Long-Term Pavement Performance (LTPP) Program Specific Pavement Studies (SPS)

Development of Experiment Design: SPS-12 Portland Cement Concrete Pavement Preservation Study

PUBLICATION NO. FHWA-HIF-18-064 October 2018

U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
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LTPP

FOREWORD

Pavement preservation represents a proactive approach to maintaining and extending the lives of existing highways. Until recently, limited rigorous performance research existed on the effects of pavement preservation treatments, and consequently there was a reliance on anecdotal information. However, research findings over the past few years are proving that preservation can be an effective approach to extend pavement's effective service life, improve safety and service condition, and is cost-efficient.

The purpose of this report is to document the recommended experimental design for the Long-Term Pavement Performance (LTPP) SPS-12 Portland Cement Concrete (PCC) Pavement Preservation Study. This study has been designed to establish the impact of selected preservation treatments on pavement performance under different loading and environmental conditions through a field study of in-service pavements starting from construction of the preservation treatments under consideration. The underlying concept of this experiment is to apply the same preservation treatment, at different times, on the same pavement structure to determine the effectiveness of a single application of a treatment as a function of pavement condition and time. This experiment is designed to answer the question on when is the best time to apply a preservation treatment on PCC pavements. It will also enable development and implementation of important pavement preservation products and tools, such as addition of pavement preservation considerations to the AASHTO Mechanistic-Empirical Pavement Design Guide and associated software. Although the recommended experiment will not be implemented under the LTPP program, the experiment and this project report can be adopted and adapted by interested highway agencies to achieve the stated benefits.

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Director, Office of Infrastructure
Research and Development

Technical Report Documentation Page

1. Report No. FHWA-HIF-18-064	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle Long-Term Pavement Performance (LTPP) Program Specific Pavement Studies (SPS) Development of Experiment Design: SPS-12: Portland Cement Concrete Pavement Preservation Study	5. Report Date October 2018 6. Performing Organization Code
7. Author(s) G.R. Rada, T.R. Thompson, G.E. Elkins and R.G. Hicks	8. Performing Organization Report No.
9. Performing Organization Name and Address Amec Foster Wheeler Environment & Infrastructure, Inc. 12000 Indian Creek Court, Suite F Beltsville, MD 20705-1258	10. Work Unit No. (TRAIS) 11. Contract or Grant No. DTFH61-14-C-00038
12. Sponsoring Agency Name and Address Federal Highway Administration Turner-Fairbank Highway Research Center 6300 Georgetown Pike McLean, Virginia 22101	13. Type of Report and Period Covered Final Report; September 2014 to July 2017 14. Sponsoring Agency Code

15. Supplementary Notes
The Contracting Officer's Representative (COR) is Mr. Jack Springer, HRDI-20

16. Abstract
Pavement preservation represents a proactive approach to maintaining and extending the lives of existing highway pavements. At the heart of the preservation decision-making process is pavement performance. This report documents the recommended experimental designs for the LTPP SPS-12 Portland Cement Concrete (PCC) Pavement Preservation Study. However, the recommended experiment will not be implemented under the LTPP program, but the experiment and this project report can be adopted and adapted by interested highway agencies to achieve the stated benefits, and consequently the impetus for publication of the report. The underlying concept of this experiment is to apply the same preservation treatment, at different times, on the same pavement structure to determine the effectiveness of a single application of a treatment as a function of pavement condition and time. This experiment is designed to answer the question on when is the best time to apply a preservation treatment on PCC pavements. It will also enable development and implementation of important pavement preservation products and tools, such as addition of pavement preservation considerations to the AASHTO Mechanistic-Empirical Pavement Design Guide and associated software.

17. Key Words Pavement Preservation, Portland Cement Concrete (PCC), Preservation Treatments, Pavement Performance, Long-Term Pavement Performance (LTPP), Preservation Experiment	18. Distribution Statement No restrictions.

19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 314	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

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 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		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 (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

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

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LIST OF ACRONYMS AND ABBREVIATIONS

AADT	—	annual average daily traffic
AASHTO	—	American Association of State Highway and Transportation Officials
AC	—	Asphalt Concrete
ACI	—	American Concrete Institute
ADT	—	Average Daily Traffic
AMPT	—	Asphalt Mixture Performance Test
AWS	—	automated weather station
CBR	—	California Bearing Ratio
CPR	—	concrete pavement restoration
CRCP	—	Continuously Reinforced Concrete Pavement
CRG	—	Communication Reference Guide
DBR	—	Dowel Bar Retrofit
DCP	—	Dynamic Cone Penetrometer
DIM	—	Distress Identification Manual
DOT	—	Department of Transportation
ESAL	—	Equivalent Single Axle Load
ETG	—	Expert Task Group
FHWA	—	Federal Highway Administration
FWD	—	Falling Weight Deflectometer

GPR	—	Ground Penetrating Radar
GPS	—	Global Positioning System
GPS	—	General Pavement Studies
HOT	—	high occupancy toll
HOV	—	high occupancy vehicle
HPMS	—	Highway Performance Monitoring System
IGGA	—	International Grooving and Grinding Association
IMS	—	Information Management System
IRI	—	International Roughness Index
ISTEA	—	Intermodal Surface Transportation Efficiency Act
JAD	—	joint associated distress
JIS	—	Joint Inspection Scope
JISS	—	Joint Inspection Scope System
JITT	—	just in time training
JPCC	—	Jointed Portland Cement Concrete
JPCP	—	Jointed Plain Concrete Pavement
JRCP	—	Jointed Reinforced Concrete Pavement
LL	—	Liquid Limit
LSPEC	—	TRB LTPP Special Activities Committee
LTE	—	load transfer efficiency

LTPP	—	Long-Term Pavement Performance
MERRA	—	Modern-Era Retrospective Analysis for Research and Applications
MIT	—	Magnetic Imaging Tools
MRL	—	Materials Reference Library
MS&T	—	materials sampling and testing
MTS	—	Materials tracking system
NASA	—	National Aeronautics and Space Administration
NCHRP	—	National Cooperative Highway Research Program
NCPT	—	National Concrete Pavement technology
PCC	—	Portland Cement Concrete
PCC/PCCP	—	Portland Cement Concrete Overlay of Portland Cement Concrete Pavement
PCI	—	Pavement Condition Index
PG	—	performance grade
PI	—	Plasticity Index
PL	—	Plastic Limit
PMS	—	Pavement Management System
PPDB	—	Pavement Performance Database
QC	—	quality control
RAP	—	reclaimed asphalt pavement

RAS	—	recycled asphalt shingles
RCO	—	Regional Coordination Office
RSCs	—	Regional Support Contractors
SAMI	—	stress-absorbing member interlayer
SHA	—	State Highway Agency
SHRP	—	Strategic Highway Research Program
SME	—	Soy Methyl Ester
SMP	—	Seasonal Monitoring Program
SPS	—	Specific Pavement Studies
TFHRC	—	Turner-Fairbank Highway Research Center
TRB	—	Transportation Research Board
TSSC	—	Technical Support Services Contractor
TTI	—	Texas Transportation Institute
VMA	—	voids in mineral aggregate
VOC	—	Volatile Organic Compound
vpd	—	vehicles per day
WIM	—	Weigh-in-Motion
WMA	—	warm mix asphalt

CHAPTER 1. INTRODUCTION

The objective of the project documented in this report was to design a Portland Cement Concrete (PCC) pavement preservation experiment for the Federal Highway Administration (FHWA) Long-Term Pavement Performance (LTPP) program. The original intent of this project report was to provide, under a single document, the complete set of requirements and supporting information needed for implementation of a PCC pavement preservation experiment under the LTPP program to capture information on the short- and long-term performance of PCC pavements subjected to preservation treatments. The resulting data would allow both user-agencies and researchers a better understanding of the potential benefits of pavement preservation and they would also enable development and implementation of important pavement preservation products and tools. The recommended experiment will not be implemented under the LTPP program, but the experiment and this project report can be adopted and adapted by interested highway agencies to achieve the stated benefits, and consequently the impetus for publication of the report. The language of this project report also reflects this – a proposed experiment.

LTPP BACKGROUND

The LTPP program was formally established by the U.S. Congress in the Surface Transportation and Uniform Relocation Assistance Act of 1987 as part of the first Strategic Highway Research Program (SHRP). While most of the SHRP initiatives ended after the first five-year SHRP effort, the FHWA was formally authorized by Congress in the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 to continue management of the LTPP program to complete the mission of performance observations over full pavement construction (new or rehabilitation) cycles. [(1)]

In 1992, the FHWA assumed management and administrative responsibilities to continue LTPP and complete the planned pavement performance monitoring in partnership with the State transportation agencies that own the LTPP test sections, the Association of State Highway and Transportation Officials (AASHTO), and the Transportation Research Board (TRB). With the 2018 data collection cycle underway, a data set reflecting nearly three decades of data collection will soon be available. The mission of the LTPP program is to promote increased pavement life through: [(1)]

- Collecting and storing performance data from a large number of in-service highways in the United States and Canada over an extended period to support analysis and product development.
- Analyzing these data to describe how pavements perform and to explain why they perform as they do.
- Translating these insights into knowledge and usable engineering products related to pavement design, construction, rehabilitation, maintenance, preservation, and management.

The program's goal is to understand how and why pavements perform as they do. As highway agencies transition to a performance-based approach to managing highway investments this goal is, if anything, more important than ever.

To accomplish the stated mission and goal, the following six objectives were established for the LTPP program in 1985: (1)

1. Evaluate existing design methods.

2. Develop improved design methods and strategies for pavement rehabilitation.

3. Develop improved design equations for new and reconstructed pavements.

4. Determine the effects of (1) loading, (2) environment, (3) material properties and variability, (4) construction quality, and (5) maintenance levels on pavement distress and performance.

5. Determine the effects of specific design features on pavement performance.

6. Establish a national long-term pavement database to support SHRP objectives and future needs.

To meet these six objectives, data characterizing about 2,500 in-service pavement test sections throughout North America and documenting their performance over a time period of up to 25 years have been collected, processed and made publicly available – figure 1 shows their geographical distribution. These pavement test sections studied are organized in 18 scientifically designed field experiments within two broad sets of studies: General Pavement Studies (GPS) and Specific Pavement Studies (SPS) – see table 1 and table 2. The GPS are a series of studies on selected existing pavement structures. These studies are restricted to pavements having materials and designs representing good engineering practices and having strategic future importance due to widespread use throughout North America. The SPS are studies of specially constructed, maintained, or rehabilitated pavement sections incorporating a controlled set of experimental design and construction features. The SPS experiments were designed to provide a broader range of pavement factors than those available from pavements designed to meet local conditions.

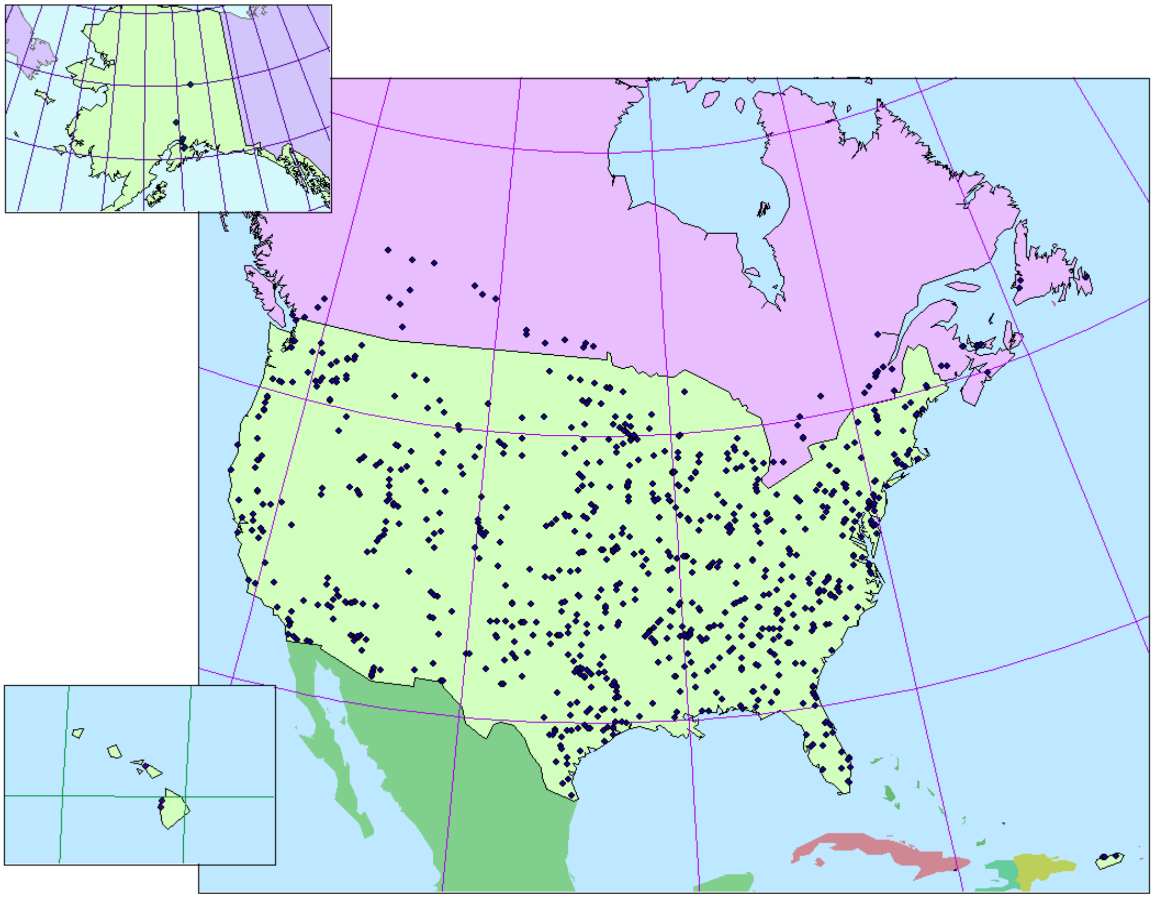

Figure 1. Map. Geographic distribution of LTPP test sections. [(1)]

Table 1. List of GPS experiments.

Experiment	Experiment Title	Total No. of Sections
GPS-1	Asphalt Concrete (AC) Pavement on Granular Base	106
GPS-2	AC Pavement on Bound Base	65
GPS-3	Jointed Plain Concrete Pavement (JPCP)	113
GPS-4	Jointed Reinforced Concrete Pavement (JRCP)	49
GPS-5	Continuously Reinforced Concrete Pavement (CRCP)	55
GPS-6	AC Overlay of AC Pavement	421
GPS-7	AC Overlay on Portland Cement Concrete (PCC) Pavement	142
GPS-9	Unbonded PCC Overlay on PCC Pavement	25
Total:		976

Table 2. List of SPS experiments by category.

Experiment	Experiment Title	Total No. of Sections
SPS-1	Strategic Study of Structural Factors for Flexible Pavements	147
SPS-2	Strategic Study of Structural Factors for Rigid Pavements	207
SPS-3	Preventive Maintenance Effectiveness of Flexible Pavements	445
SPS-4	Preventive Maintenance Effectiveness of Rigid Pavements	220
SPS-5	Rehabilitation of AC Pavements	166
SPS-6	Rehabilitation of Jointed Portland Cement Concrete (JPCC) Pavements	150
SPS-7	Bonded PCC Overlays on Concrete Pavements	39
SPS-8	Study of Environmental Effects in the Absence of Heavy Loads	50
SPS-9P/ SPS-9A	Validation and Refinements of SuperPave®Asphalt Specifications and Mix Design Process/SuperPave Asphalt Binder Study	109
SPS-10	Warm Mix Asphalt Study	72
Total:		1,605

Many insights have emerged from the LTPP program since its inception, but the continual update of existing pavement engineering tools and development of new ones are needed to stay abreast of new and emerging technological advances. To effectively design and manage pavements constructed using new emerging materials and technologies requires prediction of the long-term performance of the resulting structure under actual traffic loads and varied climate conditions; it has become apparent that long-term field observations are required to calibrate mechanistic-based pavement models.

The critical requirement in the development of any type of performance prediction model is availability of quality long-term performance data. The data have to be collected following a uniform methodology, must span the length of time between construction cycles, include measurements of significant parameters, and have measures of data quality. The recognition of these data requirement is what initially led to the development of the LTPP program in the 1980s, as such data would enable development of needed pavement engineering tools based on knowledge obtained from long-term performance observations, engineering structural measurements, climate measurements, and traffic loadings on in-service pavements.

Pavement technology has changed and it will continue to evolve. The topics from the 1980s that the LTPP program was designed to address – e.g., maintenance and rehabilitation treatments and strategies, use of recycled materials, concrete strength, base type, asphalt grade, pre-overlay treatments, layer thickness, and in-pavement drainage structures – have, in some cases, been supplemented with new questions. Although many of the topics are still relevant today and will continue to be into the future, new pavement materials, technologies and strategies have evolved and they too must be addressed within the context of long-term performance monitoring.

LTPP PAVEMENT PRESERVATION EXPERIMENTS

Pavement preservation is a technology that has been around for many decades, but there are limited data and information relating to the impact of preservations treatments on pavement performance, service life extensions and life-cycle costs. Except for a few state highway agencies (SHAs), the introduction and usage of pavement preservation treatments within the pavement management system (PMS) decision-making process has been based mostly on anecdotal information, if considered at all. Moreover, without long-term pavement performance data, the "application of the right preservation treatment, on the right pavement, at the right time" adage, will remain an abstract concept rather than an achievable goal.

In light of the above stated problem, FHWA undertook a project that had as its main objective to design and implement a pavement preservation experiment for the LTPP program. The provision of long-term performance data on in-service pavement test sections where controlled application of preservation treatments are monitored is the motivation for the LTPP experiment addressed in this document: the SPS-12 PCC Pavement Preservation Study.

In the design of the LTPP SPS-12 preservation experiment, it was beneficial to start with a definition of pavement preservation, as it provided needed background and a measuring yardstick. The definition adopted by the LTPP program (based on 2005 FHWA memorandum titled "ACTION Pavement Preservation Definitions") is as follows: [(2)]

> *Pavement preservation is a planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without significantly increasing the structural capacity). The ultimate goal of pavement preservation is the application of the right preservation treatment, on the right pavement, at the right time.*

Key postulates associated with the above definition include:

- *Typically applied to pavements in good condition having significant remaining service life.*
- *A strategy of extending service life by applying cost effective treatments to the surface or near-surface of structurally sound pavements.*
- *Preventive treatments include concrete joint sealing, diamond grinding, dowel-bar retrofit (DBR) and isolated concrete repairs to restore functionality of the slab.*

Albeit mostly anecdotally, pavement preservation has been proven to be a cost-effective approach to extend pavement's effective service life and improve safety and service condition. Moreover, given the current economic environment, most SHAs (as well as local highway agencies) are now embracing the pavement preservation philosophy to utilize more cost-effective pavement preservation techniques to better serve the public. There is, however, a clear need to demonstrate through field performance data collected under different loading and environmental conditions that this technology does indeed provide an effective approach in support of pavement decisions. Pavement performance is at the heart of the preservation decision-making process.

As stated earlier, pavement preservation treatments have been around for decades, but SHAs have not been able to use and/or optimize them appropriately due to the lack of data relating to their impact on performance, service life extensions, and life-cycle costs. However, given the budget constraints faced by SHAs, including limitations on rehabilitation and reconstruction funds, the use of preservation technology as a means to make pavements last longer has taken on a greater significance.

In addition, there are a few new pavement preservation treatments and improved technologies in the market today that were not available in the 1980s, when the SPS-4 Preventive Maintenance Effectiveness of Rigid Pavements experiment was designed. [3] Fortunately, there is also a larger agency/industry information base as well as improved industry experience. Nonetheless, issues such as treatment selection, traffic loadings and climatic conditions must be considered in the development of the SPS-12 Pavement Preservation Study.

PROJECT APPROACH

Overview

The objective of the project documented in this report was to design a PCC pavement preservation experiment for the LTPP program. To accomplish this objective, the following five tasks were completed:

- Formulation of experimental design.
- Development of construction guidelines and requirements.
- Definition of materials sampling and testing requirements.
- Definition of pavement performance monitoring requirements.
- Identification of other data collection needs.

The project commenced in September 2014. The first three tasks were performed as part of Phase I, which was completed in June 2015, while the remaining tasks were done in Phase II, which commenced in July 2015 and was completed in March 2017. This document describes the approaches and outcomes all of the above tasks performed on this project. This report also provides the guidelines that resulted from the project.

Expert Task Group (ETG)

The formation of an Expert Task Group (ETG) was vital to the success of the project, and hence it was the first project activity. The ETG was formed to review and to provide feedback during the development of the LTPP pavement preservation experiment. In selecting members to the

ETG, careful consideration was given to information each member brought to the project to ensure the key elements of the LTPP pavement preservation studies were covered – LTPP program and pavement preservation technology. It was expected that the members of the ETG would have specific areas of expertise as well as a sound understanding of both the LTPP program and pavement preservation technology, and indeed this was ultimately the case.

The ETG was to consist of eight members. Working with FHWA, the project team identified eight candidate ETG members and four potential alternatives. Candidate members were identified from the TRB LTPP committees and TRB Pavement Preservation Committees (AHD18 and AHD20), as the members of these groups are committed to the goals of their respective technology. The ETG members were to represent the full range of LTPP stakeholders as well as the diverse geographic/climate regions of the country. The final list is presented in Table 3; there were six DOT, two industry and one academia representatives. Vendors were not invited to join as it was felt there were too many pavement preservation technologies and only a limited space for ETG membership.

Two methods were used throughout the project to solicit input from the ETG. The first method of input was via webinars / teleconferences, which allowed the project team to present the progress and/or key technical issues and the ETG to provide feedback. Secondly, the ETG participated in two direct face-to-face meetings with FHWA and the project team to review and to discuss draft and final project deliverables. Table 4 provides a summary of the ETG meetings, including date, type and purpose of each.

Table 3. Project ETG membership.

ETG member	Affiliation	Expertise
Anita Bush	Nevada DOT	Pavement preservation and chair TRB pavement preservation comm.
Colin Franco	Rhode Island DOT	LTPP and pavement preservation
Morgan Kessler	FHWA	Pavement preservation and materials
David Luhr	Washington State DOT Transportation	LTPP and pavement preservation
Magdy Mikael	Texas DOT	Pavement preservation and materials
Larry Scofield	International Grooving and Grinding Association	LTPP and concrete pavement preservation
Jim Moulthrop	Foundation for Pavement Preservation	Asphalt pavement preservation and materials
Roger Smith	Texas A&M (retired)	LTPP, pavement preservation and management
Ben Worel	Minnesota DOT	LTPP and pavement preservation

Table 4. Summary of ETG meetings.

Date	Meeting Type	Purpose
January 22, 2015	Webinar / teleconference	ETG, FHWA and project team member introductions; project overview, and review and discuss experimental design and materials sampling and testing frameworks
April 23, 2015	Face-to-face (Reno, NV)	Review and discuss draft experimental design and materials sampling and testing
July 28, 2015	Webinar / teleconference	Finalize experiment design and materials and sampling plans, discuss marketing of experiments, and review upcoming activities and schedule
September 14, 2015	Webinar / teleconference	Review and discuss adjustments to the experiment design
May 2, 2016	Webinar / teleconference	Review and discuss framework for construction guidelines, data construction requirements, performance monitoring guidelines and other data collection requirements as well as review and discuss outreach activities
July 26, 2016	Face-to-face (Reno, NV)	Review and discuss completed set of experiment draft documents

Prior to each meeting, ETG members were provided with the meeting presentation as well as the reference material (i.e., draft and final documents). The project team also prepared minutes for each meeting to capture the guidance provided by the ETG members. The minutes were distributed to the ETG members for their review and comment and they were revised as appropriate. These minutes are considered an important record of the ETG input.

REPORT PURPOSE AND ORGANIZATION

The purpose of this report is to provide, under a single document, the complete set of requirements and supporting information needed for implementation of the LTPP SPS-12 PCC Pavement Preservation Study. As with other LTPP experiment, this experiment is designed to capture information on the short- and long-term performance of PCC pavements subjected to preservation treatments as well as other relevant data, which will allow both user-agencies and researchers a better understanding of the potential benefits of pavement preservation. Data collected as part of the study will also enable development and implementation of important products and tools, such as AASHTO standard specifications for the preservation treatments.

With the above in mind, this report has been organized into the following chapters:

1. Introduction – provides background information about the LTPP program and the LTPP pavement preservations studies, summarizes the approach taken to achieve the project objective, and presents the report purpose and organization.

2. Experimental Design – presents the approach established for development of the experiment, summarizes the key factors considered in the formulation of the experiment,

details the resulting experiment matrices and recommended project layouts, and summarizes the project nomination and acceptance process.

3. Construction Requirements – provides recommendations on construction guidelines, checklists and just in time training (JITT) considered critical in minimizing variability over time and from project to project, summarizes the general construction data requirements (in terms of data sheets), and provides guidelines for the preparation of individual project construction reports.

4. Materials Sampling and Testing Plans – provides and overview of the MS&T process, summarizes the MS&T requirements including layers to test, sampling plans and testing protocols, and details other MS&T considerations such as the LTPP Materials Tracking System (MTS) and LTPP Materials Reference Library (MRL).

5. Performance Monitoring Requirements – lists the performance monitoring data elements (both required and desired), provides the monitoring frequency requirements, presents the required monitoring protocols (including deviations, if any), and summarizes the monitoring data collection requirements.

