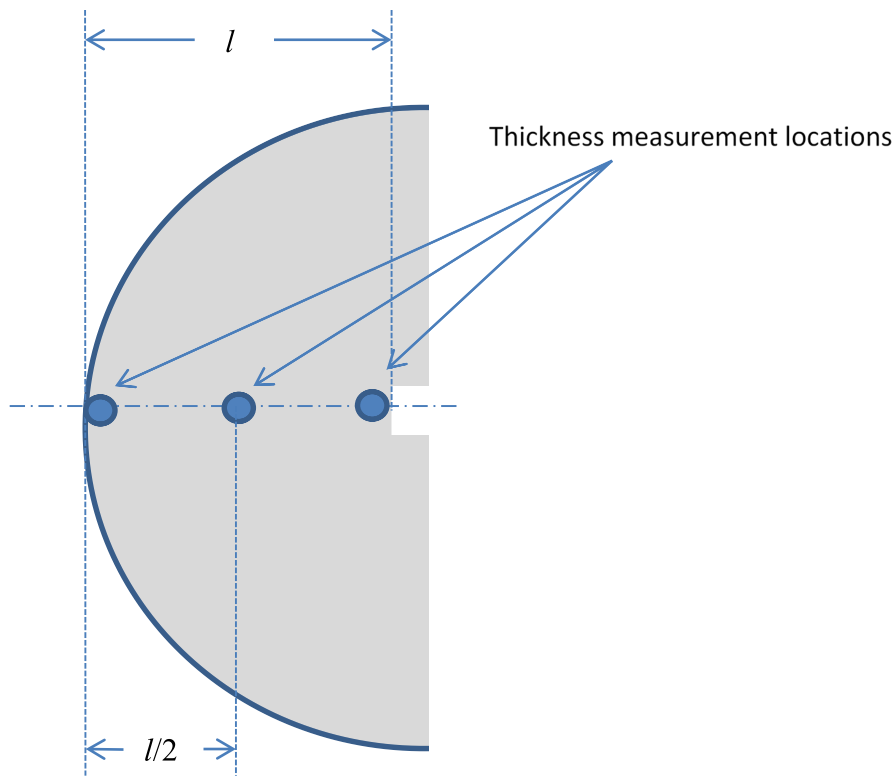
Procedure

The following subheadings provide the procedures to be followed in performing the test.

Pretest Measurements

Before testing, the following dimensions of the specimen must be measured and recorded:

- Initial ligament length, *l* (shown in figure 10): Measure at each edge of the core and in the center of the core to the nearest 0.1 mm (0.004 inch). Record the average of the three measurements.
- Specimen thickness, *h*: Measure at the three locations along the initial ligament indicated on figure 5 to the nearest 0.1 mm (0.004 inch). Record the average of the three measurements.



Source: FHWA.

Figure 10. Diagram. Specimen dimension measurements.

Specimen Conditioning

The specimens must be placed in a temperature-controlled chamber and brought to the specified test temperature. Unless the specimen temperature is monitored in some manner or can be reasonably inferred from a dummy specimen placed in the chamber at the same time, the specimen must remain in the cabinet for a minimum of 24 h before testing.

Testing

Affix the specimen to the loading apparatus using the load plates. Start the data acquisition system and apply load using a constant rate of ram displacement of 1 ± 0.004 inch (0.1 mm)/min. Testing is complete when the postpeak load diminishes to 100 N.

Calculations

Dissipated work, W_D (joules), is the area under the force versus displacement curve from the start of the test until the residual load value of 100 N is reached. Compute dissipated work using the trapezoidal rule in figure 11 and figure 12.

$$W_D = \sum_{i=1}^{n-1} (d_{i+1} - d_i) \frac{F_i + F_{i+1}}{2}$$

Figure 11. Equation. Dissipated work equation.

Where:

W_D = dissipated work, joules.
d_n = ram displacement at *n*th data point, meters.
F_n = force at *n*th data point, newtons.

$$G_D = \frac{W_D}{h \cdot l}$$

Figure 12. Equation. Fracture energy equation.

Where:

G_D = fracture energy, joules/meter^2.
h = specimen thickness, meters.
l = initial ligament length, meters.

Report

The following provides the elements to be reported for the testing.

Specimen ID

- Test temperature—Celsius.
- Specimen dimensions—h (millimeters), l (millimeters).
- Fracture energy—G_D (joules/meter^2).
- Peak load—f_{max} (newtons).
- Displacement at one-half prepeak load—δm (millimeters).
- Displacement at one-half postpeak load—δmdp (millimeters).
- Displacement at residual load—δr (millimeters).

LTPP-SPS LABORATORY MATERIAL HANDLING AND TESTING FOR EXPERIMENT SPS-10

SHEET NO. _____ OF _____

LABORATORY MATERIAL TEST DATA

STATE ________________

FENIX FRACTURE ENERGY

LAB DATA SHEET T79

STATE CODE [ ] [ ]

SHRP ID [ ] [ ] [ ] [ ]

ASPHALT CONCRETE (AC) LAYER (AC PROPERTIES)

LTPP TEST DESIGNATION AC10 / LTPP PROTOCOL P79

FIELD-SET NO. [ ] [ ]

LABORATORY PERFORMING TEST: ________________________________ **LAB CODE** .... [ ] [ ] [ ] [ ]

SAMPLED BY: ________________________________ DATE SAMPLED: ____-____-______

LAYER NO. .... [ ] [ ]

SAMPLE LOCATION DESIGNATION .... [ ] [ ] [ ] [ ] [ ] [ ]

SAMPLE NO. .... [ ] [ ] [ ] [ ] [ ] [ ] [ ]

SPECIMEN HEIGHT, *h* (millimeters) .... [ ] [ ].[ ]

INITIAL LIGAMENT LENGTH, *l* (millimeters) .... [ ] [ ].[ ]

TEST TEMPERATURE (Celsius) .... [ ] [ ].[ ]

FRACTURE ENERGY, G_0 (joules/millimeters^2) .... [ ] [ ] [ ] [ ] [ ]

PEAK LOAD, f_{max} (newtons) .... [ ] [ ] [ ] [ ]

DISPLACEMENT AT 0.5 PREPEAK LOAD, *Δm* (millimeters) .... [ ] [ ].[ ]

DISPLACEMENT AT 0.5 POSTPEAK LOAD, *Δmdp* (millimeters) .... [ ] [ ].[ ]

DISPLACEMENT AT RESIDUAL LOAD, *ΔR* (millimeters) .... [ ] [ ].[ ]

COMMENT CODES .... [ ] [ ], [ ] [ ], [ ] [ ], [ ] [ ]

COMMENT OTHER: ________________________________

TEST DATE (month-date-year) .... [ ] [ ]/[ ] [ ]/[ ] [ ]

RAW DATA FILE NAME: ________________________________

GENERAL REMARKS: ________________________________

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CERTIFIED ________________ DATE ____–____–____

VERIFIED AND APPROVED ________________ DATE ____–____–____

Laboratory Chief Month – Day – Year Month – Day – Year

Affiliation __________________ Affiliation __________________

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