6. Other Data Collection Needs – lists the remaining required data elements (both required and desired), provides the data collection frequency requirements, presents the required data collection protocols (including deviations, if any), and summarizes the data collection requirements.

In addition, appendix A contains the data forms (and associated instructions) that require completion as part of the SPS-12 experiment documentation requirements, while appendix B contains new materials sampling and testing protocols not presently in use by the LTPP program.

CHAPTER 2. EXPERIMENTAL DESIGN

This chapter documents the recommended experimental design for the LTPP SPS-12 PCC Pavement Preservation Study. As with other LTPP experiments, this experiment is designed to capture information on the long-term performance of pavement preservation treatments on PCC pavements. This is important because the monitoring of performance over time will permit verification of the purported benefits of the more common pavement preservation treatments and hence the technology. The understanding of how pavements where preservation treatments have been applied perform and why they perform as they do will also enable the development and implementation of numerous important products and tools, such as AASHTO standard specifications for the preservation treatments under consideration.

The SPS-12 experiment has been structured to ensure consistency and compatibility with the LTPP program objectives and database, while addressing information gaps regarding pavement preservation. The studies will 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 PCC pavement preservation. Collectively, this information will be used to establish the impact of preservation treatments on pavement distress propagation rates, which will enable determination of their impact on pavement life extension and performance. In turn, this information and understanding will enable determination of the optimal timing, cost-effectiveness and benefits of preservation treatments.

The experimental design described in this chapter is intended for test sections not previously in the LTPP program. Projects nominated into the SPS-12 study will be classified into cells within the experimental matrix for project selection purposes. They should also adhere to the guidelines contained in this report. Because these sections will be nominated into the program prior to construction of the preservation treatments, all preservation construction activities, materials properties, and sampling will be documented to provide complete data sets.

OVERVIEW OF EXPERIMENT APPROACH

An innovative approach that segregates treatment types and project locations into discrete groups has been adopted for the LTPP pavement preservation experiment. The underlying concept is to apply the same preservation treatment at different times on the same pavement structure to determine the effectiveness of a single application of a treatment as a function of pavement condition and time. This concept is designed to try and capture the most appropriate time to perform a treatment and to identify factors related to treatment timing. The vision of the experimental design is to choose pavements that have recently been constructed or reconstructed. Starting with relatively new pavement structures at each project site, six or seven test sections are established along a uniform road segment before any other preservation or maintenance treatments are applied. Over time (and hence change in pavement condition), the same preservation treatment is applied to different test sections. The length of the treatment application time span is intended to start before preservation treatments would normally be placed, and extend past the time use of preservation treatments is considered appropriate.

For example, a typical “diamond grinding” project in the SPS-12 experiment will contain six test sections at the same site – one control test sections (located near the middle of the project) and five treatment test sections, where the same diamond grinding treatment is applied at different times. The diamond grinding will be applied at the five treatment test sections 0, 4, 8, 12 and 16 years after inclusion of the project into the SPS-12 experiment. The untreated “control” test section will be used to normalize distress propagation rates along the project. Moreover, the remaining project sections can also serve this purpose until the time the diamond grinding treatment is applied. In Year 4, for example, there would be two test sections with an applied diamond grinding treatment and three test sections without the treatment, which can serve as additional untreated sections.

Motivations for the suggested approach include the following:

- Each pavement has a unique distress propagation rate based on the combination of pavement structure, material properties, traffic loadings and environment effects on materials used to construct the pavement. Performing a series of treatments over time on test sections at the same site provides a better indication of treatment effect versus condition/time as opposed to including pavement structures at different levels of condition in different climate, traffic load, and pavement structures.

- Only one treatment is specified for each project location in order to reduce the number of test sections required. If multiple treatments were specified at each location, this would increase the number of test sections by a multiple of two for each treatment (i.e., 12 versus 6 at each site for two treatments).

- One treatment type for test sections at the same site also offers the benefit of tailoring the timing of treatments for each specific treatment type. This avoids the issue of treatment timing when multiple types of treatments are applied to the same project location.

- One treatment per project location should enhance implementation since SHAs with experience with a specific type of preservation treatment may be more willing to participate in a treatment that they routinely use. However, SHAs are not limited to one treatment – agencies can implement multiple projects at a given site, each having six (6) test sections, but using different treatments. Indeed, it would be ideal if agencies could implement multiple projects at a single site, but it is recognized that to accomplish this, there are important issues and or limitations to address such as agency commitment, ability to find uniform location that can accommodate 18 test sections or more, etc.

- This type of approach offers significant results for each pavement test site that is meaningful to each participating agency without reliance on other SPS-12 project sites. Some of the other national pavement experiments required a global analysis of results between sites to provide data points to influence current agency practice.

- While the underlying concept is to determine the effectiveness of a single pavement preservation treatment as a function of pavement condition/time, the practicalities of this approach allow for consideration of some multiple treatments. For example, a test section that receives an early time-based treatment that returns to essentially the same condition as the control untreated section, allows the opportunity to apply a second treatment. This is an opportunity to extend the results, but is not included in the experimental design because it becomes an uncontrolled covariate in the overall scheme.

- The do nothing control test sections plus interim control test sections allow assessment of distress propagation within the limits of a project.

The suggested approach will also enable determination of the effect of the existing pavement condition on treatment life. Sometimes preservation treatments are placed on pavements in fair or poor condition and skepticism is created as to the effectiveness of these treatments when they do not perform well. Moreover, this approach also provides the base line data needed to achieve an understanding of pavement distress propagation rates, and hence enable determination of the impact of preservation treatments on pavement life extension and performance.

It is recognized that there are issues associated with the suggested approach; e.g., for application of joint sealing treatment at a given project, it is possible that the sealing material and contractor responsible for its placement may vary from one year to another. Other issues include:

- Staff turnover.

- Sections failing before application of treatment.

- Application of maintenance treatments by highway agency personnel other than the one under consideration at the site.

- Cost of mobilizing to project site every two years to apply treatment to a small area.

These issues introduce variability that is real and that is the same as that encountered by highway agency practitioners. As such, the LTPP data collection plans are designed to capture as much of that variability in the construction process as possible. Moreover, regardless of the above referenced issues, the benefits of the suggested approach far outweigh the potential negatives.

KEY EXPERIMENT CONSIDERATIONS

The SPS-12 experiment has been designed to establish the impact of the timing of preservation treatments through a field study of in-service pavements starting from construction of the preservation treatment being studied. A fundamental analysis concept of the experiment is to examine the effect of preservation treatments on pavement distress propagation rates, which will enable determination of their impact on pavement life extension and performance. In turn, this information and understanding will enable determination of the optimal timing, cost-effectiveness and benefits of preservation treatments.

This section describes the key considerations addressed in the development of the experimental design. A large number of factors were considered in formulating the experimental designs. However, given the practical constraints of financial resources and size of the experiment matrix required to adequately represent all factors, the resulting experimental designs reflect the prioritization of factors within a statistically sound study, as described later in this chapter.

Pavement Preservation Treatments

A significant number of preservation treatments exist today, well beyond that which can realistically be considered as part of the SPS-12 experiment. Three treatments were selected as the most appropriate number of treatments that could reasonably be implemented within the LTPP program and its associated budget. In deciding what treatments to incorporate, the findings from various studies were considered, including the National Cooperative Highway Research Program (NCHRP) Project 14-33: Pavement Performance Measures that Consider the Contributions of Preservation Treatments. [(4)] Based on these studies, the most common treatments for PCC pavements in order of frequency (listed in order from most to least frequent) were found to be:

- Diamond grinding.
- Partial depth patching.
- Joint sealing.
- DBR.
- Full depth patching.
- Spall repair.
- Slab replacement.
- Crack sealing.

Diamond grinding, partial depth patching, and joint sealing are the most common PCC pavement preservation treatments. Both diamond grinding and joint sealing were considered logical treatment choices for the SPS-12 experiment. In the case of diamond grinding, key issues considered in terms of this treatment included:

- What is the impact of diamond grinding on pavement performance in terms of faulting, ride quality, friction and noise?
- How does the timing and frequency of diamond grinding affect performance of pavements?

While partial depth patching is the second most common PCC treatment, it is a localized-type of treatment (unlike diamond grinding or joint sealing, which apply to the entire section), and therefore not conducive to LTPP-type test sections. Moreover, it would be difficult to get the same type and extent of repair from one section to another since the repair is related to local failure and each slab most likely would be different and unique. In addition, the analysis would be difficult to accomplish since the repairs will vary from site to site and it is not likely to produce nationwide performance models. Accordingly, this treatment was not recommended and it has not been included in the SPS-12 experiment.

Joint sealing of PCC pavement, the third most common treatment, was also considered an important treatment, albeit one that was originally rejected due to the various difficulties associated with implementing such treatment within the LTPP program. However, after careful consideration and in recognition of the most critical needs of the concrete industry, the decision was made to move forward with joint sealing to address many (but not all) important issues related to this treatment, such as:

- Does joint sealing contribute to improved performance of pavements? If so, how significant is the impact?
- Is there a difference between joint sealing capping (simple placement of more sealant over the existing seal) and removal and replacement?
- How does the frequency of joint seal maintenance affect performance of jointed pavements?

Consideration was also given to DBR of PCC pavements for the SPS-12 experiment. While it is the fourth most common treatment, the use of this treatment is anticipated to diminish in the future because many pavements will have already been treated with DBR plus most new jointed PCC pavements use dowelled joints, and hence the need for long-term performance data may be of limited future use. Accordingly, while originally considered in the SPS-12 experiment, this treatment was eventually dropped from further consideration.

In terms of the third treatment for the SPS-12 experiment, consideration was given to partial and full depth patching, spall repair, and slab replacement, but these treatments are also of a localized reactive nature and hence they do not lend themselves to successful investigation using the adopted experimental concept. Consideration was also given to crack sealing, which is the first treatment agencies apply in terms of maintenance and preservation, but they do not know the impact on pavement life extension. While it would make sense for this treatment to be included in the SPS-12 experiment, it is difficult to find sites to manage within the context of the experiment and sites considered will need continuous maintenance (i.e., application of crack sealing) to properly study the impact of the treatment of pavement performance. Accordingly, crack sealing was not included as a core SPS-12 experiment treatment.

The decision was made to move forward with joint penetrating sealers, and in particular silane- or siloxane- based sealers. These sealers are being used in many States to prevent or retard joint associated distress (JAD), which is considered a critical issue by the concrete industry. These sealers are applied to the concrete slab surfaces next to the joints in an attempt to seal the underlying PCC from entry of deleterious chemicals, and thus preserve it from further disintegration. Some of the more specific issues to be addressed under this treatment include:

- Do joint penetrating sealers contribute to the mitigation of or reduction in joint associated distress? If so, how significant is the impact?
- Should joint penetrating sealers only be applied early in the life of the pavement or should they be re-applied over time? If the latter, how often and at what time interval?

- Should joint penetrating sealers be used in combination with joint sealing or by themselves?

In summary, the following pavement preservation treatments were selected for inclusion in the SPS-12 experiment:

- Diamond grinding.
- Joint sealers.
- Joint penetrating sealers.

It is anticipated that other PCC preservation treatments could be included in the list of supplemental preservations treatments (discussed later in the document), which are strongly encouraged for implementation by the interested SHAs.

For those treatments that will be included in the SPS-12 experiment, a combination of national and local specifications has been established. National specifications address general construction and workmanship requirements – e.g., use of hot applied (not silicone) sealants, and type of diamond grinding cutting heads to be used and their spacing. Local specifications, on the other hand, pertain to specific construction and workmanship requirements – e.g., locally available asphalt sealant material will be used and agencies will control, as much as possible, material sources. To the extent possible, both national and local specifications should remain the same over time. These national and local specifications are reflected in the construction guidelines for the experiment presented in the next chapter. These guidelines address the many issues related to construction, workmanship, and construction specifications that can affect the outcome of the experiment.

Pavement Type and Age

A measure of the success of the SPS-12 experiments will be its contribution to the understanding of the performance of pavements that have been subjected to preservation treatments. Four sets of factors have been chosen to serve as main effects in the factorial pavement selection matrix: (1) pavement structure (including pavement type and pavement layer thicknesses and materials), (2) subgrade soil, (3) traffic, and (4) drainage and environmental conditions. The first two factors are addressed in this section.

In formulating the SPS-12 experiment, pavements were grouped into the following pavement structure families:

- Original jointed (plain or reinforced) PCC construction pavement (JPCP and JRCP).
- Original continuously reinforced concrete pavement (CRCP).
- PCC overlay of PCC pavement (PCC/PCCP).

The following thought process was used in the selection of the pavement structure family to include in the experiment:

- Given the limited mileage of CRCP and PCC overlay of PCC pavements in the U.S., these two pavement families were dropped from further consideration.

- Due to the extent of present usage as well as the selected preservation treatments, it was recommended that original PCC construction be limited to JPCP; JRCP were excluded from the study due to the perceived limited future use of this antiquated pavement type.

- Original PCC construction pavement families were given the highest priority for the SPS-12 experiment, as it more likely to provide more reasonable and clear outcomes for the reasons detailed in the next bullet item.

Accordingly, based on the above, the dowelled jointed plain PCC pavement (JPCP) family (with joints perpendicular in orientation and PCC shoulders) was selected for inclusion on the SPS-12 experiment. There are no minimum thickness requirements for the PCC surface layer. In the case of the joint sealing experiment, preference will be given to joints with no sealant or sealant in good condition.

The pavement family selection was made without consideration of the structural factors associated with the pavements, such as surface layer thickness, base layer type and thicknesses, subgrade soil and drainage. While important, these structural factors are not directly addressed in the experiments. Rather, the overarching assumption has been made that pavements incorporated into the experiments will have been appropriately designed for the given traffic and climate conditions, and as such the influence of the preservation treatments on the performance of the pavements will be accurately reflected. Properties of the test sections included in the study will be verified through falling weight deflectometer (FWD), cores, material tests and ground penetrating radar (GPR) testing. LTPP contractors and participating highway agencies will perform the FWD, cores and materials tests, while a specialty contractor will perform the GPR surveys, which will have a wide-ranging scope.

In addition, because the concept of preservation is premised on the assumption that the pavement receiving the treatment is in good condition, the following construction age requirements are stipulated: construction of original dowelled jointed plain PCC pavements must have been completed within the past 10 years for the diamond grinding treatment and within the past 4 years for the joint sealing and joint penetrating sealer treatments. Consideration will be given to older pavements if faulting and/or roughness has not progressed too much for the diamond grinding experiment, if the pavement (and joint sealant, if present) condition is good for the joint sealing experiment, and if JAD has not progressed significantly for the joint penetrating sealer experiment.

Detailed criteria for establishing whether or not a pavement meets the condition requirements is provided as part of the Project Nomination Guidelines detailed later in this chapter. They include:

- Desired pavement structure is a structural plain jointed PCC pavement with doweled joints, joints are oriented perpendicular to the slab edge, stabilized non-erodible base (asphalt treated base preferred), and PCC shoulders. The structural PCC layer must be the exposed surface layer; milling of an existing AC overlay is not acceptable. There are no minimum thickness requirements for the PCC surface layer. In the case of the joint sealing experiment, preference will be given to joints with no sealant or sealant in good condition.

- The original construction of the PCC surface layer must have been completed within the past 4 years for the joint seal and penetrating sealer studies (SPS-12S and -12P), and within 10 years for the diamond grinding experiment (SPS-12G). However, consideration will be given to older pavements if faulting and/or roughness has not progressed too much for the diamond grinding experiment, if the pavement (and joint sealant, if present) condition is good for the joint sealing experiment, and if JAD has not progressed too much for the joint penetrating sealer experiment.

- The pavement surface should be in good condition and preferably have no visible surfaces distresses, such as cracks or patches. For practical measures, good condition metrics include:

    - Cracking limited to less than 5% combined by area (assume a 0.5-ft width for linear cracks).

    - Rutting on the PCC surface layer less than 0.1 inch. This can include either a straight edge or wire line reference rut depths.

    - Faulting less than 0.1 inch, except for the diamond grinding experiment.

    - None to limited signs of JAD for the joint penetrating sealer study (12P). If the former, defensible basis for anticipating distress will manifest itself at project site.

    - Ride quality, as measured by the International Roughness Index (IRI), should be less than 120 inches/mile for the diamond grinding study (12G) and less than 80 inches/mile for the joint seal/sealer studies (12S/12P).

- The construction project must be of sufficient length to accommodate all of the experimental test sections. An ideal test section is 1,250 ft long, whereas a practical minimum is 800 ft long. Thus, the seven core test sections require a segment length between 1.5 to 2 mi, where the properties of the pavement along that length are as similar as possible in terms of layers types, layer thicknesses, drainage features, and subgrade. A longer length is needed if supplemental test sections are proposed.

- Traffic flow should be uniform over the length of the project. All sections should carry the same traffic stream and be located in the same direction of traffic. Intersections, rest stops, on-off ramps, weaving areas, quarry entrances, etc., should be avoided on and between test sections on a project.

- Test sections should be located on portions of the project which are relatively straight and have a uniform vertical grade. Horizontal curves greater than 3 degrees and vertical grades greater than 4 percent should be avoided.

- All test sections should be located on shallow fills. The entire length of each test section, however, should be located completely on either a cut or a fill. Cut-fill transitions or side hill fills should be avoided within the monitoring portion of each test section.

- Culverts, pipes and other substructures beneath the pavement should be avoided, but if required they should not be within the limits of the monitoring portion of a test section.

- Road sections with added lanes, added shoulders, or that have been widened are not desirable for the SPS-12 experiment.

- The project pavement must not have curb and gutter within 6 ft from the outside edge of the pavement adjacent to the test lane.

- The test sections must be located in the outside lane of the travel direction.

These criteria will help identify projects in which the relative performance of the test sections is due to the timing of the placement of the preservation treatments, and the influence of other factors such as changes in the existing pavement structure, subgrade, traffic patterns, and drainage characteristics is minimized.

Climate

A key factor affecting pavement performance is climate and consequently, it must be a key consideration in the formulation of the SPS-12 experiment. The four general climatic zone designations that have been used in the prior LTPP experiment designs will be used for the experiment in question. They are:

- Wet-Freeze.

- Dry-Freeze.

- Wet-No Freeze.

- Dry-No Freeze.

Annual precipitation will be used to define dry and wet. Climates with an average annual precipitation of less than 20 inches/year from 1990 to 2010 will be considered “Dry,” while those receiving more than 20 inches of precipitation per year will be considered ‘Wet.”

Freezing Index will be used to define the Freeze and No Freeze climates from the average annual freeze index from 1990 to 2010. A site located where the annual Freezing Index is greater than 150°F-days will be considered to be in the Freeze zone, while one located where the annual Freezing Index is less than 150°F-days will be considered to be in the No Freeze zone.

The experiment design is based on the same number of SPS-12 preservation treatments being constructed in all four climatic zones. The experiment will rely on data obtained from a climate source developed by the National Aeronautics and Space Administration (NASA), the Modern-Era Retrospective Analysis for Research and Applications (MERRA), which provides continuous hourly weather data starting in 1979 on a relatively fine-grained uniform grid and also traditional virtual weather stations from nearby operating weather stations. Installation of an automated weather station (AWS) at each project site is not required.

Traffic

Traffic factors, both in terms of loads and volumes, are a primary consideration in the performance of preservation treatments. Historically, the LTPP program has used annual application rate of equivalent single axle loads (ESALs) to characterize traffic in the formulation of the experiments as well as in the project/test section nomination/acceptance and experimental cell grouping process. Typically, a high and low level of the traffic load classification factor has been used.

The approach that will be used for the SPS-12 experiment is based on ESALs, which is consistent with most other LTPP experiments. More specifically, the same approach and threshold value used in the SPS-10 Experiment: Warm Mix Asphalt (WMA) Overlay of Asphalt Pavement Study will be used for the SPS-12 experiment. Sites receiving less than 500,000 ESALs per year are considered low traffic, while those sites with traffic greater than 500,000 ESALs per year are considered high traffic for purposes of the experiment. The basis for the 500,000 ESAL threshold values, as directly extracted from the SPS-10 Experimental Design and Research Plan is provided below: [(5)]

> *To ensure that the experiment captured a range of loading conditions, two categories were established by evaluating measured loading at the existing LTPP sites. The distribution of average annual ESALs per year is provided in figure 2, while summary statistics are provided in table 5. These data were assembled from all LTPP locations where monitored traffic data are available and represent the annual average of all years collected for each location – the ESAL values reported are for one lane in one direction of travel (i.e., design ESALs). As shown, the mean for the data set is 338 kESALs per year; however, the distribution is skewed with approximately 60 percent of the sites receiving less than 250 kESALs per year. In addition, traffic loads continue to grow thereby increasing ESAL levels. Some of the data included in figure 2 was captured in the early to the mid-1990s and they have not been adjusted for growth. Based on this distribution and considering the difficulties in obtaining lane closure in high traffic areas, the low traffic category was defined as sites receiving less than 500,000 ESALs per year. A site with traffic greater than or equal to 500,000 ESALs per year will fall into the high traffic category for purposes of this experiment.*

In summary, the approach that will be used to characterize traffic in the SPS-12 experiment makes use of ESALS to establish the traffic level at a given project as high or low.

However, this traffic parameter will be only be used for purposes of project recruitment and population of the experiments. Once incorporated into the LTPP program, traffic information will be collected at each project site as part of the monitoring data requirements. Priority will be given to continuously operating permanent Weigh-in-Motion (WIM) devices for the collection of classification and weight data. This level of data collection is preferred because it provides:

- Accurate traffic loading measurements required to develop mechanistic and mechanistic/empirical design models.

- The base data necessary to understand the intricacies of the interactions among pavement, traffic load, and environment.

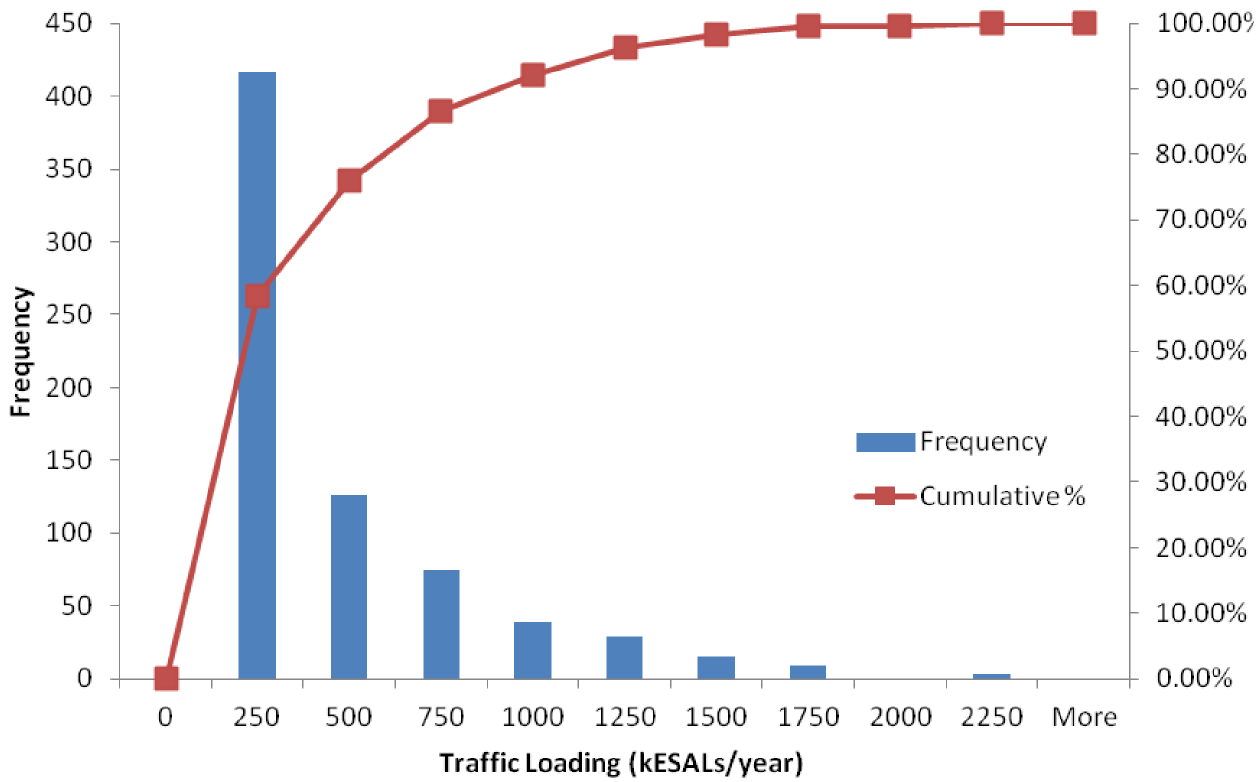

Figure 2. Graph. Distribution of annual traffic loading at LTPP sites.

Table 5. Summary of statistics of annual traffic loading at LTPP sites.

Statistic	Average Annual Traffic Loading (kESALs/yr)
Mean	338
Median	195
Standard Deviation	377
Minimum	2
Maximum	2172

More specifically, a minimum of three years of WIM data and thereafter continuous classification data collection for the remainder of the time the project remains in the LTPP program is recommended. Collection of WIM data provides information on loading and vehicle classification at a site, while continuous classification provides the basis to expand loading data for later years in the study by correctly weighting the various loading distributions.

The three-year minimum for WIM data collection should allow capture of major variations due to economic cycles. The LTPP SPS traffic validation (pooled-fund) study used five years to fully cover high and low periods of economic activity since economic cycles typically last three years. It was found in that study that weight patterns by vehicle class tend to be stable over time. A three-year requirement also recognizes that site calibration and validation required at periodic intervals is a resource demand. The quartz piezo sensor is one of the possible WIM sensors that has minimal temperature sensitivity. An installation with quartz piezo sensors would require only one validation during the expected sensor life. The calibration typically holds with a bias that will not affect pavement design evaluations for 18 to 24 months. The typical minimum life of a correctly installed sensor in good pavement is three years. An initial data collection period, where an agency could use the site to supplement an existing weight group or test a hypothesis about weight group selection would allow the data to be used for other purposes. At the end of the period, an agency decision on reinstallation would not significantly affect the availability of loading information for the SPS-12 experiment.

The purpose of the on-going classification data collection requirement is to track truck growth (up or down) and to look for potential shifts in the distribution between classes. The shift in truck distributions can impact expansion of prior year loading information. This limits the utility of volume counts for ongoing data collection. Vehicle distribution changes may be a function of route utilization or agency changes in classification trees. LTPP research has found that about a quarter of all locations will have a significant shift in distribution within a five-year period, an interval shorter than the length of the experiment.

It is recognized that the ability to achieve the recommended traffic data collection will depend on the availability of funds within the LTPP program. Should funds not be sufficient, consideration will be given to more attainable data collection requirements, but which would still provide reliable traffic data.

Replicate and Repeat Test Sections

The use of replicates in the SPS-12 experiments is highly desirable for a number of reasons. However, it is first important to describe the difference between “replicate” and “repeat” test sections. Both words suggest response measurements collected from multiple test sections with the same (or very similar) combination of design factor settings.

The most essential distinction is that replicate sections are constructed at different sites, whereas repeat sections are constructed at the same site, such as the control sections. This description implies a “replicate” is the smallest experimental unit to which the experiment factors can be independently applied. Random assignment of design, environmental, or traffic load factors is not possible here since they are fixed by climate and demographic characteristics of the country. However, they form the basis of the design that should strive to achieve a wide numerical range of these factors and also combinations of low and high values with other factors.

Maximizing numerical properties of the design matrix is important to obtaining results related to their effects on pavement performance. In the experiment design, these factors are defined as the “between” site factors, which have the important characteristic that pavement design, environmental, and traffic conditions (which can only have one specified level for each factor for all 6 or 7 sections within each site) apply to all test sections built at the site. In this case, the location of the test site case becomes the experimental unit.

A “repeat” (identical test sections built within the same site) is known as pseudo-replication. Although it could be useful for evaluating measurement error, an all too common mistake is to incorrectly consider two or more identical test sections from one location as if they were multiple experimental units. Statistical computations from data obtained through pseudo-replication typically underestimate the error term and inflate the denominator degrees of freedom for statistical tests. The impact is that confidence intervals are too narrow and p-values are smaller than they should be resulting in an increased chance of making Type I errors (i.e., falsely rejecting a true null hypothesis) or detecting treatment differences as false positives.

The control test section at each project site plus those test sections that have not yet received treatment (number will decrease with time) are considered as repeats in these experimental designs and they will be used to measure within-site variation, which for some sites may be substantial over a cumulative length of several miles. Sections repeated within a site that specify different treatments as a within-site factor would be ideal, though practical time and resource limitations of this study prevent this type of design. Within site comparisons will then be limited only to what occurs with one treatment over time, that is, the effect of accumulated environmental factors and traffic on pavement performance over time.

Replication of environmental and traffic conditions at two or more locations permits more accurate estimation of the variability for effects of the between section factors. Proper estimation of experimental error to include differences due to location makes the results relevant to a wider inference space. This feature is crucial in inferential statistics in order to compare both main and interaction effects and to estimate standard errors and their resulting confidence intervals and p-values for differences in factor means.

The recommended SPS-12 experimental design matrix is discussed later in this chapter include replication of the primary tier factorials. Replication here implies obtaining two locations with similar characteristics of pavement design, traffic, and environmental conditions; however, the actual numerical values may vary between them to an unknown extent. A minimum of two projects will be recruited for each combination of primary tier factorials of climate and traffic, but more than two replicate projects will be considered for inclusion in the LTPP program. The matrices indicate balance of the overall experiment with the factors represented, but does not prevent or limit additional replicates from being included in the program.

The ability to include replicates within the SPS-12 experiment will depend on the required time and resources, which is beyond the scope of this report to define. They will be based on the LTPP program budget in the coming years as well as the interest demonstrated by the SHAs in support of the experiment.

Supplemental Test Sections

LTPP SPS experiments to date have encouraged the use of supplemental test sections by sponsoring SHAs. The SPS-12 experiment is no exception, but given its approach, the incorporation of supplemental test sections will not be as straightforward as with other experiments. Nonetheless, the use of supplemental test sections to expand the experiment to address items of interest and/or concern as well as incorporate other preservation technologies is highly encouraged. This is especially true in light of the focus of the core experiments in terms of pavement types and treatments. As with the core experiment test sections, responsibility for construction of the supplemental test sections will fall on the sponsoring SHAs. However, this enables participating highway agencies to conduct field research of interest to them.

Various examples of supplemental test sections that could be included in the SPS-12 experiment are listed below:

- Addition of Supplemental Test Sections (Option 1) – At core projects that have been accepted for inclusion into the SPS-12 experiment, agencies can incorporate supplemental test sections that consider the exact same factors addressed by the core test sections for the single treatment under consideration at that project, but the treatment for the supplemental test sections is placed at different times as those for the core test sections. For example, if diamond grinding is applied to the core test sections in years 0, 4, 8, 12 and 16 after inclusion in the LTPP program, then the agency could opt for the application of the same treatment at supplemental test sections in years 2, 6, 10 and/or 14.

- Addition of Supplemental Test Sections (Option 2) – At core projects that have been accepted for inclusion into the SPS-12 experiments, agencies can incorporate supplemental test sections that consider factors not addressed by the core test sections for the single treatment under consideration at that project. For example, at the joint penetrating sealer projects, Silane products are required for the core test sections. The agency could choose to include supplemental test sections that use Siloxane and/or Silicone products at the same times as the core test sections. Other examples include:

    - Diamond grinding using different diamond grinds or with or without sealant and/or using different sealants.

    - Joint sealing projects using different sealing material (silicone versus asphalt), using different frequency of application or using different base type (treated versus unbound).

    - Joint penetrating sealer projects using different penetrating products or different frequency of application.

- Addition of Supplemental Projects (Option 3) – Adjacent to projects that have been accepted for inclusion into the SPS-12 experiments or new sites, interested agencies could set-up supplemental projects that consider alternate preservation treatments or technologies enabling performance comparisons between treatments under the given site conditions. For example, an agency interested in comparing the performance of DBR and/or diamond grinding with DBR (supplemental studies) versus that of diamond grinding without DBR (core study), could establish a DBR project adjacent to the diamond grinding project, where treatments in the two projects are applied at the same time.

- Addition of Supplemental Sub-Experiments (Option 4) – If multiple agencies are interested in the same treatment (whether part of the core experiment but using different materials/ techniques or not), the establishment of one or more additional (supplemental) treatments could be considered. For example, a group of highway agencies may be interested in considering a preservation treatment not included in the core experimental treatments, such as spall repair of PCC pavements or DBR.

- Other examples (albeit more appropriately core experiment options) include:

    - Build the three core projects sections at one site; i.e., diamond grinding, joint sealer, and joint penetrating sealer projects.

    - Build time series of LTPP core test sections and build mirrored site using same time schedule, but alternative treatment to determine best treatment timing.

    - Add shadow set of core test sections that allow multiple treatments to be placed over time; e.g., place two treatments (one core test section and one supplemental test section) of the same type on two different test sections and at future time, place second treatment on supplemental test section so that multiple combinations over time can be used to extend study results.

In addition to the above supplemental test section options, it is important to highlight the following two considerations:

- If so desired, SHAs participating in the experiment will be afforded the opportunity to place more than one preservation treatment at one location. As such, these agencies are able to construct SPS-4 style projects, and the multiple treatments over time.

- Following-up on above bullet item, treatments that are going to be applied at a project on a given year must be constructed within a short period of time, preferably one week, to optimize LTPP resources.

In summary, a wide range of options exist for interested SHAs to incorporate supplemental test sections into the SPS-12 experiment, ranging from individual test sections to projects to full experiments. Moreover, these test sections can address the full spectrum of factors associated with preservations treatments, including materials, techniques, and timing.

Lessons Learned from Other LTPP Experiments

Another important set of considerations in the development of the SPS-12 experiment was the lessons learned from the SPS-3, SPS-4 and other LTPP experiments. Those lessons addressed in the development of the experiment design include:

- An experimental design for preservations treatments, where a core set of the same treatments were placed at each site has an issue with not being able to apply a specific treatment. In the SPS-3 experimental design, one of the core treatments was crack sealing. If the location designated for the cracking sealing section has no cracks to seal, which happened on SPS-3 sites, then the crack seal section becomes an anomaly. The lesson learned is that consideration of treatments appropriate to the pavement condition for pavement preservation activities must be considered in the experimental design.

- After initial construction of experimental treatments, it was difficult to get agencies to use a prescribed regimen on follow-up treatments. In the case of the crack sealing sections on SPS-3 sites, getting an agency to seal only the cracks on the crack sealing section and not any of the other sections at the site was nearly impossible because of the way maintenance type of activities are administered. The lesson learned is not to get too complex with prescribed treatments that are outside of normal agency practices.

- One often reported observation from previous preventive maintenance experiments was that chip seals worked well in states that regularly use chip seals and slurry seals worked well in states that regularly use slurry seals, etc. This is perhaps a reflection of the knowledge based on construction techniques developed by agencies, experience of pavement contractors in those states, and understanding what works well given available materials, climate, and traffic loadings. The lesson learned was that while development of national models has various planning applications, the desired outcomes of these types of studies are findings that State and districts within a State can use to improve their practice – i.e., Texas is not interested in what works well in Alaska.

- The standard 500-ft long LTPP test section was based on needs for mechanistic based structural analysis of pavement performance. This length can be too short for pavement preservation investigations. The exception to this rule is the 1,000-ft long Concrete Pavement Restoration (CPR) included in the LTPP SPS-6 experiment. These sections were designated to be double the length of normal LTPP test sections since they consisted of a mixture of preventive/preservation treatments to address specific distress condition at each site. The lesson learned was that test sections must be based on how the resulting data will be interpreted. Accordingly, while 500-ft long test sections were selected for the experiment, the lesson learned was considered when establishing test section lengths.

- The materials sampling and testing plan for the existing pavement structure at LTPP SPS-3 and -4 experiments relied exclusively on the associated LTPP test section. This meant that no cores were taken to document the thickness or structural properties of each individual preventive maintenance test section. All of the existing structural properties have to be inferred from the existing LTPP test section. There was one site in the SPS-4 experiment that has no associated LTPP test section; as a result, there are no measured layer structure or material properties in LTPP database and the test section was released from the program. The lesson learned from this experience was that every field pavement test section, including those located on the same construction project site, must have a rudimentary set of field cores taken at each end of the test section, if only to visually classify the material and measure layer thicknesses.

- When the performance of field test sections was analyzed within the context of formal statistical experiments, it was easy to miss the significance of outliers which do not follow trends. Case in point is the SPS-3 chip seal sections placed in Arizona. These chip seal sections exhibited advanced rutting whereas the adjacent sections with slurry seals and thin overlays experienced little to no rutting under the same traffic conditions. The lesson learned from these observations is that it is not possible to determine from statistical analysis of empirical observations of pavement condition time histories alone, why pavement behave as observed. This type of observation supports the need for supplemental monitoring studies to aid in the engineering interpretation of the performance of test sections that cannot be directly determined through statistical analysis techniques that are the underpinning of all statistical experiment designs.

- Recent findings in pavement preservation research related to slurry seals indicate that optimum levels of preservation were achieved from application of multiple treatments at distinct time intervals from initial construction date. To design a field experiment to discover optimal timing of single treatments, multiple applications of a single treatment, multiple applications of different treatments, and sequence of multiple treatments types to obtain optimum performance requires an impossible number of field test sections to cover the factor space.

- In the early LTPP SPS experiments, participating agencies were asked to fund materials testing on SPS sites and aid in collection of construction data. This resulted in a mixture of varying level of data completeness, availability, comparability, accuracy, and uniformity. The lesson learned from this experience was that the best way to promote data uniformity is for LTPP to fund and perform these activities using contractors subject to LTPP quality control and assurance requirements.

- One of the more unique activities performed on the LTPP SPS-3 and -4 experiments were tours of the active test sections by active national, federal and State agency engineers. While these groups were not supposed to compare the performance of different preventive maintenance treatments against other preventive maintenance treatments, this was about impossible to do since the main concern was what treatment works best. The lesson learned from this experience was that one of the fastest routes to implementation of research findings is to engage key State practitioners in the research process.

- Past LTPP field experiments were based on construction of the same pavement structures at a site which appeared to rely on an analysis of between test section performance at each site. What has been shown in analysis of these types of field experiments is that when differences are observed between the different treatments between different project sites, more information is needed to explain between site differences in performance. The lesson learned from this observation was that when more than one site is included in a field study, then measurement of factors such as traffic loading is required to explain possible site to site variations in performance.

- The thrust of the national LTPP experiments in the past was designed to discover universal effects such as climate, traffic load, materials, and soil type on pavement performance. In practice, SHAs have a limited set of these factors that are of concern to their business practices and engineering decisions. A lesson learned from past LTPP research was that while agencies can in some cases be persuaded to participate in national studies, they are more interested in participating in studies that lead to improvement in their practice.

EXPERIMENT DESIGNS

The objective of the SPS-12 experiment is to provide long-term performance data on in-service pavement test sections where controlled application of preservation treatments is monitored. The underlying concept is to apply the same treatment, at different times, on the same pavement structure to determine the effectiveness of a single application of a treatment as a function of pavement condition and time. This concept is designed to establish the impact of preservation treatments on pavement distress propagation rates, which in turn will enable identification of the most appropriate time to perform a treatment as well as the factors related to treatment timing.

To accomplish the stated objective, the experimental design consists of multiple experiments, where each experiment addresses a specific treatment. Those treatments or experiments, are:

- SPS-12G – diamond grinding of original dowelled jointed plain PCC construction.

- SPS-12S – joint sealing of original dowelled jointed plain PCC construction.

- SPS-12P – joint penetrating sealers for original dowelled jointed plain PCC construction.

Construction of the dowelled jointed plain PCC pavement should have been completed within the past 10 years for the diamond grinding treatment and within the past 4 years for the joint sealing and joint penetrating sealer treatments. However, consideration will be given to older pavements if faulting and/or roughness has not progressed too much for the diamond grinding experiment, if the pavement (and joint sealant, if present) condition is good for the joint sealing experiment, and if JAD has not progressed significantly for the joint penetrating sealer experiment. In the case of the joint sealing experiment, preference will be given to joints with no sealant or sealant in good condition.

The generic SPS-12 experiment project selection matrices are presented in figure 3 through figure 5. These matrices identify how to select project site characteristics with a design based on categorization that will be numerical data. To the extent possible, it is essential to select project sites with these characteristics that are substantially below or above the indicated numerical break-point for each factor. This will provide variability among the design factors, which in turn will help ensure that the available data will efficiently achieve the experiment objective. In addition, it is highly desirable that at least one project be nominated and constructed per cell and that there be replicate projects for each cell.

Each of the SPS-12 experiment projects will be located across North America, such that the appropriate range and distribution of climate (moisture and temperature) and traffic conditions are captured; these site factors are identified across the top of the matrix in figure 3 through figure 5. Besides these site factors, the other major factor incorporated into the experiment design was timing of treatment, which relates to both age and condition of the pavement structure.

	Wet				**Dry**				**Annual Precipitation**
	Freeze		**No Freeze**		**Freeze**		**No Freeze**		**Average Annual Freezing Index**
Treatment	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**Annual ESALs**
Diamond Grinding									

Figure 3. Illustration. SPS-12G experiment matrix: diamond grinding experiment.

	Wet				**Dry**				**Annual Precipitation**
	Freeze		**No Freeze**		**Freeze**		**No Freeze**		**Average Annual Freezing Index**
Treatment	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**Annual ESALs**
Joint Sealant									

Figure 4. Illustration. SPS-12S experiment matrix: joint sealing experiment.

	Wet				**Dry**				**Annual Precipitation**
	Freeze		**No Freeze**		**Freeze**		**No Freeze**		**Average Annual Freezing Index**
Treatment	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**Annual ESALs**
Joint Penetrating Sealers									

Figure 5. Illustration. SPS-12P experiment matrix: joint penetrating sealer experiment.

Within each of the SPS-12 experiments, there will be up to seven (7) core test sections broken into control and treatments test section (along with their timing) as follows:

- Diamond grinding: one (1) control test section and five (5) treatment test sections.
    - Control test section: no diamond grinding during life of test section in LTPP program.
    - Treatment test sections.

        - Diamond grinding at 0 years from inclusion (where inclusion is defined as date of project's formal acceptance into LTPP program).
        - Diamond grinding at 4 years from inclusion.
        - Diamond grinding at 8 years from inclusion.
        - Diamond grinding at 12 years from inclusion.
        - Diamond grinding at 16 years from inclusion.

- Joint sealing: two or three (3) control test sections and four (4) treatment test sections.
    - Control test sections.
        - No sealant during life of test section in LTPP program; if present, sealant will be removed from test section at time of inclusion.
        - Apply sealant to test section at time of inclusion and maintain sealant during life of test section in the LTPP program.
        - Keep sealant of test section as-is at time of inclusion; do not maintain. If there is no joint sealant present, this section is not included in the project.
    - Treatment test sections.
        - Apply capped sealant at 5 years from inclusion and re-cap at 5-year intervals.
        - Remove and replace sealant at 5 years from inclusion and replace at 5-year intervals.
        - Apply capped sealant at 10 years from inclusion and re-cap at 10-year intervals.
        - Remove and replace sealant at 10 years from inclusion and replace at 10-year intervals.
- Joint penetrating sealers: two or three (3) control test sections and four (4) treatment test sections.
    - Control test sections.
        - No sealant and no joint sealer during life of test section in LTPP program; if present, remove sealant from test section at time of inclusion.
        - Apply joint sealant to test section at time of inclusion and maintain sealant during life of test section in the LTPP program; do not apply joint penetrating sealer.

        - Keep sealant of test section as-is at time of inclusion; do not maintain or apply joint penetrating sealer. If there is no joint sealant present, this section is not included in the project.

    - Treatment test sections.

        - Apply sealer at 0 years from inclusion and reapply at 2-year intervals.

        - Apply sealer at 0 years from inclusion, but do not reapply over remaining life of test section in LTPP program.

        - Apply sealer at 5 years from inclusion and reapply at 5-year intervals.

        - Apply sealer at 5 years from inclusion, but do not reapply over remaining life of test section in LTPP program.

It is possible that the above timing schedule could change based on observed pavement conditions. For example, the timing schedule for diamond grinding could be accelerated (e.g., 0, 3, 6, 9 and 12 years from inclusion) if roughness deterioration rate is higher than anticipated (e.g., more than 5 IRI points per year). Alternatively, the timing interval between treatments could be increased (e.g., 0, 5, 10, 15 and 20 years from inclusion) if the condition of pavement remains stable. The need for change to the timing schedule will be identified by the LTPP Regional Support Contractors (RSCs). The RSCs will also address the associated changes in data collection and monitoring schedules.

The layout of the SPS-12 test sections within each core project is discussed in the next section. In addition to the core test sections, it is important to recognize that supplemental test sections are highly encouraged, and hence there may be more than the six or seven SPS-12 core test sections at a given project site.

PROJECT LAYOUT

Uniformity along the length of the SPS-12 projects is critical to the success of the experiment; i.e., same traffic, pavement structure, subgrade, and drainage conditions. Lane widening projects with traffic entry/exit points within its length are not suitable for the experiment. An ideal LTPP test section is illustrated in figure 6. Each test section is 1,250 ft long, with a 500-ft lead in, 500-ft monitoring section, and 250-ft leave zones. Directly next to each end of the monitoring section are two 50-ft buffer zones where destructive material tests, such as cores and test pits, and traffic monitoring scales are prohibited. Next to the buffer zones are material sampling areas where destructive samples are allowed. The treatments applied to each test section must cover the entire designated test section length.

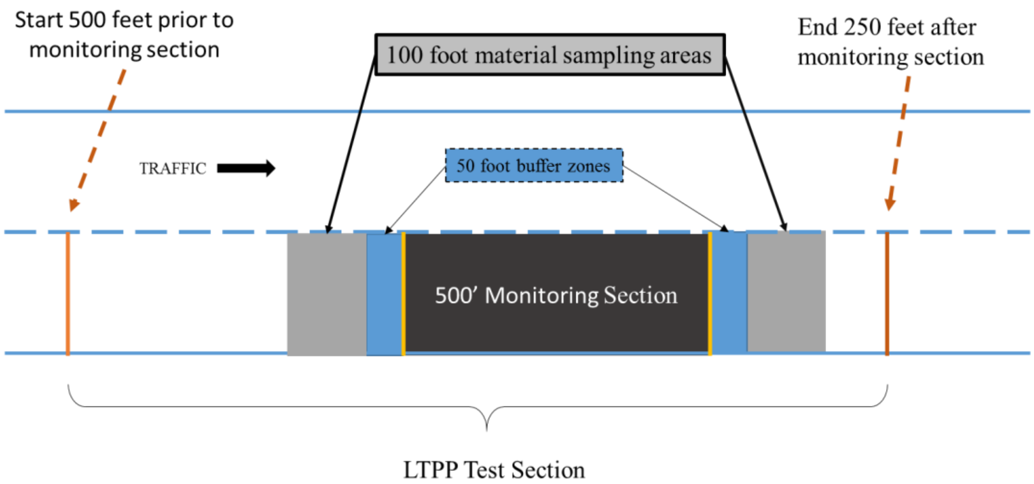

Figure 6. Illustration. Typical SPS-12 test section.

While the layout of test sections on a project site must be adjusted to site conditions, the rule of thumb is that about 1.5 mi of a relatively consistent pavement structure with little to no intersections, driveways, sharp horizontal curves, subsurface drainage features, bridges, speed limit changes, cut/fill transitions, vertical grades, or other features that could influence the performance of the test sections being studies is desired. This length could increase if agency specified supplemental test sections are proposed. In all cases, test sections are established in the outside lane for practical and safety reasons. Typical SPS-12 project layouts are shown in figure 7 through figure 9 for the diamond grinding (12G), joint sealing (12S) and joint penetrating sealer (12P) experiments, respectively. They are labeled as typical layouts because the order of the test sections can be altered on a project, but the number of core test sections must remain the same.

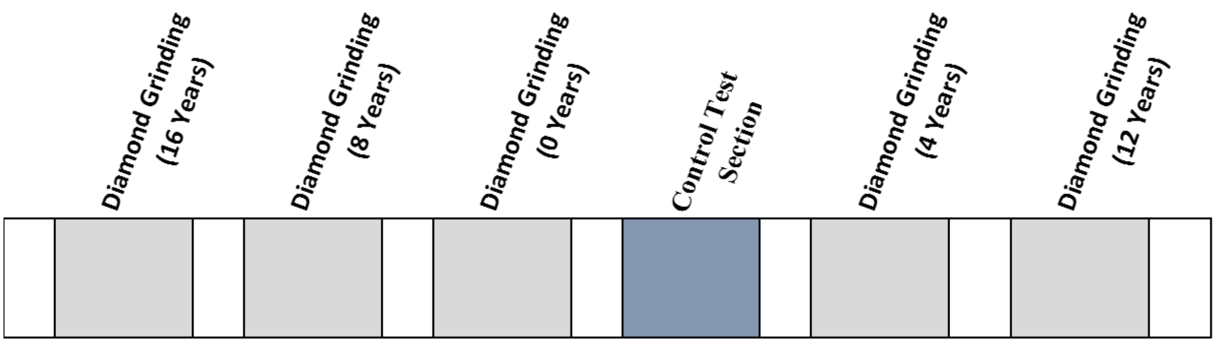

Figure 7. Illustration. Typical SPS-12G project layout: diamond grinding experiment.

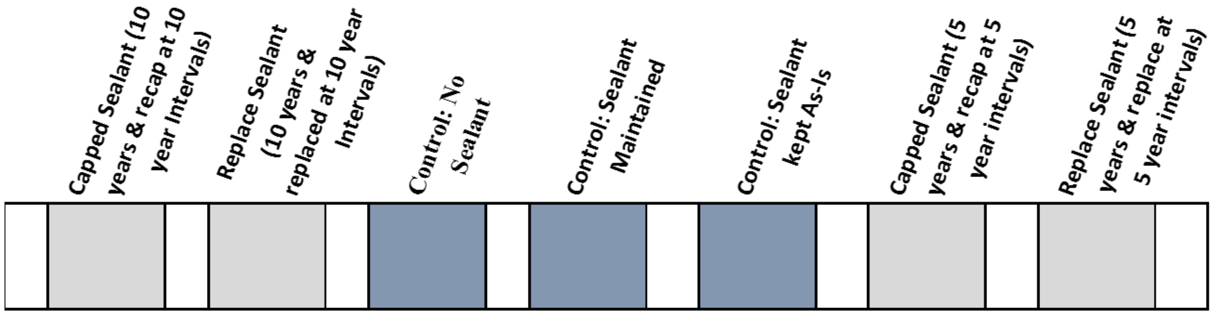

Figure 8. Illustration. Typical SPS-12S project layout: joint sealing experiment.

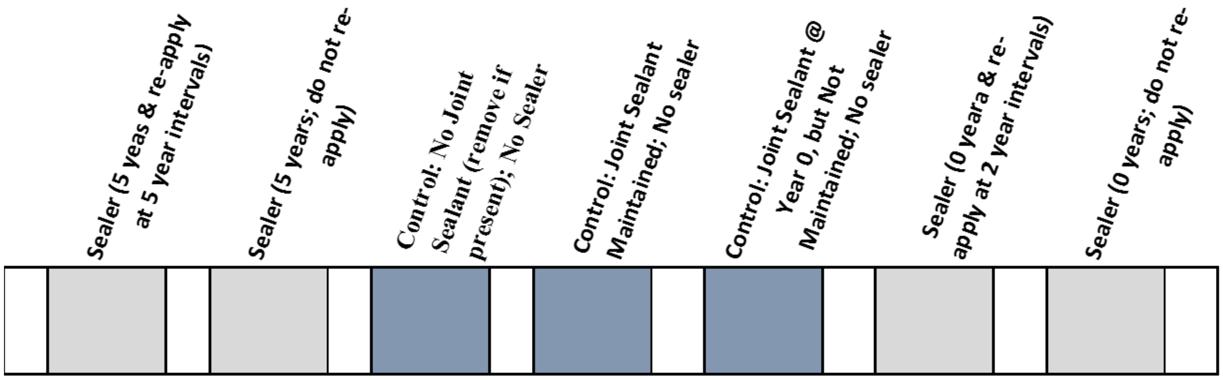

Figure 9. Illustration. Typical SPS-12P project layout: joint penetrating sealer experiment.

OTHER EXPERIMENTAL CONSIDERATIONS

Benefits to Participating Highway Agencies

The SPS-12 experiment, while being coordinated through the FHWA LTPP team, is to be conducted for SHAs. Therefore, the details of the experiment have been selected to address the needs of the highway community. However, the experimental rigor necessary to achieve the desired results requires that participating agencies agree to the same experimental factors and to construct the required test sections in a consistent manner. The statistical aspects of this experiment make the full cooperation of participating agencies crucial to its success. While all agencies will benefit from the information, knowledge and products that result from this research, participating agencies will accrue additional direct benefits. Since a portion of this research will be conducted in an agency's jurisdiction on test sections constructed using materials, specifications, and techniques employed by that agency and exposed to local climate and traffic loadings, participating agencies will be able to make direct use of the results.

The SPS-12 experiments will also allow SHAs the opportunity to quantify the performance differences associated with a given preservation treatment that depends on the timing of the application of the treatment, therefore addressing critical issues such as the right timing for the treatment and its associated benefits. In addition to these direct benefits, participating agencies will also receive ancillary benefits as a result of direct involvement in the experiment process including valuable insights and exchange of ideas through interaction with the FHWA team, researchers and highway personnel from other agencies.

Project Responsibilities

Participating Highway Agency

Participating highway agencies play a key role in the development and implementation of the SPS-12 experiments, including the following activities:

- Participation in experiment and implementation plans.
- Nomination of test sites.
- Provide inventory data for existing pavements.
- Preparation of plans and specifications.
- Selection of construction contractors.
- Materials sampling assistance, including coring and auguring activities.
- Conduct of JITT prior to construction of test sections.
- Construction of test sections.
- Construction control, inspection, and quality management.
- Collection and submission of traffic data.
- Provide snow removal and deicing information.
- Provide traffic control for test site data collection.
- Assistance with collecting and reporting as-built construction data.
- Conducting and reporting of maintenance and rehabilitation activities.
- Test section signs and markings and maintenance of those signs and markings.

A more detailed description of the agency participation requirements is provided in the Project Nomination Guidelines presented in the next section. In addition, the long-term commitment required of participating highway agencies cannot be emphasized enough.

FHWA LTPP Team Responsibilities

The primary role of the FHWA LTPP team is to provide coordination and technical assistance to participating highway agencies to help ensure uniformity and consistency in construction and data collection to achieve the desired study results. Some of the activities the FHWA team will be responsible for include:

- Development of experimental designs.
- Coordination among participating agencies.
- Validation of in situ conditions at site, including GPR surveys that will be performed by a specialty contractor.
- Final acceptance of nominated test sites.
- Development of uniform data collection guidelines and forms.
- Coordinating and conducting of materials sampling and testing.
- Collecting and time-series reporting of as-built construction data.
- Periodic monitoring of pavement performance, including surface distress surveys, deflection testing and surface profile and texture surveys.
- Collecting snow removal and deicing information from participating highway agencies.
- Support of SHA traffic data collection activities, including technical support and data quality reviews.
- Development and operation of comprehensive database and data entry platform.
- Control of data quality.
- Data analysis and reporting.

PROJECT NOMINATION AND ACCEPTANCE PROCESS

A comprehensive set of guidelines and accompanying forms were developed to support the SPS-12 project nomination process and that information is detailed in this section. The project nomination and acceptance process is coordinated between FHWA, the SHAs, the RSCs, and the Technical Support Services Contractor (TSSC). The project nomination and acceptance process for each SPS-12 project site consists of the following steps:

1. Highway agency reviews project requirements and nominates project site for inclusion in the study. Highway agencies are encouraged to contact LTPP RSC personnel to assist in the site selection process.
2. Highway agency fills out and submits project nomination form to FHWA LTPP staff; see appendix A.1 to this report.

3. FHWA LTPP staff reviews project site nomination and, if needed, contacts highway agency to resolve questions and issues. LTPP staff submits project site nomination and recommendation on acceptability of proposed project site to FHWA staff.

4. FHWA staff provides preliminary approval of project site and informs interested state highway agency.

5. On-site review and pre-acceptance testing (distress survey, deflection testing, profile survey, and GPR survey) are performed by LTPP staff (with traffic control support from highway agency) on project site that has received preliminary approval.

6. Adjustments to project site location details and final acceptability recommendation are made by FHWA LTPP staff.

7. FHWA staff make final decision on acceptance of project site and informs highway agency as to acceptability of project site.

Highway Agency Participation requirements

Highway agencies considering participating in the SPS-12 experiment must be willing to perform the following activities:

- Prepare plans, specifications, quantities, and all other documents necessary as part of the agency’s contracting procedure. The agency must also provide construction control, inspection and management in accordance with their standard quality control and assurance procedures. LTPP RSC staff will be on-site during construction to collect construction documentation required by LTPP.

- Construct the test sections described in the SPS-12 experimental design document detailed in this chapter. This includes placing the same pavement preservation treatments at different times on test sections located at a project site. The treatments should also be applied across all adjacent lanes over the length of each test section in the direction of travel.

- Provide and maintain signing and marking of test sites.

- Assist LTPP RSC staff with collecting and reporting project site information and construction data.

- Perform and/or provide for time-series drilling, coring and sampling of in-place pavement materials used in the test sections. Costs for this work are to be borne by the participating agency. LTPP RSC staff will be on site to perform sample logging and sample shipment. Testing of material samples will be performed by FHWA or its contractors.

- Provide traffic information. For an SPS-12 project site, a continuously operating permanent device for classification and weight data is required. This level of data collection is desired for two reasons: (1) to provide the accurate traffic loading measurements required to develop mechanistic and mechanistic/empirical design models and (2) to provide the base data necessary to understand the intricacies of the interactions among pavement, traffic load, and environment.

- Three years of continuous WIM traffic measurements followed by on-going vehicle classification measurements is required. The minimum recommended traffic data collection effort for each site is two weeks of continuous classification data, four times per year (a total of eight weeks of classification data per year). It is the agency's responsibility to ensure representative data is collected that accounts for seasonal variation, weekday/weekend differences, and inconsistent truck loading patterns throughout the year.

- When nominating a project location, consideration should be given to the location of existing WIM equipment. Sites where existing WIM equipment can be used to capture the traffic loading would allow for traffic data to be captured without the installation of additional equipment.

- Provide periodic traffic control for on-site data collection activities performed by agency and LTPP RSC staff, such as drilling and materials sampling, distress surveys, deflection testing, and other monitoring activities.

- Coordinate maintenance activities on the test sections to prevent application of premature treatments that alter the characteristics of the test sections and limit their use in the study.

- Notify LTPP RSC prior to the application of overlays or other such treatments when any of the test section reach an unsafe condition or become a candidate for rehabilitation. As much lead time as possible is needed to allow recording of the terminal condition of the test sections.

If highway agency personnel would like to discuss the details of these participation requirements, they should contact the LTPP RSC for their region. Again, the long-term commitment required of participating highway agencies cannot be emphasized enough.

Project Selection Criteria

The following criteria will be considered in evaluating candidate projects for inclusion in the SPS-12 experiment:

- Desired pavement structure is a structural plain jointed PCC pavement with doweled joints, joints are oriented perpendicular to the slab edge, stabilized non-erodible base (asphalt treated base preferred), and PCC shoulders. The structural PCC layer must be the exposed surface layer; milling of an existing AC overlay is not acceptable. There are no minimum thickness requirements for the PCC surface layer. In the case of the joint sealing experiment, preference will be given to joints with no sealant or sealant in good condition.

- The original construction of the PCC surface layer must have been completed within the past 4 years for the joint seal and penetrating sealer studies (SPS-12S and -12P), and within 10 years for the diamond grinding experiment (SPS-12G). However, consideration will be given to older pavements if faulting and/or roughness has not progressed too much for the diamond grinding experiment, if the pavement (and joint sealant, if present) condition is good for the joint sealing experiment, and if JAD has not progressed too much for the joint penetrating sealer experiment.

- The pavement surface should be in good condition and preferably have no visible surfaces distresses, such as cracks or patches. For practical measures, good condition metrics include:

    - Cracking limited to less than 5 percent combined by area (assume a 0.5-ft width for linear cracks).

    - Rutting on the PCC surface layer less than 0.1 inch. This can include either a straight edge or wire line reference rut depths.

    - Faulting less than 0.1 inch, except for the diamond grinding experiment.

    - None to limited signs of JAD for the joint penetrating sealer study (12P). If the former, defensible basis for anticipating distress will manifest itself at project site.

    - Ride quality, as measured by the IRI index, should be less than 120 inches/mile for the diamond grinding study (12G) and less than 80 inches/mile for the joint seal/sealer studies (12S/12P).

- The construction project must be of sufficient length to accommodate all of the experimental test sections. An ideal test section is 1,250 ft long, whereas a practical minimum is 800 ft long. Thus, the seven core test sections require a segment length between 1.5 to 2 mi, where the properties of the pavement along that length are as similar as possible in terms of layers types, layer thicknesses, drainage features, and subgrade. A longer length is needed if supplemental test sections are proposed.

- Traffic flow should be uniform over the length of the project. All sections should carry the same traffic stream and be located in the same direction of traffic. Intersections, rest stops, on-off ramps, weaving areas, quarry entrances, etc., should be avoided on and between test sections on a project.

- Test sections should be located on portions of the project which are relatively straight and have a uniform vertical grade. Horizontal curves greater than 3 degrees and vertical grades greater than 4 percent should be avoided.

- The entire length of each test section should be located completely on either a cut or a fill. Cut-fill transitions or side hill fills should be avoided within the monitoring portion of each test section.

- Culverts, pipes and other substructures beneath the pavement should be avoided, but if required they should not be within the limits of the monitoring portion of a test section.

- Road sections with added lanes, added shoulders, or that have been widened are not desirable for the SPS-12 experiment.

- The project pavement must not have curb and gutter within 6 ft from the outside edge of the pavement adjacent to the test lane.

- The test sections must be located in the outside lane.

These criteria will help identify projects in which the relative performance of the test sections is due to the timing of the placement of the preservation treatments, and the influence of other factors such as changes in the existing pavement structure, subgrade, traffic patterns, and drainage characteristics is minimized.

Test section homogeneity is important to the success of the experiment. Construction history records, while valuable, often do not fully reflect the variability of in-service pavements. It is requested that the agency evaluate the homogeneity of potential projects prior to nominating them, and include the evaluation results with their submission. Tools to evaluate homogeneity include distress surveys, FWD testing, and GPR testing. As noted earlier, LTPP will also perform preconstruction tests on proposed sites to aid in determining test section locations and assessing the uniformity of the proposed site.

It is recognized that projects containing all of the desirable characteristics are not always readily available. Each candidate site will be evaluated individually to determine the extent of compliance with the desired criteria and usefulness to the experiment. Deviations from the desired project characteristics may be necessary in order to obtain sufficient projects for the experiment. For example, projects will be considered where it is not possible to locate all of the test sections completely in either cuts or fills. In this case, it may be necessary to locate some test sections in cuts and others in fills. Also, on a project in rolling terrain, with limited distance between intersections, it may be necessary to locate a test section over a shallow cut-fill transition (less than 10 ft difference). Generally, engineering judgment will be used to evaluate the impact of such non-uniformities on test section performance.

The criteria presented in this section will be used to evaluate and rank candidate projects in cases where more than the required number of projects are available. They can also be used as a guide by a highway agency to identify candidate projects in their jurisdiction that are most suitable for nomination.

Special consideration will be given to projects sites that include test sections that are located near existing or previous LTPP projects or test sections as well as to those project sites that incorporate more than one SPS-12 experimental treatment.

Candidate Project Nomination Forms

The forms and instructions provided in appendix A.1 should be used to complete a set of SPS-12 candidate project nomination forms. One set of forms is required for each SPS-12 project site being nominated.

CHAPTER 3. CONSTRUCTION REQUIREMENTS

This chapter addresses construction-related elements critical to the success of the SPS-12 experiment. The first of those elements is construction guidelines, checklists and JITT, which are critical to minimizing variability associated with the application of preservation treatments at a given project site over time as well as from one project to another, which could otherwise make analyses of the data more difficult and complex.

The second element addresses the construction-related data requirements, including those prior to construction, during construction, and after construction. The third and last element addresses the requirements associated with the construction reports for each SPS-12 project, which provide valuable information to users of the LTPP data.

CONSTRUCTION GUIDELINES

For those treatments included in the SPS-12 experiment, a combination of national and local specifications have been established. National specifications address general construction and workmanship requirements – e.g., use of hot applied (not silicone) sealants, and type of diamond grinding cutting heads to be used and their spacing. Local specifications, on the other hand, pertain to specific construction and workmanship requirements – e.g., locally available asphalt sealant material will be used and agencies will control, as much as possible, material sources.

This section discusses the guidelines and specifications recommended for placement of the SPS-12 treatments. The guidelines address the many issues related to construction, workmanship, and construction specifications that can affect the outcome of the experiment. It includes not only the types of guidelines available, but also other considerations to minimize the variability of the treatments, which will be applied over time. To the extent possible, the guidelines and specifications presented in this chapter should remain the same over time.

Diamond Grinding

Guidelines for performing diamond grinding have been developed by several agencies, but the most important ones are those developed by AASHTO, FHWA National Concrete Pavement Technology (NCPT) or International Grooving and Grinding Association (IGGA). [6, 7, 8] Diamond grinding can be done in conjunction with DBR or by itself. Self-propelled machines equipped with diamond blades and spaces mounted on a spindle to provide the desired pattern are used. It is important that the SPS-12G experiment limit as many variables as possible. Some of the factors to consider are listed below:

- Similar cutting heads and spaces for each of the SPS-12G projects. The cutting heads are typically spaced in the range of 50-60 blades/ft depending on the hardness of the aggregate.
- Grinding should be performed continuously along the traffic lane for best results
- Because of the relative narrow width of the cutting head, more than one pass is required per lane. It is recommended that a 1-inch overlap be maintained between adjacent passes.

- Ride quality measurements in terms of the IRI need to be taken before and after the grinding operation. The measured IRI value after grinding should be 100 inches/mile or less.

Most highway agencies will use their own specifications for construction of the SPS-12G project test sections, but there are guides and/or sources of information that can be used to provide uniformity in the application of these treatments. Table 6 summarizes some of these sources for guidelines and/or best practices. It is recommended that the AASHTO construction guide and FHWA inspection practices be followed for the SPS-12G experiment. (6, 9) Both contain information to ensure good quality products.

Table 6. Construction guidelines and/or best practices for diamond grinding.

Agency	Title	Reference
AASHTO	Construction Specifications for Diamond Grinding	Section 560, Diamond Grinding of Concrete Pavement, Guide Specifications for Highway Construction, AASHTO, 2008 (6)
NCPT Center	Concrete Pavement Preservation Guide, 2nd edition, Chapter 9	FHWA Publication No. FHWA-HIF-14-014, September 2014 (7)
IGGA	Conventional Diamond Grinding for Pavement Preservation	IGGA, 2014 (8)
FHWA	Checklist for Diamond Grinding, PPC 107	FHWA/FP2 (9) https://www.fhwa.dot.gov/pavement/preservation/ppcl00.cfm

Joint Sealants

Guidelines for the placement of joint sealants for concrete pavements will rely on the work by AASHTO and the FHWA NCPT. (10, 11) It is important that the SPS-12S experiment limit the number of variables as much as possible. Some of the factors to consider are listed next:

- After the sealant material has been selected, careful attention must be paid to the installation procedures to ensure performance of the sealant. For the SPS-12S experiment, the type of sealant used should be as uniform as possible to reduce the efforts of this variable. The types of sealants commonly used by agencies include hot applied/ thermoplastic sealants or cold applied thermo-setting sealants (e.g. Silicone). It is recommended that the hot applied sealants be used in this study. Silicone sealants can be considered for the supplemental studies.

- The AASHTO construction guides contain information on the proper way to clean the joint, make sure the reservoir for the sealant is proper, and contains the necessary language to install the sealant.

- Proper seal application is a process that relies heavily on the care of the contractor. Paying close attention to application quality during construction greatly increases the changes of minimizing premature failures.

- Permeability tests should be performed on the joint-sealant system at various times after installation. Field measurements using the Texas A&M joint infiltration or flow (Falling-Head Permeameter) test are recommended for measuring the effectiveness of the sealants; this test is discussed in more detail later in the report as well as in appendix B.5.

- Since sealants will be placed over time, this will introduce other variables including the type of sealant and the sealant contractor who places the product. It is desired that the highway agency control, to the extent possible, the sealant type source, but it is anticipated that they may not be able to use the same contractor for subsequent applications of the joint sealants.

Most highway agencies will use their own specifications for construction of SPS-12S project test sections, but there are guidelines and/or sources of information that could be used to provide some uniformity in the placement of this treatment. Table 7 summarizes some of these sources for guidelines and/or best practices. The AASHTO specifications should be the minimum requirement for placement and the inspection checklist developed by FHWA should be followed as well. [10, 12] As noted earlier, hot applied joint sealants should be the primary sealant used in the SPS-12S experiment.

Penetrating Sealers

Penetrating sealers have been used widely in the midwest to prevent chlorides (salt water) from penetrating into the concrete at the joints. (See references 13 through 18.) Without such sealers, the joint deteriorates either from the top or the bottom of the slab resulting in significant distress and often the need for the removal and replacement of the joint. Other ways of minimizing the damage are to modify the mix design and ingredients used in the concrete. This latter treatment works for new concrete, but not for preservation.

Sealers, however, can be used on both new and old concrete pavements. The types of sealers studied in the lab and in the field include Silanes, Siloxanes, and Soy products used as pore blockers and water repelling materials. One of the major issues with the use of these products is that specifications are not readily available from AASHTO or FHWA. Therefore, the experiment will need to rely on specifications used in the midwestern States. A limited number of specifications exist currently for applying these products; e.g., the Nebraska, Illinois and Michigan DOTs. A consolidation of several State guides as well as the specifications from Michigan DOT for Silanes are provided in appendix B.2.

Table 7. Construction guidelines and/or best practices for joint sealants in concrete pavements.

Agency	Title	Reference
AASHTO	Construction Specifications for Joint Sealants	Section 553, Resealing Joint, Liquid Sealant, and Section 555, Resealing Joint, Silicone Sealant, Guide Specifications for Highway Construction, AASHTO, 2008 (10)
NCPT Center	Concrete Pavement Preservation Guide, 2nd edition, Chapter 10 Survey on Joint Practices	FHWA Publication No. FHWA-HIF-14-014, September 2014 (11) http://www.cptechcenter.org/ncc/F2015%20NCC/Masten-NCC%20Joint%20Sealing%20Survey.pdf
FHWA	Checklist for Joint Sealants, PPC 106	FHWA/FP2, 2003 (12) https://www.fhwa.dot.gov/pavement/preservation/ppcl00.cfm

It is important that the SPS-12P experiment limit the number of variables as much as possible. Some of the factors to consider are listed below:

- Determine the most promising sealers to be used in the SPS-12P experiment. Research done to date has focused on Silane, Siloxane, and Silicone sealers. Silicone sealers have been shown to be not as effective as the others. Some of the States (e.g. Indiana) no longer specify these products because of the volatile organic compound (VOC) content. As a result, they are evaluating the use of a blend of Silane with differing percentages of alkylsilane and a new product Soy Methyl Ester (SME) containing 5 percent Polystyrene. At this time, it is recommended that Silane products be used for the main study while other products could be used in supplemental sections

- It is important to measure the penetration depth of the sealers as well as its permeability or ability to prevent salt water from entering the concrete. Permeability tests will be required on the sealed concrete at various times after installation. This, in turn, will require samples of the concrete at the joint to be periodically taken and tested for permeability and other properties in the laboratory.

Considerable research on these products has been completed in the midwest at Purdue, Iowa State, and Michigan Tech Universities. The best information on this Silane product can be found in a TechBrief developed by the Seal No Seal group titled “Use of Silanes for Sealing Joints in Concrete Pavements.” (15)

JUST IN TIME TRAINING (JITT)

Contractor and Highway Agency Training

Training on the construction of the various treatments is essential to the success of the SPS-12 experiment. While many of the treatments have been placed for many years, the quality of the finished product depends on good construction practices and having good quality control programs for the contractors as well as a well-defined inspection program for agency personnel.

Where available, AASHTO guidelines for construction should be used in the JITT program and the FHWA inspection checklists should be used as training guides for the agency personnel to ensure that the products are placed in the most appropriate manner.

Quality contractors are also a must to ensure the placement of good treatments. Low bid contracts can result in contractors that do not place quality treatment. Every effort should be made to ensure that the contractors that are placing the treatments over time are certified and can place a quality product. If possible, all contractors should be certified in placing these treatments.

The training will be the responsibility of the participating agencies and it should be included in the contract price for placing each of the treatments. This will be the simplest and best approach for including the cost of the training.

Delivery

All training should be conducted by a qualified instructor or instructors just prior to the construction of the treatments. The contractor and highway agency inspectors should attend this training. It is recommended that the training take place over a period of 2 to 4 hours for each treatment.

It is important that the instructor or instructors be qualified to deliver training for each of the treatments. It may involve someone from a highway agency and/or a contractor who has been qualified prior to the training. The approval of the training staff will have to be discussed at more length before a recommendation can be made as to their selection.

CONSTRUCTION DATA REQUIREMENTS

A key component of achieving the objectives of the SPS-12 experiment is to develop and execute a construction monitoring plan capable of tracking and collecting the construction data for the selected pavement preservation treatments. The guidelines for collecting construction data and the periodic collection of monitoring data are described in this section. Detailed construction information (in text as well as tables and figures) are to be collected including, at a minimum, the following elements:

- Construction documents pertaining to the project. This will include the following (if available):
    - Plans, Specifications, and Special Provisions.

    - Strip charts during production.

- Condition of the joints prior to applying joint sealants or penetrating sealers needs to be determined.

- Equipment used to diamond grind and to collect the waste material need to be identified. For the joint sealant and penetrating sealers, the equipment used to place the sealant and sealer are required.

- Materials used for the joint sealant and penetrating sealer studies need to be provided including materials sampling and testing data sheets.

- Field QC test results performed by the agency or contractor. This should also include:

    - Daily log of activities/equipment/weather.

    - Daily field notes from personnel on-site.

    - Texture after the diamond grinding needs to be recorded and for the joint sealants and penetrating sealers studies, application rates should be collected.

- Copies of the layouts from the MS&T Plan. This shall include a copy of the "as-sampled" layout from the MS&T Plan used in the field and the original designed MS&T Plan, with any differences noted between the two plans.

Much of the construction data collected will be recorded by the LTPP RSCs with support from the participating agencies in the construction data sheets provided in appendix A.2. The remaining construction data collected will be included in construction reports to be prepared by the LTPP RSCs in accordance to the guidelines provided in the next section. Again, construction data are important information to assess the effectiveness of pavement maintenance. [(3)]

The SPS-12 data sheets include items for identifying general project and section specific attributes, as well as many layer and material specific items. The construction data sheets listed in table 8 were developed for the SPS-12 experiment. These data sheets and the instructions for completing them are included in appendix A.2. Supplemental sections may contain treatment types for which the SPS-12 data sheets are not adequate to record the necessary information about these treatments. For these sections, additional data sheets from the "LTPP Maintenance and Rehabilitation Guide," addressed under LTPP directive, should be used to supplement the SPS-12 data sheets. This guide contains further information on which sheets are appropriate for each construction event type.

Table 8. List of LTPP SPS-12 data sheets and titles.

LTPP SPS-12 Construction Data Sheet Number	LTPP SPS-12 Construction Data Sheet Title
LTPP SPS-12 Data Sheet 1	Project Identification
LTPP SPS-12 Data Sheet 2	Project Stations
LTPP SPS-12 Data Sheet 3	General Information
LTPP SPS-12 Data Sheet 4	Layer
LTPP SPS-12 Data Sheet 5	Age and Major Improvements
LTPP SPS-12 Data Sheet 6	Snow Removal/Deicing
LTPP SPS-12 Data Sheet 7-8	HPMS Data Items
LTPP SPS-12 Data Sheet 9	PCC Aggregate Properties
LTPP SPS-12 Data Sheet 10	PCC Mix Design
LTPP SPS-12 Data Sheet 11	PCC Strength
LTPP SPS-12 Data Sheet 12	PCC Construction
LTPP SPS-12 Data Sheets 13-14	PCC Joint Data
LTPP SPS-12 Data Sheets 15-17	AC Aggregate Properties
LTPP SPS-12 Data Sheet 18	AC Binder
LTPP SPS-12 Data Sheets 19-20	PMA Lab Mix Design
LTPP SPS-12 Data Sheet 21	PMA Lab Mix Design Warm Mix
LTPP SPS-12 Data Sheets 22-23	PMA Mix Prop
LTPP SPS-12 Data Sheet 24	Superpave Mixture Properties
LTPP SPS-12 Data Sheets 25-26	PMA Construction
LTPP SPS-12 Data Sheets 27-28	Unbound
LTPP SPS-12 Data Sheets 29-30	Subgrade
LTPP SPS-12 Data Sheet 31	QC Measurements
LTPP SPS-12 Data Sheet 32	Field Thickness
LTPP SPS-12 Data Sheet 33	Notes and Comments
LTPP SPS-12 Data Sheet 34	Improvement Listing
LTPP SPS-12 Data Sheet 35	Diamond Grinding
LTPP SPS-12 Data Sheets 36-37	Joint Sealant Application
LTPP SPS-12 Data Sheet 38	Penetrating Sealant Application

SPS-12G Diamond Grinding

The construction related data required for the SPS-12G diamond grinding projects are presented in table 9. Multiple references could be utilized when developing a diamond grinding project. (See references 6 through 9.) The collected data are grouped in three categories: before construction, during construction, and after construction.

Table 9. Construction data collection for diamond grinding.

Before Construction	During Construction	After Construction
• Plans, Specifications, Special Provisions • Pavement condition prior to the treatment • Construction schedule • Existing ride quality • Existing pavement condition (cracking, faulting, joint load transfer efficiency) • Equipment specifications • Manufacturers' instructions • Diamond grinding design (depth and spacing) • Existing Surface texture • Hardness of existing concrete pavement surface • Verify that the pavement profiler meets requirements of the contract documents	• Daily construction logs from the contractor and engineer • Contractor information including description of equipment on site • Field QC test results • Any construction issues or problems • Verify the depth of grind and surface texture depth • Verify the sizes of land and groove • Verify the proper transverse slope (tolerance between passes – transverse straightedge) • Diamond ground texture meets smoothness specifications (before and after smoothness levels (IRI)) • Concrete slurry is adequately vacuumed and removed • No icy weather condition during diamond grinding	• Annual snow removal/deicing information • Annual precipitation information • Smoothness measurement • Pavement condition assessment

SPS-12S Joint Sealants

The construction related data required for SPS-12S joint sealants are presented in table 10. Multiple references could be utilized when using joint sealants. [10, 11, 12] The collected data are grouped in three categories: before construction, during construction, and after construction.

Table 10. Construction data collection for joint sealants.

Before Construction	During Construction	After Construction
• Plans, Specifications, Special Provisions • Pavement condition prior to the treatment • Construction schedule • Detailed materials information • Existing condition (crack severity and extent) and presence of existing sealant • Surface preparation prior to treatment (sidewalls, method of cleaning) • Cleanliness and joint reservoir dimensions • Manufacturer's sealant installation instructions • Agency application requirements • Equipment inspection and calibration	• Daily construction logs from the contractor and engineer • Contractor information including description of equipment on site • Field QC test results • Any construction issues or problems • Reservoir dimensions for the sealant • Method of removing old sealant is appropriate • Bond breaker size and type • Type and properties of sealant • Chemically curing sealants are within shelf life • Sufficient quantities of all materials are available • Application rate	• Annual snow removal/deicing information • Annual precipitation information • Smoothness measurement • Pavement condition assessment • Permeability of joint

SPS-12P Penetrating Sealers

The construction related data required for SPS-12P penetration sealer projects are presented in table 11. Multiple references could be utilized when using penetrating sealers. (See references 13 to 18). The collected data are grouped in three categories: before construction, during construction, and after construction.

Table 11. Construction data collection for penetrating sealers.

Before Construction	During Construction	After Construction
• Plans, Specifications, Special Provisions • Pavement condition prior to the treatment • Construction schedule • Detailed materials information • Existing joint condition and cleanliness • Needed surface preparation prior to treatment • Manufacturer's sealer installation instructions • Properties of sealer	• Daily construction logs from the contractor and engineer • Contractor information including description of equipment on site • Field QC test results • Any construction issues or problems • Type and properties of sealer • Sealers are within shelf life • Sufficient quantities of all materials are available • Application rate • Permeability of joint • Size and shape of joint	• Friction in the area of the seal • Annual snow removal/deicing information • Annual precipitation information • Smoothness measurement • Pavement condition assessment • Permeability of sealed joint

CONSTRUCTION REPORTS

A lesson learned from construction of the SPS-1 through -10 experiment projects is the importance of having project-specific construction reports. Further, having standardized report elements helps the entire pavement community in comparing projects to one another and to the original experiment design. Accordingly, guidelines for what should be included in each SPS-12 construction report were developed.

Construction reports for all projects accepted into the SPS-12 study will be prepared by the LTPP RSCs following the guidelines contained in this chapter. Because of the time-based approach to the experiment, an initial construction report will be completed after the initial application of a preservation treatment, in accordance with the guidelines presented in this chapter. The report will then be updated, as appropriate and as needed, each time a project test section receives application of the preservation treatment under investigation at the site. Special attention will be given to ensuring that test section specific information is clear for all test sections in the project. Both the original and updated construction reports will be provided to FHWA for review and comment.

Report Specifications

All reports will be prepared in accordance with the FHWA Communications Reference Guide (CRG). These documents are considered as research reports and will follow the guidelines contained in chapter 5 of the CRG for Research Reports. A Times New Roman 12-point font will be used for all text. Contractors' names may not appear in the report, except in block 9 of the Technical Report Documentation Page (form DOT F 1700.7). Contractor logos should not appear at all, and paid consultants should not be acknowledged anywhere else in publication.

The following list provides the required elements for each SPS-12 Construction Report:

- Front Cover.
  - Front cover.
  - Inside front cover (R&D Foreword and Disclaimer Notice).
- Front Matter.
  - Technical Report Documentation Page (Form DOT F 1700.7).
  - SI/Metric Conversion Chart.
  - Table of Contents (preferably auto-generated using the MS Word Style feature).
  - List of Figures (preferably auto-generated using the MS Word Style feature).
  - List of Tables (preferably auto-generated using the MS Word Style feature).
  - List of Abbreviations and Symbols.
- Body of Report.
  - Chapter 1: Introduction.
  - Chapter 2: Project Description.
  - Chapter 3: Construction Details.
  - Chapter 4: Summary.
  - Chapter 5: Key Observations.
- Back Matter.
  - Appendix A: Construction Photographs.
  - Appendix B: Mix Designs.

- Appendix C: Materials Sampling and Testing Layouts.
- Appendix D: Other Construction Documents.
- Appendix E: Complete Set of SPS-12 Construction Forms.
- Appendix F: Deviation Report (if any).

- Back Cover (blank).

The minimum contents for each element of the report are described next.

Front Cover

The front cover page will use the current LTPP research report cover design. RSCs will obtain the current cover format from their LTPP Contract Officer Representative at the start of creation of each construction report. The title of the construction report will include the official reference and title of the SPS-12 study, name of participating highway agency, short name for project location and other elements required by the FHWA CRG.

Front Matter

The front matter will include the latest Technical Report Documentation Page (Form DOT F 1700.7), SI/metric conversion chart, table of contents, list of figures, list of tables, and abbreviations and symbols.

Body of Report

The body of the report will contain the following chapters, in the specified order, whose content will include the following elements as a minimum, but can also include other information of significance based on the RSC's judgment.

Chapter 1: Introduction

The following overview will be included in the introduction of each SPS-12 Construction report.

General Overview of SPS-12 Study

Pavement preservation is a technology that has been around for many decades and it has been proven, mostly anecdotally, to be an effective approach to extend pavement's effective service life, improve safety and service condition, and is cost-efficient. Given the current economic environment, most highway agencies are embracing pavement preservation, which utilize more cost-effective techniques to better serve the public.

Because pavement performance is at the heart of the pavement preservation decision-making process, provision of long-term performance data on in-service pavement test sections where controlled application of pavement preservation treatments are monitored is the motivation for the LTPP experiment titled the SPS-12: PCC Pavement Preservation Study. The objective of the

SPS-12 experiment is to establish the impact of timing of preservation treatments on pavement distress propagation rates, which will enable determination of their impact on pavement life extension and performance. In turn, this information and understanding will enable determination of the right timing and cost-effectiveness of preservation treatments.

The SPS-12 experiments are intended for test sections not previously in the LTPP program. As such, all construction activities, materials properties, and sampling over the entire history of the roadway on which the test sections are located will be documented in this report.

Specific Project Summary Overview

Included in the introduction of the construction report will be a summary overview description of the project that includes, as a minimum, the following basic information:

- Location details that include route designation, direction of travel, and Highway Performance Monitoring System (HPMS) functional classification.
- Existing pavement structure and history of pavement construction events at the site.
- Total number of experimental test sections constructed.
- Types of preservation treatment(s) used.
- Agencies standard preservation treatment specifications for the project site.

Report Organization

A brief description of the report organization will be included to provide a summary of the report sections/chapters and their respective contents. For example:

- Chapter 2 of this report gives the project location, description, and other attributes of the project.
- Chapter 3 describes the materials and construction procedures for each layer and then continues to the detailed construction sequence and operations.
- Chapter 4 provides a summary of the test section construction.
- Chapter 5 contains a documentation of the key observations.
- Appendix A contains a collection of construction photographs from the project.
- Appendix B contains the treatment requirements for each section.
- Appendix C contains the materials sampling and testing layouts.
- Appendix D contains construction documents including the plans, specifications, mix designs and special provisions of the project; strip charts during production; project

related correspondence; and daily logs and field notes of activities, equipment, and weather.

- Appendix E contains the SPS-12 Construction Forms.
- Appendix F contains the Deviation Report (if any).

Chapter 2: Project Description

The project description will include basic information on the project with the use of text as well as tables and figures. It will serve as an introduction to the specific SPS-12 experiment. Project information will contain, at a minimum, the following:

Test Section Layout

Include one or more figures that show the test section layout, stationing, transition areas, pavement layers, intersections, ramps, driveways, bridges, subsurface drainage features, nearby bodies of water, etc.

Physical Attributes

The report should include the physical attributes of the project (i.e. project location, surrounding terrain, road geometry, existing pavement condition, etc.). The highway, interstate or state route, the nearest township/city, and the Global Positioning System (GPS) coordinates will be described. A figure of the location of the project on a map will be included. Also included should be the immediate terrain (rolling hills, flat, etc.), embankments, cuts, side-slope cut/fill, cut/fill transitions, etc. The description of the pavement should include the structure, layers, maintenance and rehabilitation history, shoulder types, lane and shoulder width, horizontal curves, pavement cross slope, super-elevation transitions, vertical grades, and condition. The existing pavement condition should also be included. The existing pavement condition should also be included; condition will be presented in terms of distresses, transverse profile, longitudinal profile, and texture at each test section location.

Climate

Summary climate statistics will be presented for the project location that include as a minimum:

- Average annual precipitation.
- Average annual freeze index.
- Annual hours of sunshine.
- Average annual relative humidity.
- By month, average daily high air temperature, average daily low air temperature, average precipitation, average snowfall, average relative humidity and hours of sunshine.

- The location of the climate statistics.

Traffic

To provide a brief overview of the traffic conditions of the project, a table should be used to describe the AADT of the project site in each direction. The table should also include the percent of heavy trucks and combination vehicles in the LTPP test lane. Finally, the table should include the estimated cumulative 18,000 ESALs and the design traffic data for the project, which may include 18K ESAL applications, traffic load spectra, assumed growth rates, etc. If load spectra traffic data are available, they will be described in this section and included in an appendix.

The traffic monitoring measurement plan during the performance observation period will be described in as much detail as possible. The plan should indicate the type of monitoring equipment, equipment location, sampling time intervals, calibration details, and other information that will assist in proper interpretation of the resulting traffic monitoring data.

Supplemental Test Sections

Sponsoring agencies have the opportunity to expand the experiment to address their own interests and concerns as well as to incorporate innovative technology through the construction of supplemental test sections. If supplemental test sections are included in the project, a brief overview will be included that includes all of the information noted for the core test sections.

Project Personnel

The project personnel involved should be noted, including personnel from the governing agency, and construction contractor(s). The agency should be noted along with the personnel from the project including the resident engineer for the project, the assistant resident engineer, the inspector(s) and their responsibilities, the field sampling and testing crew, and others involved with the coordination and execution of the project. The prime contractor should be noted along with the project manager and construction superintendent. Also included with the prime contractor should be the subcontractors, if used, and the aspects of the project they were tasked with, respectively. When possible, include pictures of project personnel in a report appendix, but only with the permission from the personnel involved. The figure title will identify people in each picture.

Project Timeline

A project timeline will be presented, which documents the date and time of significant events in the implementation of the project site. Such events include as a minimum:

- Dates of preconstruction distress, profile, and deflection measurements.
- Date of start of associated construction activities as it relates to each test section.
- Traffic closure.

- Pre-treatment construction activities including patching, shoulder restoration, maintenance actions, etc.
- Quality control tests.
- Start and finish of treatment application activities.
- Traffic opening date/time.
- Dates and time of material sampling including cores, bulk materials from mix plant, etc.

Chapter 3: Construction Details

Detailed construction information – in text as well as tables, figures, and pictures – will be provided including, at a minimum:

- Work activity dates, including pre-treatment work such as patching and crack sealing.
- Description of equipment on-site.
- Detailed materials information (designs should be included in appendix B).
- Field QC test results performed by the contractor.
- Acceptance testing performed by the agency.
- Section by section construction details including construction issues or problems.

All pictures will include global coordinates and timestamps in the electronic metadata stored in the electronic picture file.

Chapter 4: Summary

The summary chapter will be an overview of key project details and construction activities. It will note the number of LTPP test sections within the project, the highway, interstate or state route number, and the nearest city where the project was located. A brief recap of each section's attributes will also be included. Attributes to include will be pavement thicknesses, preservation treatment used, and pre-treatment preparation activities performed. Also included will be the project's beginning construction date and ending construction date. Finally, any construction issues encountered will be included, with a more detailed description included in chapter 5.

Chapter 5: Key Observations

This chapter will capture noteworthy observations by test section. It will also document issues encountered during construction, including, but not limited to equipment breakdowns, weather and/or material variability, experiment deviations, or other details that may be important to understanding the resulting performance of the experimental test sections.

BACK MATTER

This part of the report includes the appendices.

Appendix A: Construction Photographs

Appendix A will contain photos of each section before, during, and after application of treatment. Photographs of the treatment application operation will also be contained in this appendix. All pictures will include GPS coordinates and timestamps in the electronic metadata stored in the picture file.

Appendix B: Treatment Requirements

Appendix B will contain complete treatment information and requirements for the project (core and supplemental).

Appendix C: Materials Sampling and Testing Layouts

Appendix C will contain copies of the layouts from the MS&T plan. This will include a copy of the "as-sampled" layout from the MS&T plan used in the field and the original/design MS&T plan, with any differences noted between the two plans.

Appendix D: Other Construction Documents

Appendix D will contain other construction documents pertaining to the project. This will include the following (if available):

- Plans, specifications, mix designs, and special provisions.
- Strip charts during production.
- Project related correspondence.
- Daily log of activities/equipment/weather.
- Other available construction information.
- Daily field notes from personnel on-site.

Appendix E: SPS-12 Construction Forms

Construction data for the SPS-12 experiments include primarily items related to the preservation treatment technologies and their application. Copies of the construction data forms and notes collected for the project will be contained in this appendix.

Appendix F: Deviation Report

Include the deviation report, if applicable.

CHAPTER 4. MATERIALS SAMPLING AND TESTING PLANS

A material 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 properly 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 and other soils information can help determine the location of cut/fill sections and possible variations in subgrade materials.

Detailed instructions and guidelines for developing and implementing MS&T plans are provided in this chapter. The chapter also addresses new MS&T protocols that are not presently in use by the LTPP program, but which are important to the success of the SPS-12 experiment.

MATERIALS SAMPLING AND TESTING OVERVIEW

The following is the general process to be used to obtain and report the necessary materials information from SPS-12 projects:

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

- Formulation of a field materials sampling and test plan. This plan should take into account site conditions and the laboratory material testing requirements. An adequate number of samples must be obtained to assure that all laboratory material characterization tests can be performed, as well as to provide additional samples for storage in the MRL.

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

- Development of field sampling and testing protocols for all materials. All field tests and sampling must be performed in accordance with LTPP standard protocols and reported on standard LTPP data forms, which are contained in appendix A.3.

- Testing of material samples in the laboratory. All tests must be performed in accordance with LTPP test protocols and reported on standard LTPP data forms. Because the SPS-12 experiment involves new materials tests or protocols, these protocols are included in appendix B of this report.

- Compilation and storage of data. This will include compilation of field sampling, field testing and laboratory material test data and entry of this data into a LTPP database.

The primary objective of the materials and sampling and testing plans is to identify the sample needs and tests to support the LTPP SPS-12 pavement preservation effort. As such, it includes materials and sampling and testing for the following situations for the SPS-12 experiment:

- Prior to construction.
- During/post construction of the treatments.

It also includes information dealing with the requirements for sampling for the MRL, including the necessary labeling and shipping requirements for the samples.

Finally, information describing the laboratory sampling and testing of the existing pavement materials and the preservation treatments used for the SPS-12 experiment is also described. The remainder of this chapter covers the following:

- Sampling requirements.
- Test methods including LTPP protocols.
- Identification of new tests to be used as a part of this study.
- Sample handling, labeling and storage procedures.
- Estimated costs for the sampling and testing.

MATERIALS SAMPLING AND TESTING REQUIREMENTS

The SPS-12 test sections will consist of pavement preservation projects on existing PCC pavements. Coring and auguring must be used to obtain samples of the existing materials. Sampling of the existing pavement materials can be performed prior to placement of the preservation treatments.

Preconstruction

The objective of the preconstruction sampling and testing is to characterize the material properties and subsurface condition of the existing pavement structure prior to application of the experimental treatments. The scope of the existing field material sampling and testing to be performed on SPS-12 projects includes the following:

- Layers to test.
- Sampling plan.
- Testing protocols.

Layers to Test

This section discusses the layers of the existing pavements to test for the SPS-12 projects.

Subgrade/Embankment

- Bulk sampling of the subgrade for material classification tests.
- Dynamic Cone Penetrometer (DCP) testing.
- Shoulder auger probe for sampling.

Base Layers

- Visual material classification.
- Bulk sampling for material classification tests.
- Layer thickness measurements.
    - From cores of bound base.
    - From auger holes in unbound base.
- DCP testing.

Existing PCC Layers

- Coring for thickness measurements.
- Coring for laboratory testing.

Overall Pavement Structure

- FWD/GPR to establish the structural condition of the pavement sections.
- Drainage survey to determine if water could be a problem within the sections.

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

Sampling Plan

In developing the field sampling plan for a SPS-12 site, it is imperative that a sufficient type and amount of samples be obtained to ensure completion of all test procedures as well as to provide additional samples for storage in the MRL. Therefore, a laboratory testing plan always needs to be tailored for specific site conditions in concert with the field material drilling and sampling plan. The plan needs to list the tests to be performed and the samples to be used for each test in a format similar to that shown later in this chapter. 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 test plan should address the testing requirements for both the primary SPS experiment test sections and the supplemental test sections.

The site-specific field material sampling, field testing, and laboratory testing plan for each SPS-12 site should include the following elements:

- Project layout plan.
- Detailed material sampling layout.
- Detailed field testing layout.
- Laboratory testing plan.

The field sampling 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 is required for each material layer, layouts must be developed for each layer (i.e., prepared subgrade, base course, surface course, and/or overlay).

Figure 10 illustrates an overview of the sampling areas to be used in developing a site-specific plan. This figure shows an ideal project location where all six defined test sections in the core SPS-12 experiment plan are located on a site that has uniform geomorphic characteristics along the entire test site. In this ideal example, all test sections are located on a consistent cut or fill, no cut/fill transitions occur between or within test sections, and no significant subsurface drainage structures exist. In this idyllic project overview, two types of sampling areas are identified.

- Travel lane sample areas. These are sample areas within pavement travel lane, where enough materials can be obtained to allow material characterization tests to be performed. From the sampling core, the thickness of each layer including PCC, bound or unbound base can be assessed.
- Shoulder probes. The purpose of the shoulder probes is to auger down to approximately 20 ft below the surface in order to discover near surface rigid layers, water tables, and locations to obtain sufficient subgrade samples to minimize repair requirements for subgrade samples obtained from cores through pavement surface. Where a project location includes both cut and fill test sections, adequate samples of the underlying subsurface pavement structure and documentation of subsurface features will be obtained.

In situations where the idyllic situation of uniformity along the project site does not exist, more samples should be taken to provide a proper representation of the project site for intensive pavement performance research analysis.

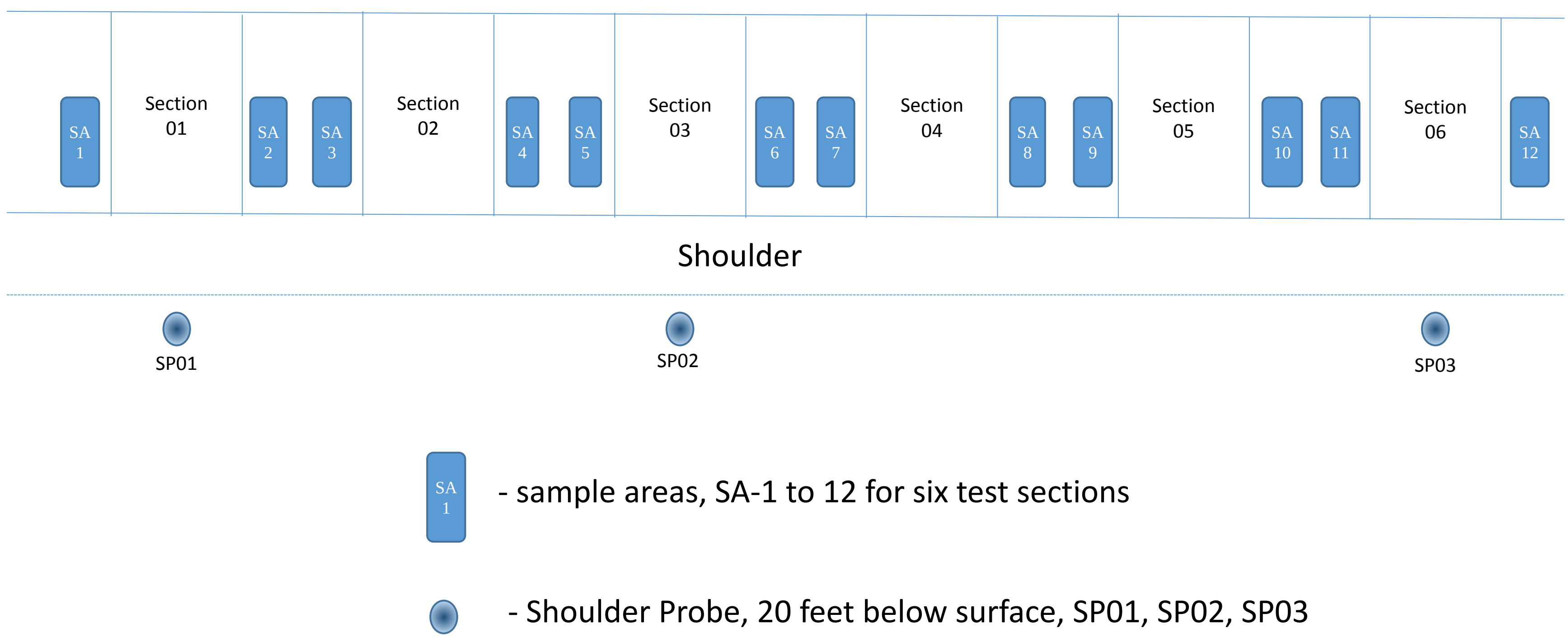

Figure 10. Illustration. Overview of SPS-12 project level sampling areas.

Figure 11 and figure 12 illustrate the sampling requirements at travel lane sample areas on the leave and approach side of a test section, respectively. The 4-inch cores will be used to obtain layer thickness information, concrete material testing, bulk specific gravity, and access to unbound layers for DCP testing. If needed, 6-inch cores can be used for DCP testing if the DCP test equipment requires a core hole greater than 4-inch diameter. The 6-inch cores will be used for both unbound materials and bound material testing.

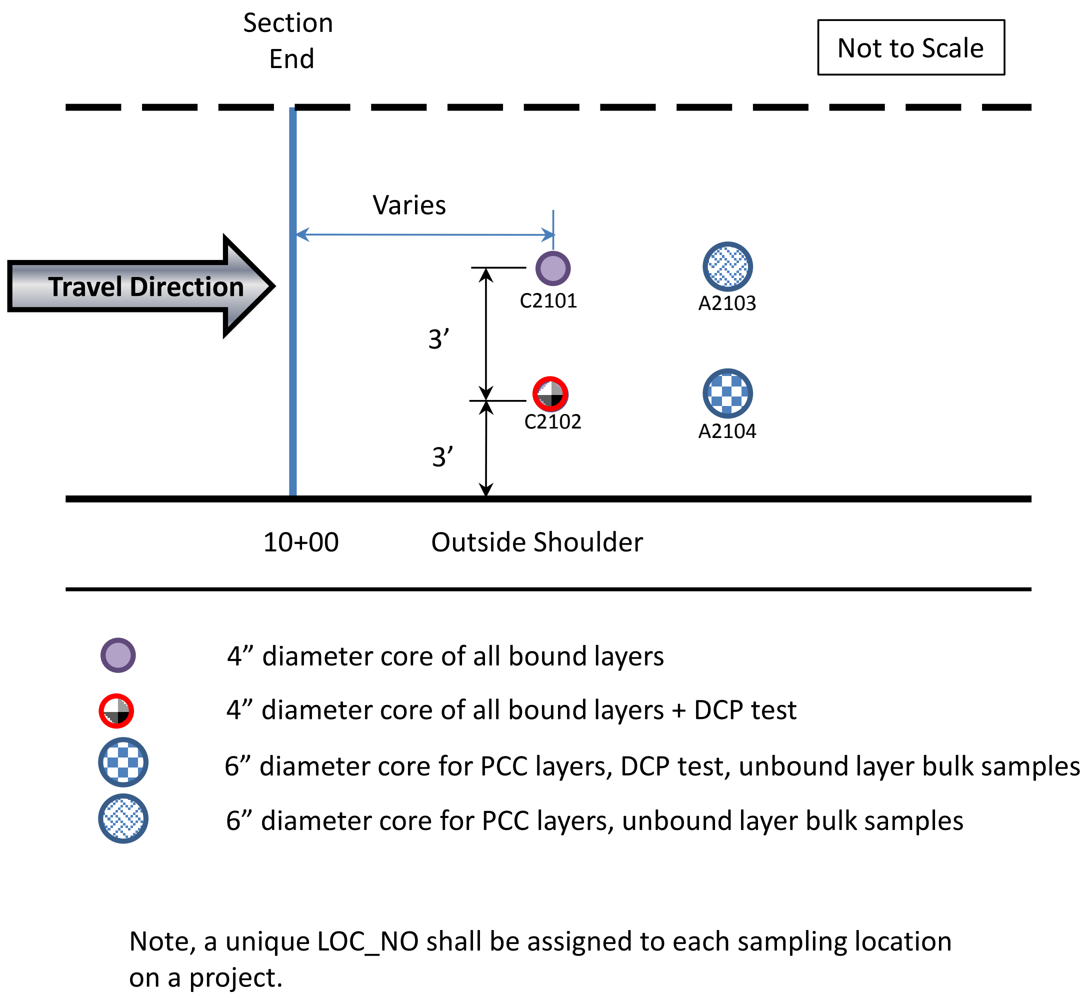

Figure 11. Illustration. Example sampling locations on leave side of test sections.

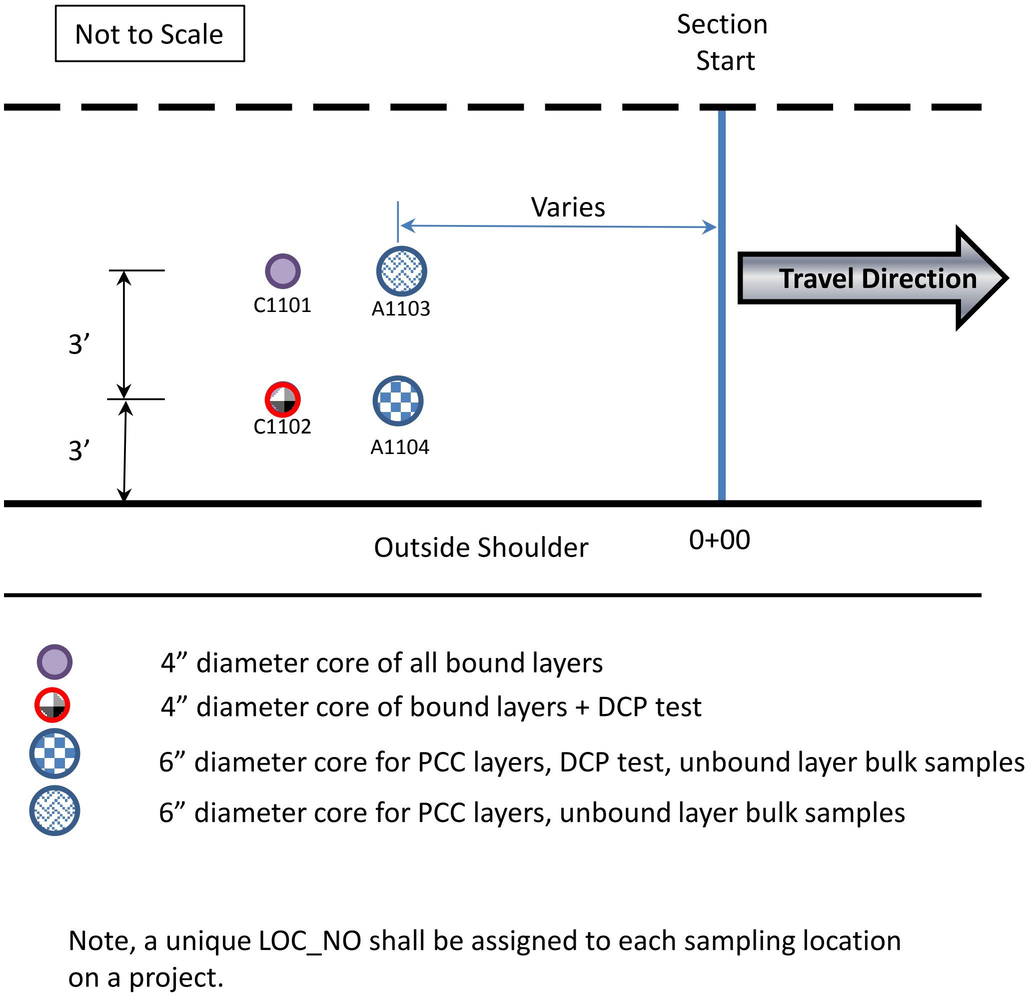

Figure 12. Illustration. Example sampling locations on approach side of test sections.

In addition, sample tracking tables specifying the sequence of tests to be performed on each material sample are needed. Other items that may be included with the plan are soil profile logs, plan and profile sheets, and other project-specific information which are pertinent to the plans. The recommended plan should be compiled and submitted for review and approval by FHWA prior to implementation.

To ensure consistency in data reporting, a detailed pavement layer structure should be developed prior to sampling and testing for the entire SPS 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 will have personnel on site during sampling activities who are familiar with the development of the plan, and who can make changes to the plan and data collection forms as well as to the layer numbering based on their observations. This will limit the need to re-sample any materials and allow assignment of LAYER NO while in the field. An example project level layer numbering is shown in table 12 for a newly constructed SPS-12 project.

Table 12. 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 Existing Binder Course
F	01	HMA Overlay 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 will contain an embankment layer. It must be noted that 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. Since this can vary over the extent of a test site, the sampling plan will also be tailored to site conditions based on an initial site inspection visit prior to developing the sampling and testing plan. Shoulder augur probes are used to supplement samples of subgrade materials obtained through core holes in the existing pavement and to investigate subsurface conditions such as rigid layers and near surface water table depths.

The layering for the bound and unbound bases and subbases is rather straight forward. However, if any test section is located on a treated subgrade layer, this is considered a treated subbase layer in the project layering table. Sampling in the transition areas at the beginning and end of the test section, along a project site, should be done to establish the variability in these materials.

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 chapter 5 of the latest version of the *Long-Term Pavement Performance Project: Laboratory Material Testing and Handling Guide*.[(19)]

Material Sampling and Test Requirements

All testing will follow the LTPP test protocols for testing the various layers in the pavement structure. This section identifies the types of tests to be used for the various layers in the SPS-12 experiment. Subsurface layers are all layers in the pavement structure beneath the existing pavement surface prior to placement of the experimental treatment layers. Subsurface layers will be sampled and tested according to their material type.

Subgrade

The subgrade is the natural soil under the pavement structure. This is always 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 of the regional engineers must be used to decide if sample 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

Bulk samples should be obtained for each project subgrade layer. If the subgrade layer is uniform throughout the project, only three subgrade samples are required. If the subgrade layer is found to be different for each section, additional samples will be needed. Bulk samples of the subgrade should be obtained by auguring through the sampling areas or shoulder augur probe locations, depending on conditions at each test site.

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 auguring should be 4 ft below the top of the natural subgrade or fill embankment material directly beneath the base and/or subbase layers. If rock, 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 will be made at a different location with a longitudinal offset of at least 2 ft. If rock, boulders or refusal is encountered at the second location, sampling will be terminated. The sampling operation should be performed following the procedures contained in the *Long-Term Pavement Performance Project: Laboratory Material Testing and Handling Guide*. [(19)] Each subgrade bulk sample should consist of a minimum of 150 lb of material. The bag will include a jar sample of the material for moisture content measurements. The jar sample will be placed in the bulk sample bag prior to the bag being tied shut.

Laboratory Testing

Laboratory tests to be performed on subgrade materials are shown in table 13, which includes the size of sample needed. All tests are to be performed using the indicated LTPP test protocol.

Table 13. Subgrade testing.

Sample Type / No. of Samples per test	Sample Location	Test Type	LTPP Designation	Min. No. of Tests for each project layer[1]
150 lb Sample	All A, BA and SP locations as appropriate	Sieve Analysis	SS01	3
		Atterberg Limits	SS03	3
		Classification	SS04	3
		Standard Proctor	SS05	3
		Resilient Modulus[2]	SS07	3
1 qt. Mason Jar		Natural Moisture Content	SS09	3

Note 1: Minimum number of tests per project layer.
Note 2: If Resilient Modulus cannot be run, an alternate method such as using back calculation can be used.

Dynamic Cone Penetrometer

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. As a minimum, DCP test should be performed at one location per test section, using one of the cores in the outer wheelpath. Testing is performed in accordance to LTPP Protocol P72 of the *Long-Term Pavement Performance Project: Laboratory Material Testing and Handling Guide*. [19]

Unbound Base Layers

Base and subbase layers composed of unbound materials should be sampled and tested following similar guidelines as those used for subgrade. These samples will be obtained from similar locations as subgrade samples. In the field, the thicknesses of these layers need to be determined in-situ, preferable through direct measurement from large diameter augur holes. The material tests are those required for classification, moisture density tests, and resilient modulus.

Bulk Sample

Bulk samples should be obtained for each project base and/or subbase layer. If the layer is uniform throughout the project, only three samples are required. If the layer composition is found to be different for each section, additional samples will be obtained by auguring through the 12-inch or 6-inch core holes. Sample combination may be needed to acquire the minimum of 150 lb of material for each of the three sampling areas.

Laboratory Testing

Laboratory testing to be performed on unbound base/subbase layers is shown in table 14. All of these tests are LTPP standards.

Table 14. Base/subbase testing.

Sample Type / No. of Samples per test	Location Number	Test Type	LTPP Designation	Min. No. of Tests per project layer[1]
150 lb Sample	BG010XX	Sieve Analysis	UG03	3
		Classification	UG08	3
		Atterberg Limits	UG04	3
		Standard Proctor	UG05	3
		Resilient Modulus[2]	UG07	3

Note 1: Minimum number of tests per project layer.
Note 2. In lieu of Resilient modulus test, back calculated modulus for these layers could be considered if regional contractor performs satisfactory backcalculation from FWD test results.

Thickness Measurement

The thickness of base layers must be obtained from inspection and measurement of the auger borings from auger sampling locations.

Bound (Treated) Base Layers

Cores of bound base layers should be obtained. Depending on the type of bound material, the laboratory test will either be AC01 and AC08 (AMPT) for high quality asphalt concrete base material, or TB01 for other types of bound bases. At least three tests should be performed per project layer; however more are desired to capture thickness variations. Laboratory testing requirements are shown in table 15.

Table 15. Bound base testing.

Sample Type	No. of Samples per Test	Sample Location	Test Type	LTPP Designation	Min. No. of Tests per project layer[1]
6” Core	1	All 6-inch diameter cores	Examination & Classification	TB01 or AC01	3
6” Core	3	All 6-inch diameter cores used for AMPT testing	AMPT Dynamic Modulus	AC08	3

Note 1: Minimum number of tests per project layer.

Existing PCC Layers

In general, samples of the sub-surface layers can be obtained from the same cores used to obtain samples of the experiment layer. The PCC cores should be taken as per the LTPP protocols given in the *Long-Term Pavement Performance Project: Laboratory Material Testing and Handling Guide*. (19) The required laboratory testing is shown in table 16.

Table 16. Testing on existing PCC materials.

Test Name	Test Designation	LTPP Test Protocol	No. of Cores	No. of Tests
Compressive Strength	PC01	P61	3	3
Split Tensile Strength	PC02	P62	3	3
Coefficient of Thermal Expansion	PC03	P63[1]	3	3
Static Modulus of Elasticity	PC04	P64	3	3
Core Examination & Thickness	PC06	P65	0	12
Air Content of Hardened Concrete	PC08	P68	0	3

Note 1: AASHTO T-336

At this time, it is not envisioned that any new tests will need to be performed on the existing PCC layer. Therefore, only the tests currently adopted are recommended.

During and Post Treatment Construction

The during/post construction phase of material sampling is defined as the time starting with placement of each pavement preservation treatment and ending one month after placement of each treatment. During construction, the focus of the test sampling and testing will be on the preservation treatments selected for testing. These will include the following, plus any additional supplemental sections a particular agency might want to include:

- Diamond grinding.
- Joint sealants.
- Penetrating sealers.

Diamond grinding

The field tests required for evaluating the effectiveness of the diamond grinding test sections will include measurements for ride quality, surface texture, and noise. For diamond grinding, the primary field performance test will be ride quality to determine the life extension of the preservation treatment. This should be run before and after the grinding and in each lane for the entire test section of the experiment. In addition, the surface texture and noise will be measured over time.

Otherwise, the only materials testing required for these sections will be on the following

- The hardness of the concrete prior to the grinding operation. The Mohs hardness scratch test is the tests recommended by IGGA.
- The surface texture of the concrete using either the sand patch test (ASTM E965) or the laser line test. [(20)]
- The ASTM method C856 title "Petrographic Examination of Hardened Concrete" is also recommended by IGGA. [(21)]

Joint Sealants

The products to be used for joint sealing may include both hot applied bituminous and silicon based products. The specifications which apply for these products are included in ASTM D 6690 title "Joint Sealant, Hot Applied Elastomeric-Type, for Portland Cement Concrete Pavements." [(22)] At the present time, there are no national specifications for Silicone products; therefore it is recommended that the hot applied products be use for the main experiment. Samples of the sealant materials will be tested to make certain the materials conform to the specifications

Penetrating Sealers

At this time, the material tests for the sealers will include those tests used to specify the products. Field tests to evaluate the effectiveness of the treatment will include tests for permeability of the concrete before and after treatment and the condition of the joint using the TTI camera test, which is discussed later in this report and in appendix B.4.

New Tests Needed

New test methods to be used in the SPS-12 experiment are identified in this section. These new test protocols are included in appendix B to the report.

Diamond Grinding

For the SPS-12 diamond grinding project test sections, new tests will be used to help select the best grind for the concrete surface. The tests include the following:

- Surface texture. ASTM E965, "Sand Patch Test" is the easiest, but consideration should be given to the portable line laser. [20, 24]

- Mohs hardness of concrete. This test is recommended by the IGGA prior to grinding to assist in developing the plan for the grinding process. [25] The test procedure is given in appendix B.3.

- Petrographic tests on the concrete (research tool only). The recommended test is ASTM C856-17, "Standard Practice for Petrographic Examination of Hardened Concrete". [26]

Joint Sealants

For the SPS-12 joint sealant project test sections, the new tests that should be considered include the following:

- Texas Transportation Institute (TTI) camera test to determine the condition inside the joints before the sealant is applied. The test procedure is given in appendix B.4. [27] This test needs to be done for SPS-12S test sections prior to application of sealant.

- TTI permeability test to evaluate the effectiveness of the sealant. The test procedure is given in appendix B.5. [28]

- ASTM tests for hot applied joint sealants or silicone sealants, including ASTM D-6690-15, "Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements" and ASTM D 5893, "Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements." [29, 30]

Penetrating Seals

For the SPS-12 penetrating sealer project test sections, the new tests will include the following;

- TTI camera test to determine the condition inside the joints before and after the sealer has been applied (see appendix B.4). [27] This test needs to be done for SPS-12P test sections prior to application of sealant.

- Sorption Test. ASTM C-1585, "Standard Test Method for Measurement of Rate of Absorption of Water by Hydraulic-Cement Concretes" will be used to measure the sorptivity of concrete, which has been conditioned to a constant relative humidity. [31]

- Chloride Ion Test. AASHTO T-259/ 260. This test is only applicable for new concrete that has not gone through a winter exposed to deicing chemicals. [32]

- Low temperature differential scanning calorimetry (LT-DSC). This test has been used in the Midwest. An AASHTO test procedure is currently being developed for this test, but it is not yet available. It may be available in 2017 or 2018, as the SPS-12 projects are included in the LTPP program.

- Assessment of joint damage. This test, still under development by Jason Weiss of Oregon State University, can be used on cores to evaluate the ingress and reaction with salts. [33] A draft procedure should be ready by the end of 2017.

FIELD MATERIALS SAMPLING

This section describes procedures and guidelines for field materials sampling, field testing and handling of cores and other material samples in the field and during transfer to the laboratory for testing. 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

The scope, intensity and time constraints imposed on the field coring and sampling for this SPS experiment are such that it is recommended that additional field personnel, above and beyond those needed for routine construction acceptance testing, be present on the site. These personnel should have sole responsibility for obtaining the necessary material samples, completing the necessary data sheets and forms, and performing the necessary testing. It is recommended that the field crew include a qualified and experienced on-site project supervisor who is experienced with LTPP sampling procedures and data collection and reporting requirements. 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, field coring and sampling techniques and the timing of all field activities.

Field Operations

Field operations at each SPS-12 project site will include the following activities:

- Prior to construction, 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 will be assigned to assist the participating highway agency and contractors to ensure that field operations are performed in accordance with the proper procedures and the field sampling and testing plan, and to perform all necessary written documentation.

- The joint field team will lay out the project site, mark initial sample locations and perform the sampling and testing operations. It is important to follow the sequence of boring as specified in the sampling plan to reduce the risk of mixing the 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.

- The LTPP field representative will record, report, and resolve problems encountered during the field operations.

- Test samples will be prepared for shipping together with complete logs and other records.

Collection of Samples, Marking, Packaging, and Shipping

Because of the research nature of this project, and because samples will be shipped over long distances, it is extremely important that the samples be packaged carefully. The samples will be packaged and preserved in accordance with Group B of ASTM D4220 - 95(2007). [34] Extreme care must be taken in packaging and shipping of test samples to eliminate damage to the samples or modification of their properties. General requirements for marking and packaging individual samples are as follows:

- Sample numbering systems (as provided later in this section).

- Indelible ink pens of black or other suitable color will be used for marking labels.

- Labels and tags will be of high quality moisture resistant material. It is recommended that labels be color coded to indicate the destination of the sample (e.g., contract Lab, FHWA Lab, MRL, etc.).

- Samples of portions of auger and bulk samples of materials to be used for laboratory moisture content determination will be plastic lined 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 for this purpose.

- Bags for large bulk samples will be heavy cloth, plastic lined with wire-ties for closing.

- Cores will be placed in “zip-lock” storage bags or other suitable material (e.g., heavy duty plastic or “bubble-wrap’ wrap) to ensure that they are sealed from moisture, then wrapped for their entire length with tape (e.g., plastic transparent mailing tape 2 inches 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 code format:

S-LL-XX

Where,

S = Sample location type:
- A – 6-inch diameter core and/or auger locations
- C – 4- or 6-inch diameter core locations
- BA – 12-inch diameter core and/or auger locations
- B – Bulk sample location
- F – field bulk HMA sample (uncompacted bulk mix obtained on site)
- T – nuclear density/moisture gage
- H – Samples obtained from the HMA plant
- AD – Distributor or applicator equipment
- TR – Delivery Truck

LL = Sample location number: two-digit sample number assigned sequentially to each location of the same type. Only a single location number is necessary for on-site, non-roadway bulk sampling locations (AD, TR)

XX = Section number: two-digit designation for test section number (e.g., 01, 02, and 03). This makes the sample location unique to that test section. For bulk samples not collected on site, use the first section number to which the materials apply.

Examples of valid sample location numbers are provided in table 17.

Table 17. Examples of valid sample location numbers.

Code	Detail
A0203	A-type core location 02 from Test Section 03.
C1003	C-type core location 10 from Test Section 03.
TR0101	Delivery truck for Test Section 01.
H0101	HMA Plant 1 used for the project for Test Section 01.

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, compacted) will be assigned a sample code 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 will consist of the following format:

S-M-##-XX

Where,

S = Sample type:
- C – core sample
- B – bulk sample
- M – moisture sample

M = Material type:
- A – Asphalt concrete
- C – Portland cement concrete
- T – Treated, bound, or stabilized base/subbase
- G – Untreated, unbound granular base/subbase
- S – Subgrade soil or fill material
- U – Aggregate
- E – Emulsified asphalt

= Sample number: up to a two-digit sample number assigned sequentially to each sample with the same sample type and material type.

XX = Section number: two-digit designation for test section number (e.g., 01, 02, and 03). This makes the sample location unique to that test section. For bulk samples not collected on site, use the first section number to which the materials apply.

Examples of valid sample location numbers are provided in table 18.

Table 18. Examples of valid samples code numbers.

Code	Detail
CA2402	Asphalt concrete core number 24 obtained from Test Section 02
CA0101	Asphalt concrete core number 01 taken from Test Section 01
CT0203	Treated base core number 02 from Test Section 03
BG0101	Bulk sample number 01 of granular base from Test Section 01. Assign numbers consecutively as samples are obtained from each test section, BG0101, BG0201, etc.
BA0102	Bulk sample number 01 of uncompacted AC from Test Section 02. Assign numbers consecutively as samples are obtained from each test section, BA0102, BA0202, etc.
BS0102	Bulk subgrade sample of material from Test Section 02. Assign sample numbers consecutively for multiple samples from the same test section.
MS0102	Subgrade moisture content sample number 01 obtained from bulk sampling location on Test Section 02.

Materials Tracking System – Hole ID and Specimen ID

The LTPP MTS is based on the use of a single, unique specimen identification number (SPECIMEN ID) for each test specimen. This identification will be directly written on the specimen (in the case of cores), or on the bag, bucket or can that contain the specimen in the case of bulk samples. While other identifying information, such as STATE_CODE, SHRP_ID, LAYER_NO, etc. may be transmitted along with the specimen, the SPECIMEN ID is intended to be the primary means of identifying the specimen in communications between RSC, lab and other stakeholders. The SPECIMEN ID will be assigned by the RSC. The first character of the SPECIMEN ID will indicate the RSC that assigned the SPECIMEN ID, in accordance with table 19.

Table 19. Specimen ID RSC codes.

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

This RSC identifier will be followed by five alphanumeric characters that form a unique sequence for the sampling location. It is not required that any specific information be encoded in this sequence, and it is up to the RSC to develop a system that ensures that this sequence be unique. This combination of the RSC code and five-character unique sequence is called the HOLE ID for specimens obtained by coring/boring. The final three characters of the SPECIMEN ID will be ‘L’ and the layer number corresponding to the specimen. An example is shown in figure 13.

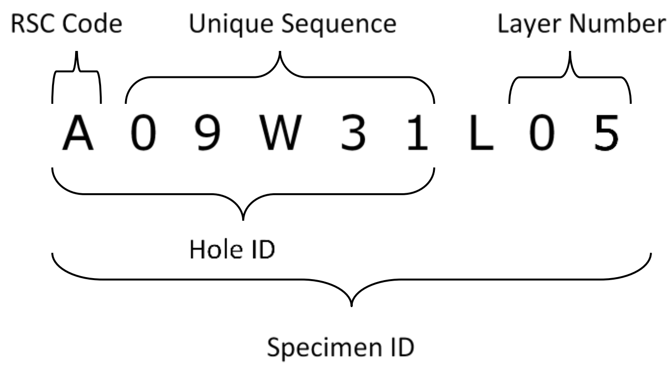

Figure 13. Illustration. SPECIMEN ID Diagram.

Plant specimens, such as 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 will be keyed to a single test section, and the layer number encoded in the SPECIMEN ID will be the layer number appropriate for that test section. An example “A” type core/boring location, “C” type core and bulk AC sample from the same hypothetical test section, along with example SPECIMEN IDs are shown in figure 14.

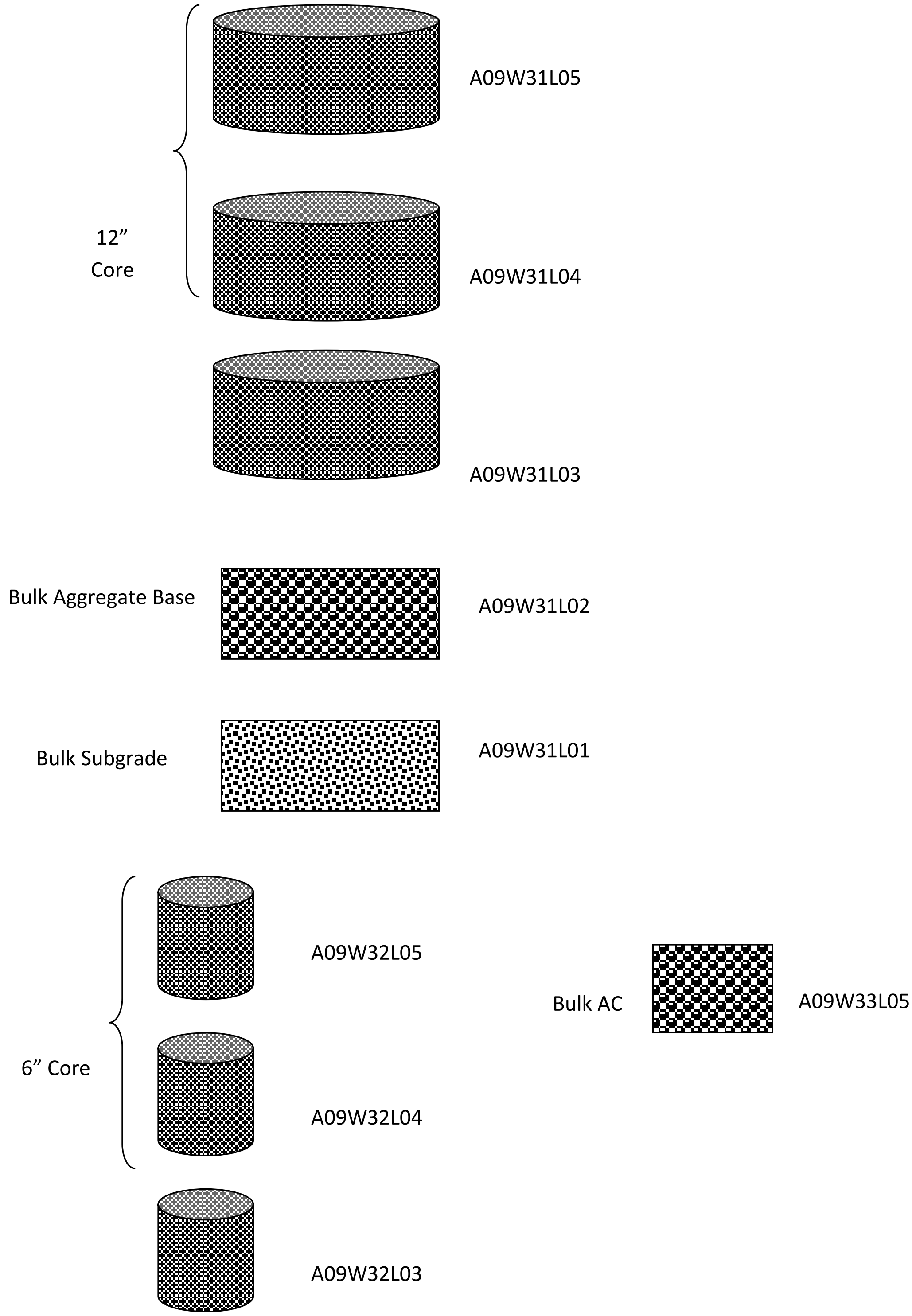

Figure 14. Illustration. Example SPECIMEN IDs.

Labels and Tags

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

- SPECIMEN ID.
- STATE CODE.
- SHRP ID.
- LOCATION DESIGNATION.
- SAMPLE NUMBER.
- DATE (mm-dd-yy, sampling date).
- FIELD SET (one digit number which will be 1 for the first round of sampling).

For cores, the HOLE ID will be written directly on the core. If the core contains more than one layer, layer boundaries will be clearly marked, and each layer numbered. For bulk samples, the SPECIMEN ID will be written directly on the bag, bucket or can that contain the sample.

Packaging

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

1. All samples of like material (e.g., asphalt concrete surface and binder) will be placed in separate boxes or separate compartments of one box.
2. Each sample will have a label or tag attached that clearly identifies the material. It is recommended that the label be color-coded by destination (e.g., contract Lab, FHWA lab, MRL, etc.)
3. Each core will be surrounded with "bubble-wrap" or other acceptable cushioning material on all sides within the shipping box.
4. All bulk samples will be marked with two labels or tags. One will be placed inside the bag and one attached to the outside. A jar sample for moisture testing of each bulk sample will be placed inside the bulk sample bag.
5. All shipping boxes should be wood of suitable grade and construction to withstand shipping and subsequent moving without breakage of the box or damaging of samples.
6. All boxes should be adequately secured by nails or screws prior to shipping.

Field Operations Information Sheets 1 and 2 will be sent with each shipment of materials samples.

Shipping

All samples should be shipped within five days to the laboratory designated by FHWA. Each box will be labeled to include the State Code, SHRP ID, type(s) of samples, box number (for each series of boxes for the specific project to each delivery point). The boxes should be labeled “Handle with Care” or similar wording. Samples will 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 will be sent to the appropriate RSC.

All of the above guidelines are designed to protect the integrity of the material samples to the highest degree possible within economic limits. 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 to the laboratory with a minimum of damage.

Patching and Clean-up

Following the completion of the sampling and testing of each layer, the sampling personnel will be especially careful to remove all debris created by the operations. Field sampling and testing personnel will also repair and restore all bulk sampling, auger probe, or coring locations, etc. by replacing all materials and compacting the layer as per the participating agency practice. The method of repair of each type of sampling area will 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. These are 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 insure the accuracy and integrity of the collected data, and to forward the data sheets to the appropriate personnel. This person must have a thorough understanding of 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 prior to forwarding the sheets to the appropriate personnel.

GPS Coordinates

A GPS measurement will be taken at each static sampling location. This includes cores, bulk samples of uncompacted mixture, bulk samples of asphalt cement, and in-situ density measurements. GPS coordinates are not necessary for locations that are mobile such as a haul truck or distributor. Sampling Data Sheets 2, 4, 8, 10, 10A, and 21 include fields for recording GPS measurements. The GPS measurement will be taken using a receiver that meets all of the following requirements:

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

All GPS measurements will 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 time periods in which material sampling and field testing were conducted on the project. A field set number can apply to more than one day since sampling of test sections may require more than one day.

Cores

A separate log will be completed for each core hole. The depth of penetration of each coring operation and the average length of the recovered core will be recorded to the nearest 0.1 inch. Data sheets for these logs are included in appendix A.3. Sampling Data Sheet 2 will be used to record pavement cores from C-type sampling areas. These logs will show the general type of material in accordance with terminology described in appendix A.3. The general code 001 will be used to identify dense graded HMA, and 091 will be used to identify dense graded WMA. Remarks will include the type of cooling medium, difficulties encountered in coring, defects observed in the core (such as cracks, voids and disintegration), and other pertinent observations.

A-Type Sampling

Data for each A-type sampling hole will be recorded on Sampling Data Sheet 4. This includes auguring used to obtain subgrade bulk samples and to perform material classification and layer thickness measurements on base and subbase layers. This data should include descriptions of the subgrade layers, samples depths, 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 *Long-Term Pavement Performance Project: Laboratory Material Testing and Handling Guide*. (19)
2. Thickness of each layer encountered in the hole to the nearest 0.1 inch.
3. Presence and levels of any water encountered.

Bulk Sampling of Subgrade

Observations and measurements performed during subgrade sampling will be logged as the excavation progresses and will be reported on Sampling Data Sheet 4. The record will include description of the exposed subgrade and thickness of any layers to the nearest 0.1 inch, sample numbers and number of bags per sample, test numbers, any water seepage, sloughing, voids and other pertinent items.

Bulk AC Materials Sampling

Data for bulk HMA mix, asphalt and asphalt emulsions, and aggregates should be recorded on Sampling Data Sheets 10, 10A, and 21, respectively. The record will include information on when and where the sample was obtained, as well as the size and other basic characteristics of the sample.

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-12 test site. The forms will appear in the final assembled data packet in the order provided in appendix A. The title page will always be the first (top) sheet of the data packet and it will 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 6 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 will insure 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 will be stored at the RSC office.

MRL Samples

Scheduling information should be furnished to the LTPP MRL contractor as soon as this information is available. This information should, at the minimum, contain: (1) sampling date, (2) highway agency contact name, (3) shipping address, and (4) telephone number. The contact name information for the MRL is as follows:

Program Manager
FHWA Materials Reference Library
1625 Crane Way
Sparks, NV 89431
Phone: 775-329-4955

Fax: 775-329-5098
Website: www.ncenet.com/ltpp/mrl

Shipping of samples to the MRL will be performed by a common carrier and the costs borne by FHWA. The RSC should contact the MRL office for coordination and sample shipping details.

Prior to shipping samples to the MRL, the specimens will be logged into the MTS, along with the appropriate shipment information. A copy of LTPP Field Operations Information Form 1 should be completed and attached to all MRL shipments.

If necessary, cores for the SPS-12 projects can also be shipped and stored at the MRL if the LTPP Testing Contractor is not yet able to test or store the material designated for it to test. The MRL should be contacted for shipping containers and instructions.

LABORATORY MATERIALS TESTING

This section contains general guidelines to be used by laboratories participating in the SPS-12 laboratory materials testing program. All of the protocols, test data reporting sheets, definitions, etc. referenced in this section can be found in the document *Long-Term Pavement Performance Project Laboratory Material Testing and Handling Guide*. (19) 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 Pavement Performance Database portion of the LTPP Information Management System (IMS) for dissemination. The general instructions included in this SPS-12 materials sampling and testing chapter 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.

Subgrade Materials Testing

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-12 test sections. The LTPP protocols containing the test procedure, reporting requirements and data forms for these tests are:

- Natural Moisture Content — Protocol P49
- Sieve Analysis — Protocol P51
- Atterberg Limits — Protocol P43
- Material Classification — Protocol P52
- Resilient Modulus — Protocol P46

The following general procedures will 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. Make sure the jar samples do not break.

- 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-12 projects.

- Thoroughly mix the combined bulk sample and then dry the sample in accordance with the procedure described in AASHTO R058-11. [35]

- The mixed and dried sample is to be reduced to the appropriate test size using the procedures described in AASHTO T248-11. [36] The test samples will be representative of the total bulk sample.

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

It is likely that a substantial amount of material may be left over after testing of the subgrade soil. This extra material ensures that an adequate amount of sample is available to run all of the required characterization tests. This extra material will not be disposed of until all testing has been completed and all results have been received by the RSC and passed quality control checks.

Laboratory Testing of Embankment Materials

Materials from embankment layers greater than or equal to 4 ft thick will be treated as subgrade materials and tested in accordance with Laboratory Testing of Subgrade Materials discussed above. Materials from embankment layers less than 4 ft thick will be considered as a subbase but tested as a subgrade material.

Laboratory Testing of Unbound Granular Base/Subbase Material

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

- Particle Size Analysis (Protocol P41).

- Atterberg Limits (Protocol P43).

- Classification of Granular Base/Subbase Materials (Protocol P47).

- Resilient Modulus (Protocol P46).

The following general procedures will 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-12 projects.

- Thoroughly mix the combined bulk sample and then dry the sample in accordance with the procedure described in AASHTO R058-11. [35]

- The mixed and dried sample is to be reduced to the appropriate test size using the procedures described in AASHTO T248-11. [36] The test samples will be representative of the total bulk sample.

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

Extra material will not be disposed of until all testing has been completed and all results have been received by the RSC and passed quality control checks.

Laboratory Testing of Existing HMA Materials

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

- AC01 will be performed by the RSCs. Each RSC is responsible for performing AC01 on every core drilled within its region. AC01 should be completed and the results verified before the core is shipped to the LTPP central laboratory contractor.

- AE11 will be performed by FHWA Turner-Fairbank Highway Research Center (TFHRC).

Bulk Samples of AC Binder

The following tests will be performed on each asphalt cement used in the SPS-12 experiment HMA mixtures. Normally this will only be for the 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.

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

- Binder specific gravity (P23).

- Dynamic Shear Rheometer, Unaged (P27).

- Dynamic Shear Rheometer, RTFO (P27).

- Multiple stress creep recovery, RTFO (P73).

- Dynamic Shear Rheometer, RTFO+PAV (P27).

- Bending Beam Rheometer, RTFO+PAV (P28).

AC Layers other than Surface Layer

The following tests will be performed on each AC layer other than the experimental surface layers. For overlay projects, these correspond to the existing AC layers. These tests will only be done for cores sampled at the time of construction. All testing will be performed by the central laboratory contractor, with the exception of AC01 which will be performed by the RSC.

- **Mix Stiffness** - Three 6-inch cores per section required, except supplemental sections:
    - Examination and thickness, performed on each core (P01).
    - Bulk specific gravity, performed on each core (P02).
    - Dynamic modulus, performed on specimens prepared from one of the three cores (P74).
- **Maximum Specific Gravity and Component Properties -** Two 12-inch cores per section required, except supplemental sections. Multiple 6-inch cores may be substituted to achieve same volume of material:
    - Examination and thickness (P01).
    - Maximum specific gravity (P03).
    - Extraction, asphalt content (P04).
    - Abson Recovery (P21).
    - Dynamic Shear Rheometer, unaged (P27).
    - Bending Beam Rheometer, unaged (P28).
    - Multiple stress creep recovery, unaged (P73).
    - Aggregate gradation (P14).

Treated Base/Subbase/Subgrade Materials

If a treated base, subbase or subgrade is present, it will be examined using protocol P31. This examination can be performed on 4-inch diameter or greater cores. One test will be performed for each section. Testing will be performed by the RSCs.

Laboratory Testing for Concrete Materials Testing

For the existing concrete pavements, the following tests need to be run on the concrete cores as shown in table 20. These are essentially the same ones identified earlier in this chapter.

Table 20. Test to be run on concrete cores.

Test Name	Test Designation	LTPP Test Protocol
Compressive Strength	PC01	P61
Split Tensile Strength	PC02	P62
Coefficient of Thermal Expansion	PC03	P63[1]
Static Modulus of Elasticity	PC04	P64
Core Examination & Thickness	PC06	P65
Air Content of Hardened Concrete	PC08	P68

Note 1: AASHTO T 336

Laboratory Testing for Preservation Treatments

Diamond grinding

Prior to diamond grinding it is recommended that the Mohs hardness test and the ASTM C856 test on Petrographic Examination of Hardened Concrete be used to assist the construction in planning the grind. (26) No materials tests are involved during the diamond grinding treatment. As such, it is not necessary to obtain samples of this treatment. It will be necessary to run tests on the treatment before and after construction including:

- Ride quality.
- Surface texture.

These tests should be run as a part of the SPS-12 experiment to determine how these properties change over time. The test methods are detailed under Chapter 5 Performance Monitoring of this report.

Joint Sealants

At this time, there are specifications for hot applied sealants, but not for Silicone treatments. These products are often included on the agencies approved product lists. Field tests should include the following:

- Permeability of the joint system using the Texas A&M joint infiltration or flow (Falling-Head Permeameter) test. (37)
- Assessment of joint condition using camera probe that enables viewing of slab walls at the joints. (27) This is also a TTI test method and is described in appendix B.4.

Penetrating Sealers

At this item, most of the proposed products are not included in ASTM nor AASHTO specs. It will be important to test the concrete for water permeability and using petrographic testing. Tests that will be used to evaluate sealers and their effectiveness include:

- Permeability tests on the portland cement concrete before and after application.

- Assessment of joint condition using camera probe that enables viewing of slab walls at the joints. [27]

- New test methods are evolving; they are presented in appendix B.

Sample Record Keeping

The laboratories conducting the testing for the SPS-12 projects are required to keep in close coordination 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 will be inspected by the laboratory manager (or their designee) for completeness of the shipment (as compared to the MTS), damage, contamination, sufficient quantity, and proper identification. 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 will be entered in the MTS.

Test Data Reporting

The participating laboratory is required to use electronic data formats for recording test results. Electronic data formats will be verified and agreed to by FHWA before testing is performed. At a minimum, the electronic record will 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 Material Testing and Handling Guide*. [19] For each test performed, the lab will update the MTS with the name of the electronic data file containing the test results. Data file shipments will 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-12 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 while intending not to make the storage requirements burdensome on the participating laboratory. Identification assigned to the materials will 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 will be fully enclosed and not subjected to the natural elements. This type of area will provide protection against contact with water (rain or wet floor) and exposure to direct sunlight. Also, the storage area will be capable of maintaining each sample in the required temperature range as specified below. Samples will be marked to indicate their status; such as “hold material - do not use.”

The following guidelines will be followed for storage of materials from the LTPP experiments:

Asphalt Concrete Materials

Asphalt materials will be stored between 40°F and 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 and at a temperature between 40°F and 80°F in an environmentally protected storeroom.

Other Than Asphalt Treated Materials

Other than asphalt treated base/subbase and subbase cores and materials should be stored in a fully supported condition and at a temperature between 40°F and 100°F in an environmentally protected storeroom.

Bulk/Moisture Samples

Bulk and moisture samples of base, subbase and subgrade material should be kept in an environmentally protected storage area at temperatures between 40°F and 100°F.

Emulsions

Emulsions used in the chip seals and micro-surfacings do not store well. They should be tested during or shortly after construction. If the samples are tested after 21 days, the results will not be reliable.

Joint Sealants and penetrating sealers

These materials should be stored in an environmentally protected storeroom. They will be collected at the time of construction.

Sample Handling and Shipping

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

Packaging

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

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

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

4. Shipping boxes will 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 will be adequately secured by nails or screws prior to shipping.

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

Shipping

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

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

Summary

The sample preparation and shipping guidelines provided herein are designed to protect the integrity of the materials samples to the highest degree possible within economic limits. 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 a minimum of damage.

CHAPTER 5. PERFORMANCE MONITORING

OVERVIEW

A key component to achieving the objectives of the SPS-12 experiment is to develop and execute a performance monitoring plan capable of tracking and collecting the short- and long-term data for the selected pavement preservation treatments. The guidelines for the periodic collection of monitoring data are described in this chapter.

The performance monitoring requirements include data elements that are part of the standard LTPP performance monitoring activities as well as new, additional monitoring data elements. They are:

- Standard LTPP monitoring.
    - Deflection testing.
    - Distress surveys.
    - Profile and texture surveys.
- Additional monitoring.
    - Joint sealant condition surveys.
    - Surface friction surveys.

The first four data elements – deflection testing, distress surveys, profile and texture surveys, and joint sealant surveys – are considered required (i.e., mandatory). The joint sealant condition surveys only apply to the SPS-12S joint sealant and SPS-12P penetrating sealer projects. The fifth data element – surface friction surveys – is considered desirable (i.e., not mandatory) because these surveys have not been performed in a controlled basis within the LTPP program (but they could be expanded to other LTPP test sections). In addition, they introduce program expenses (retaining the services of specialty data collection contractor) that may not be available within the LTPP budget.

The monitoring frequency requirements for the performance measures in question are summarized in table 21. As shown, the following three monitoring time frames are specified:

- Pre-treatment monitoring – these are measurements taken prior to (within one month) application of the treatment to capture the condition of pavement with respect to the measure in question prior to the treatment.
- Post-treatment monitoring – these are measurements taken immediately (within one month) after application of the treatment to capture the initial impact of the treatment on the measure in question.

- Routine monitoring – these are measurements taken over the life of the project test sections, at approximately (but within three months) the same date and time as the initial after treatment measurements, while active within the LTPP program to capture the short- and long-term performance of the pavements.

Table 21. Performance monitoring guidelines: frequency requirements.

Monitoring Type	Data Element	Monitoring Frequency		
		Pre-Treatment	Post-Treatment	Routine Monitoring
Standard LTPP Monitoring	Deflection Testing	Within 1 month prior to treatment application	Not Required	Approximately every 3 years, but not to exceed 5-year intervals, within 3 months of the anniversary date of initial after treatment testing
	Distress Surveys	Within 1 month prior to treatment application	Within 1 month after treatment application	Annual basis within 3 months of the anniversary date of initial after treatment survey
	Profile and Texture Surveys	Within 1 month prior to treatment application	Within 1 month after treatment application	Annual basis within 3 months of the anniversary date of initial after treatment survey
Additional Monitoring	Joint Sealant Condition Surveys	Not required	Within 1 month after treatment application	Annual basis within 3 months of the anniversary date of initial after treatment survey
	Surface Friction Surveys	Within 1 month prior to treatment application	Within 1 month after treatment application	Annual basis within 3 months of the anniversary date of initial after treatment survey

The pre- and post-treatment measurements are to be performed on those project test sections receiving the treatment in a given year. Performance measurements shall be conducted on all test sections at a site any time a performance measurement is scheduled for any test sections at the project site.

As shown in table 22, deflection testing, distress surveys and profile and texture surveys are to be conducted in accordance with existing LTPP protocols, except as follows: [38, 39, 40]

- Deflection testing on SPS-12 projects will be performed using the SPS-2 JPCP Test Plan 5, which provides adequate deflection data, while reducing time and hence traffic control requirements. [38]

Table 22. Performance monitoring guidelines: protocols.

Monitoring Type	Data Element	Protocols/References	Protocol(s) Changes/Deviations
Standard LTPP Monitoring	Deflection Testing	LTPP Manual For Falling Weight Deflectometer Measurements Version 4.1 (FHWA-HRT-06-132) or latest version and applicable directives [38]	Deflection testing on SPS-12 projects will be performed using the using the SPS-2 JPCP Test Plan 5
	Distress Surveys	Distress Identification Manual for the Long-Term Pavement Performance Program – May 2014 (FHWA-RD-13-092) or later version and applicable directives [39, 41]	Addition of JAD for SPS-12P test sections, receiving penetrating sealer treatment, addition of camera probe to assess pre- and post-treatment condition of joints for SPS-12S joint sealant and SPS-12P penetrating sealer test sections, and addition of joint opening measurements for SPS-12S joint sealant test sections.
	Profile and Texture Surveys	LTPP Manual for Profile Measurements and Processing December 2013 - Revised Appendix B or later version and applicable directives [40]	No changes or deviations to referenced protocols
Additional Monitoring	Joint Sealant Condition Surveys	AASHTO JS-14 “Project Work Plan for NTPEP Evaluation of Portland Cement Concrete (PCC) Pavement Joint Sealant Material” (FHWA “Materials and Procedures for Repair of Joint Seals in Portland Cement Concrete Pavements: Manual of Practice”). [42, 43]	Field measurements will be performed using the Texas A&M joint infiltration or flow (Falling-Head Permeameter) test
	Surface Friction Surveys	ASTM E2340, Standard Test Method for Measuring the Skid Resistance of Pavements and Other Trafficked Surfaces Using a Continuous Reading, Fixed-Slip Technique [44, 45]	No changes or deviations to referenced protocols

- Distress surveys of SPS-12 projects will be conducted per the latest version of the “Distress Identification Manual for the Long-Term Pavement Performance Program” or DIM. [39] However, the following changes to the DIM will be required:
    - Addition of procedure for identifying and quantifying the presence of shadowing near the joints, which is an early indication of JAD, and then of JAD deterioration over time for the SPS-12P penetrating sealer project test sections.

- Addition of assessment of joint condition using camera probe that enables viewing of slab walls (hence condition) at the joints for pre- and post-treatment distress surveys of SPS-12S joint sealant and SPS-12P penetrating sealer project test sections.

- Addition of joint opening measurements for the SPS-12S joint sealant project test sections in accordance with the guidelines provided in the LTPP SMP: Instrumentation Installation and Data Collection Guidelines. [41]

For the joint sealant condition surveys, the latest version of the AASHTO JS-14 standard is to be used along with the recommended practices resulting from a FHWA sponsored project, adapted to the SPS-12 experiment. [42, 43] While for the surface friction surveys, the latest version of the ASTM E2340 standard is to be used. [44] In addition, highway agencies are encouraged to perform parallel friction measurements using one or more other devices such as the ASTM E274 skid trailers and the GripTester. [45]

Responsibility for the collection of the required performance measures data elements is summarized in table 23. As shown, the LTPP RSCs are responsible for all data collection activities except for the surface friction surveys, which will be performed by a specialty data collection contractor.

Table 23. Performance monitoring guidelines: data collection responsibilities.

Monitoring Type	Data Element	Responsible Data Collection Party
Standard LTPP Monitoring	Deflection Testing	LTPP Regional Support Contractors
	Distress Surveys	LTPP Regional Support Contractors
	Profile and Texture Surveys	LTPP Regional Support Contractors
Additional Monitoring	Joint Sealant Condition Surveys	LTPP Regional Support Contractors
	Surface Friction Surveys	Specialty Data Collection Contractor

Each of the recommended performance measures is discussed in greater detail next, including objectives, hypotheses, monitoring frequency, and testing protocols.

STANDARD LTPP MONITORING

Deflection Testing

The objectives for carrying out deflection testing (using FWDs) on the pavement preservation project test sections are to:

- Estimate the stiffness of the individual pavement layers as well as the overall pavement structure for all SPS-12 project test sections.

- Determine the degree of interlock between adjacent slabs (or load transfer efficiency) of the SPS-12 project test sections.

It is hypothesized that the SPS-12 treatments under consideration will not have a significant impact, if any, on the structural capacity of the pavements over time, but the joint sealant and/or and joint sealer treatments could potentially influence the load transfer efficiency performance of those test sections.

Deflection testing is to be conducted at least one month prior to application of the treatment at a given project test section (as well as at project control test section) to not only establish the pre-treatment structural condition of the pavement, but also confirm whether or not the test section meets the structural condition criteria stipulated in the SPS-12 project nomination guidelines.

Deflection testing immediately after application of a treatment at a given project test sections is not required, as none of the SPS-12 treatments in question are expected to significantly affect the structural condition of the pavement, as determined by the pre-treatment testing. Accordingly, only routine monitoring – testing every 3 years but not to exceed 5 years – is required after the pre-treatment testing to monitor change in structural capacity, if any, over time. These routine testing should be performed at approximately (but within three months) the same date and time as the initial after treatment testing for each project.

All deflection testing is to be performed by the LTPP RSCs in accordance with the LTPP Manual for Falling Weight Deflectometer Measurements, Version 4.1, or latest version and applicable directives. [(38)] Testing will be done in accordance with the SPS-2 Test Plan specification 5 – i.e., SPS-2 JPCP Test Plan 5. This test plan provides adequate deflection data to determine the structural condition of the pavements, while reducing testing time and hence traffic control requirements.

Distress Surveys

The objective of the pavement surface distress surveys on the SPS-12 project test sections is to identify the distress types present at those test sections as well as to quantify their extent and severity and, by doing so, capture the impact of preservation treatments on the life and performance of the pavements. The project test sections to be included in the SPS-12 experiment are to be in good condition, as detailed in the project nomination guidelines. Consequently, it is anticipated that limited pavement surface distress will be present on these project test sections when introduced into the LTPP program.

It is hypothesized that the SPS-12 treatments under consideration will impact pavement surface distresses as follows:

- Other than temporarily hiding distresses, diamond grinding is not expected to have a significant impact, if any, on pavement surface distresses.

- The joint sealant and penetrating sealer treatments are expected to result in significant reductions in joint associated distresses.

Distress surveys will be conducted on all SPS-12 project test sections at least one month prior to application of the treatment at a given project test section as well as within one month after application of the treatment. These surveys are intended to establish pavement surface distress conditions immediately prior to and after application of the treatments. These two surveys – immediately prior to after application of treatment – are only applicable to those project test sections being treated as well as the project control test sections.

In addition, distress surveys will be performed on all project test sections on an annual basis, at approximately (but within three months) the same date and time as the initial after treatment survey, to monitor the progression of distresses over time.

All distress surveys are to be performed by the LTPP RSCs in accordance with the Distress Identification Manual for the Long-Term Pavement Performance Program, May 2014 or latest version and applicable directives. (39) However, the following changes to the DIM will be required:

- Addition of procedure for identifying and quantifying the presence of shadowing near the joints, which is an early indication of JAD, and then of JAD deterioration over time for the SPS-12P penetrating sealer project test sections.

- Addition of assessment of joint condition using camera probe that enables viewing of slab walls (hence condition) at the joints for pre- and post-treatment distress surveys of SPS-12S joint sealant and SPS-12P penetrating sealer project test sections. These assessments will be required at the same joint locations where load transfer efficiency will be evaluated using the FWD.

- Addition of joint opening measurements for the SPS-12S joint sealant project test sections in accordance with the guidelines provided in the LTPP SMP: Instrumentation Installation and Data Collection Guidelines. (41) These measurements will be required at the same joint locations where load transfer efficiency will be evaluated using the FWD.

Profile and Texture Surveys

The objectives of the pavement surface profile and texture surveys are to:

- Collect longitudinal profile data along the wheel paths to evaluate the roughness of the pavement at a given point in time as well as the change in roughness over time, which is an important indicator of pavement performance.

- Collect texture data along the wheel paths to evaluate the texture characteristic of the pavement surface at a given point in time as well as the change in texture over time, both of which related to pavement surface friction characteristics.

Directly related to the above objectives, it is hypothesized that the SPS-12 treatments will affect pavement roughens and texture as follows:

- Application of the PCC diamond grinding will have a significant impact on pavement surface roughness (and potentially texture), with the most significant impact being smoother pavement surfaces.

- Application of the remaining treatments are not expected to significantly affect pavement surface roughness, if at all.

Profile and texture surveys will be conducted on all SPS-12 project test sections at least one month prior to application of the treatment at a given project test section as well as within one month after application of the treatment. These surveys are intended to establish pavement surface roughens and texture conditions immediately prior to and after application of the treatments. While these surveys are only intended for those project test sections being treated as well as the project control test section, it is just as easy to collect profile and texture data over the entire project, hence the RSCs have the option to conduct the surveys on the two required test sections or over the entire project length.

In addition, profile and texture surveys will be performed on all project test sections on an annual basis, at approximately (but within three months) the same date and time as the initial after treatment survey, to monitor the progression of roughness and texture over time.

All profile and texture surveys are to be performed by the LTPP RSCs in accordance with the LTPP Manual for Profile Measurements and Processing, November 2008 (plus Revised Appendix B, December 2013) or latest version and applicable directives. [(40)] No deviations or changes to the requirements stipulated in the manual are required for purposes of the SPS-12 experiment.

ADDITIONAL MONITORING

Joint Sealant Condition Surveys

Joint sealant conditions surveys are to be performed only on those SPS-12S joint sealant and SPS-12P penetrating sealer project test sections where a sealant has been applied at the joints. The objectives of these surveys are to:

- Visually assess the condition of the joint sealant at a given point in time as well as over time; condition of the respective joints will be assessed as part of the distress surveys addressed earlier.

- Assess, through actual field measurements, the functioning of the joint sealants (relative to their ability to prevent water from entering the pavement system) at a given point in time as well as over time.

It is hypothesized that the application of joint sealants at the referenced project test sections will affect the pavements as follows:

- For those project test sections where the joint sealant has been properly applied and maintained (re-capped or replaced, treated), it is anticipated that the pavements will perform better (reduced distress, retained structural capacity and smoother pavement over time) than pavements where the joint sealant has not been properly maintained and much better than pavements that have not been sealed.

Joint sealant condition surveys will be conducted within one month after application of the sealant and thereafter on an annual basis, at approximately (but within three months) the same date and time as the initial after treatment survey, to monitor the condition of the joint sealants over time. Pre-treatment joint sealant condition surveys are not required. Also, for some project test sections (refer to SPS-12 experiment design), maintenance (re-capping or replacement) of the sealant may be triggered if the field measurements show the sealant is not performing well in terms of preventing water from entering the pavement system.

All visual assessments of joint sealant condition surveys are to be performed by the LTPP RSCs in accordance with the AASHTO JS-14 Project Work Plan for NTPEP Evaluation of PCC Pavement Joint Sealant Material, as supplemented by the background material presented in FHWA's "Materials and Procedures for Repair of Joint Seals in Portland Cement Concrete Pavements: Manual of Practice." (42, 43) Field measurements of the sealant condition will be performed using the Texas A&M joint infiltration or flow (Falling-Head Permeameter) test. (28) These measurements will be performed at the same joint locations where load transfer efficiency will be evaluated using the FWD.

Surface Friction Surveys

The objective of the surface friction surveys is to establish the skid characteristics of the SPS-12 project test sections at a given point in time as well over time, which is another important pavement performance indicator. Towards achieving this objective, the texture surveys discussed in the previous section will supplement and complement the data gathered by the surface friction surveys.

Unlike the performance measures detailed up to this point, surface friction surveys are desired, but not required, for the SPS-12 experiment. One reason these surveys are not required is because they have not been performed in a control basis within the LTPP program (but they could be expanded to other LTPP test sections). Another reason is that they introduce program expenses (to retain the services of specialty data collection contractor) that may not be available within the LTPP budget.

Directly relating to the stated objective for the performance measure in question, it is hypothesized that the SPS-12 treatments may affect the pavement surface friction characteristics of the existing pavement prior to application of treatment. In the case of diamond grinding, those characteristics are expected to improve, while in the case of joint sealants and penetrating sealers, their impact is anticipated to be negligible.

Surface friction surveys will be conducted on all SPS-12 project test sections. The surveys will be conducted at least one month prior to application of the treatment at the referenced project test section as well as within one month after application of the treatment. These surveys are intended to establish pavement surface friction characteristics immediately prior to and after application of the treatments.

As was the case with the profile and texture surveys, the pre-treatment surface friction surveys are only intended for those project test sections being treated as well as the project control test section; however, consideration may be given to performing surveys over entire project if this does not introduce significant additional expenses. In addition to the pre-treatment surveys, surface friction surveys will be performed on all project test sections on an annual basis, at approximately (but within three months) the same date and time as the initial after treatment survey, to monitor the change in surface friction characteristics over time.

All friction surveys are to be performed by a specialized and experienced contractor in accordance with ASTM E2340 Standard Test Method for Measuring the Skid Resistance of Pavements and Other Trafficked Surfaces using a Continuous Reading, Fixed-Slip Technique or latest version of the standard. [(44)] No deviations or changes to the requirements stipulated in the standard are required for purposes of the SPS-12 experiment.

In addition to the ASTM E2340 continuous friction measurements, highway agencies are encouraged to perform parallel friction measurements using one or more other devices such as the ASTM E274 skid trailers and the GripTester. [(45)] Such measurements will be planned, coordinated and executed with the support of the respective LTPP RSC to ensure the data are stored in the LTPP database.

CHAPTER 6. OTHER DATA COLLECTION

OVERVIEW

Another important element of the SPS-12 experiment is to develop and execute a plan for collecting those data necessary for understanding the short- and long-term performance of pavements subjected to preservation treatments, which have not been addressed by the MS&T plans and the performance monitoring guidelines addressed in earlier chapters. Guidelines for the collection of those data are described in this chapter, while guidelines for the collection of maintenance and rehabilitation data are provided under separate LTPP directive.

The additional SPS-12 data collection requirements include data elements that are part of the standard LTPP data collection processes as well as new data elements. These data elements can be grouped into pre-treatment testing and monitoring data:

- Standard LTPP data.
    - Traffic data.
    - Climate data.
    - Maintenance and rehabilitation data.
- Additional data collection.
    - Pre-Treatment testing data.
        - GPR data.
        - Magnetic Imaging Tools (MIT) Scan-2 data.
    - Monitoring data.
        - Snow removal and deicing data (freeze areas only).

Except for the MIT Scan-2, all of the above data elements are considered required (i.e., mandatory). The MIT Scan-2 data is considered desired and the reason for this is that the SPS-12 experiment requires relatively new pavements and, as such, appropriate dowel bar placement (i.e., alignment) is presently not considered a problem issue with these pavements. It is recognized that GPR data (and MIT Scan-2 if collected) will require the LTPP program to retain the services of specialty data collection contractors, which introduces expenses that could potentially be beyond the available program funding. However, GPR data is considered mandatory for the SPS-12 experiment because it yields information critical to understanding the performance of pavements subjected to preservation treatments. Without these data, the usefulness of the proposed data collection effort is handicapped.

The data collection frequency requirements for the data elements in question are summarized in table 24. As shown, the following two data collection time frames are specified:

Table 24. Other data collection needs: frequency requirements.

Monitoring Type	Data Element	Data Collection Frequency	
		Pre-Treatment	**Routine Data Collection**
Standard LTPP Data	Traffic	Not Required	3 years of continuous WIM and thereafter continuous classification data collection for remainder of time project remains in LTPP program
	Climate	Not Required	MERRA data will be updated at intervals of 1 year or less, while virtual weather station data will be generated for the project when it enters LTPP and then updated at intervals not to exceed 5 years
Additional Data Collection	Ground Penetrating Radar (GPR)	Within 3 months prior to treatment application	Not Required
	Magnetic Imaging Tools (MIT) Scan-2	Within 3 months prior to treatment application	Not Required
	Snow Removal and Deicing	Not Required	RSCs will work with highway agencies to establish frequency for providing required information, but in no case, should it exceed 1 month during winter months

- Pre-treatment data collection – these are measurements taken within three months prior to the application of a treatment to capture preconstruction pavement condition. GPR and MIT Scan-2 measurements should be performed within the pre-treatment time frame. These measurements should be performed on all test sections at a project site prior to inclusion of the project in the LTPP program. As indicated in the SPS-12 project nomination guidelines, projects must meet minimum specified structural capacity and condition requirements for inclusion in the experiments.

- Routine data collection – these are measurements taken over the life of the project test sections while active within the LTPP program to enable understanding of the short- and long-term performance of the pavements where preservation treatments have been applied. Routine data collection is to be performed on all project test sections, whether they are control or treatment test sections and, if a treatment test section, whether or not it has received the treatment.

As shown in table 25, traffic and climate data are to be collected in accordance with existing LTPP protocols and/or practices, except as follows: (See references 46 through 52.) The traffic data collection effort will entail 3 years of WIM data collected using piezo quarts or better quality sensors and thereafter continuous classification data for the remainder of the time the project remains in the LTPP program.

Table 25. Other data collection needs: protocols.

Monitoring Type		Data Element	Protocols/References	Protocol(s) Changes/Deviations
Standard LTPP Data		Traffic	SPS traffic pooled fund protocols for load data and FHWA Traffic Monitoring Guide (September 2013) for classification data (see References 46 through 50.)	3 years instead of 5 years of WIM data will be collected using piezo quartz sensors
		Climate	Current LTPP MERRA and virtual weather station approaches or updated version will be used to generate climatic data [51, 52]	No changes or deviations to referenced protocols
Additional Data Collection	Pre-Treatment Testing Data	Ground Penetrating Radar (GPR)	AASHTO R-37-04 Standard Practice for Application of Ground Penetrating Radar (GPR) to Highways [53]	Supplemented by ASTM D4718-10 Standard Test Method for Determining the Thickness of Bound Pavement Layers Using Short-Pulse Radar, ASTM D6432-11 Standard Guide for Using Ground Penetrating Radar for Subsurface Investigation, Research Report FHWA/ TX-92/1233-1 Implementation of the Texas Ground Penetrating System [54, 55, 56]
		Magnetic Imaging Tools (MIT) Scan-2	Appendices A and B of Use of Magnetic Tomography Technology to Evaluate Dowel Placement, November 2005 (FHWA-IF-06-006) [57]	Survey will be performed on those same joints where load transfer efficiency will be evaluated using FWD deflection testing
	Monitoring Data	Snow Removal and Deicing	Not required; data sheet for information required from agencies has been prepared	Not applicable

Data for the remaining data elements – snow removal and deicing, GPR and MIT Scane-2 – are to be collected using procedures that are new to the LTPP program:

- GPR – the primary protocol for the collection of GPR data is AASHTO R-37-04 Standard Practice for Application of Ground Penetrating Radar (GPR) to Highways, supplemented by ASTM D4718-10 Standard Test Method for Determining the Thickness of Bound Pavement Layers Using Short-Pulse Radar, ASTM D6432-11 Standard Guide for Using Ground Penetrating Radar for Subsurface Investigation, and Research Report FHWA/ TX-92/1233-1 Implementation of the Texas Ground Penetrating System. (See references 53 through 56.) Given the nature of GPR data collection and interpretation, it is envisioned that the surveys and subsequent data analyses will be carried out by one or more specialized GPR contractors in accordance with the stated protocols.

- MIT Scan-2 – data will be collected at SPS-12 projects in accordance with the procedures detailed in appendices A and B of the FHWA report "Use of Magnetic Tomography Technology to evaluate Dowel Placement (FHWA-IF-06-006)." (57) The only deviation to these procedures is that the MIT surveys are to be performed only at those same joint locations where load transfer efficiency was evaluated using the FWD.

- Snow removal and deicing – rather than a protocol, a data sheet detailing the information required from the highway agencies at SPS-12 projects is included under appendix A.4. The LTPP RSCs will work with the agencies to collect these information on a routine basis.

Responsibility for the collection of the required data elements is summarized in table 26. These responsibilities were based on FHWA committing to the leadership role in implementation of this experiment. These responsibilities could change if these experiments are implemented outside the existing LTPP program structure. As shown, the LTPP RSCs are responsible for all data collection activities except as follows:

- Traffic data will be collected by the State DOTs with support from the LTPP program.

- GPR and MIT Scan-2 surveys will be performed by specialty data collection contractors.

Each of the additional data collection elements required is discussed in greater detail next, including objectives, hypotheses, monitoring frequency, and testing protocols.

Table 26. Other data collection needs: data collection responsibilities.

Monitoring Type		**Data Element**	**Responsible Data Collection Party**
Standard LTPP Data		Traffic	State DOTs and LTPP Regional Support Contractors
		Climate	LTPP Technical Support Services Contractor
Additional Data Collection	Pre-Treatment Testing Data	Ground Penetrating Radar (GPR)	Specialty Data Collection Contractor
		Magnetic Imaging Tools (MIT) Scan-2	Specialty Data Collection Contractor
	Monitoring Data	Snow Removal and Deicing	LTPP Regional Support Contractors

STANDARD LTPP DATA

Traffic

Traffic is one of four key factors that influence the performance of pavements – the other three factors are climate, foundation subgrade soil and pavement structure. As such, the objective of this data collection effort is to obtain high-quality traffic data, both in terms of loads and volumes. It is hypothesized that, all other factors being the same, the performance of pavement is inversely proportional to traffic. The greater the loads and/or volumes, the greater the reduction in performance.

Traffic information will be collected by the participating State DOTs (with LTPP support) at all SPS-12 project sites using existing LTPP SPS traffic validation (pooled-fund) protocols. (See references 46 through 49). However, instead of 5 years of WIM data, a minimum of 3 years' worth of collected using a quartz piezo sensor will be required. Once completed, continuous classification data will be collected for the remainder of the time the project remains in the LTPP program. The FHWA Traffic Monitoring Guide will be used for purposes of the continuous classification data collection. (50) The WIM data will provide information on loading and vehicle classification at each site, while continuous classification will provide the basis to expand loading data for later years by correctly weighting the various loading distributions.

The 3-year minimum for WIM data collection should allow capture of major variations due to economic cycles. The LTPP SPS traffic validation (pooled-fund) study used 5 years to fully cover high and low periods of economic activity since economic cycles typically last 3 years. It was found in this study that weight patterns by vehicle class tend to be stable over time. A 3-year requirement also recognizes that site calibration and validation required at periodic intervals is a resource demand. The quartz piezo sensor is one of the possible WIM sensors that has minimal temperature sensitivity. An installation with quartz piezo sensors, based on LTPP data studies would require only one validation during the expected sensor life. The calibration of a quartz piezo sensor typically holds with a bias that will not affect pavement design evaluations for 18 to 24 months. The typical minimum life of a correctly installed sensor in good pavement is 3 years. An initial data collection period, where an agency could use the site to supplement an existing weight group or test a hypothesis about weight group selection would allow the data to be used for other purposes. At the end of the period, an agency decision on reinstallation would not significantly affect the availability of loading information for the SPS-12 experiment.

The purpose of the on-going classification data collection requirement is to track truck growth (up or down) and to look for potential shifts in the distribution between classes. The shift in truck distributions can impact expansion of prior year loading information. This limits the utility of volume counts for ongoing data collection. Vehicle distribution changes may be a function of route utilization or agency changes in classification trees. LTPP research has found that about a quarter of all locations will have a significant shift in distribution within a 5-year period, an interval shorter than the length of the experiment.

All SPS-12 traffic data will be handled via electronic files and hence, data sheets are not required for this data element.

Climate

Like traffic, climate is one of four key factors that influence the performance of pavements – the other two factors are foundation subgrade soil and pavement structure. Accordingly, the objective of this data collection effort is to obtain climatic data, including moisture and temperature related information. It is hypothesized that, all other factors being the same, the performance of pavement is inversely proportional to moisture. The higher the moisture content in the pavement layers, the greater the performance reduction. In the case of temperature, the impacts on performance will depend on the specific pavement type and the metric used to measure performance. For example, the likelihood of rutting in asphalt pavement will increase as temperature increases.

The SPS-12 experiments do not require the installation of an AWS at each project site. Instead, climate data will be collected using two existing LTPP approaches. (51,52) One of them relies on climate data obtained from a new emerging climate data source developed by NASA, MERRA, which provides continuous hourly weather data starting in 1979 on a relatively fine-grained uniform grid. The second approach relies on the traditional LTPP virtual weather stations from nearby operating weather stations. Both of these approaches are well established within the LTPP program and, as a result, no deviations are planned.

For purposes of the SPS-12 experiment, MERRA data will updated at 1-year intervals or less, while virtual station data will be generated for the project when it enters the LTPP program and then updated at intervals not to exceed 5 years. Both of these activities will be carried out by the LTPP TSSC. Like the traffic data, climatic data will be handled via electronic files and hence, data sheets are not required for this data element.

ADDITIONAL DATA COLLECTION

Pre-Treatment Testing

Ground Penetrating Radar

The objective of the GPR surveys is to clearly establish the condition of the pavement prior to and as part of the inclusion of a project into the SPS-12 experiment. Specific data elements to be pursued include:

- Determination of layer thickness information.
- Conduct of quality control.
- Presence of moisture within the pavement structure.
- Detection of voids within the pavement structure.
- Level of bonding, if any, between the pavement layers.
- Evaluation of granular base material.

- Presence of construction defects.
- Other pavement structure information that may affect pavement performance.

The project nomination guidelines specify pavement condition requirements that must be met in order for the project to be included in the SPS-12 experiments. This is important because the experiments assume that the project pavement will be in good condition and that preservation treatments will be applied to sections within the project at different points in time, starting when the pavement is in good condition and then at later times when the pavement has deteriorated to various levels.

As noted earlier, the GPR surveys will be conducted in accordance with AASHTO R-37-04 Standard Practice for Application of GPR to Highways, as supplemented by ASTM D4718-10 Standard Test Method for Determining the Thickness of Bound Pavement Layers Using Short-Pulse Radar, ASTM D6432-11 Standard Guide for Using Ground Penetrating Radar for Subsurface Investigation, and Research Report FHWA/ TX-92/1233-1 Implementation of the Texas Ground Penetrating System. (See references 53 through 56.)

Unlike previous data collection efforts in this document, it is envisioned that the GPR surveys and subsequent data analyses will be carried out by a specialized GPR contractor (in accordance with the stated protocols) due to the highly specialized nature of GPR technology.

GPR surveys will only be conducted once at the SPS-12 projects, within 3 months prior to the application of the first preservation treatment at the project to enable determination that the project pavements meet the minimum condition requirements stipulated in the experiment nomination guidelines. All GPR data will be handled via electronic files and hence, data sheets are not required for this data element.

Magnetic Imaging

Magnetic tomography (a desired, but not required data element) surveys are to be conducted at all SPS-12 projects only prior to the application of treatments at the project site. These surveys will make use of the MIT Scan-2 technology to accurately establish the placement of the dowel bars including their: [57]

- Depth.
- Side shift or lateral position error.
- Vertical misalignment.
- Horizontal misalignment.

It is widely recognized that achieving good dowel alignment is important to the performance of PCC pavements that make use of dowel bars. Inadequate concrete cover can lead to steel corrosion and spalling. Bars that are not properly centered under the joint saw cut may not be effective in providing load transfer. Misaligned dowel bars can interfere with the proper functioning of the joint, which in turn, can lead to spalling or cracking of the concrete. If severely misaligned, they can also cause looseness around the dowel bars, greatly reducing their effectiveness. In summary, it is hypothesized that those test sections where the dowel bars are properly aligned will perform significantly better than those where the dowel bars are not properly aligned.

Like the GPR surveys, the MIT Scan-2 surveys are important because the project nomination guidelines specify pavement condition requirements that must be met in order for the project to be included in the SPS-12 experiment. In the formulation of the SPS-12 experiment, it has been assumed that the project pavements will be in good condition, and this includes proper dowel alignment for the reasons stated in the previous paragraph.

The MIT Scan-2 surveys and the interpretation of the resulting data will be done in accordance with the instructions provided in appendix A – MIT Scan-2 Operations Guide and appendix B – Guidelines for Evaluating Dowel Alignment Using MIT Scan-2 contained in FHWA report FHWA-IF-06-006, Use of Magnetic Tomography Technology to Evaluate Dowel Placement, November 2005. (57) The only deviation to the instructions provided in the referenced report is that surveys will be performed on those same joints where load transfer efficiency will be evaluated using FWD deflection testing.

MIT Scan-2 surveys will only be conducted once at the SPS-12 projects, within 3 months prior to the application of the first preservation treatment at the project to enable determination that the project pavements meet the minimum condition requirements stipulated in the experiment nomination guidelines. All MIT Scan-2 data will be handled via electronic files and hence, data sheets are not required for this data element.

Monitoring Data

Snow Removal and Deicing

The collection of data on snow removal and deicing is another important data requirement for those SPS-12 projects in freeze areas. The objective is to collect information on snow removal and deicing equipment and materials as well as their frequency of use and history. It is hypothesized that all other factors being the same, snow removal equipment such as plows and snow blowers and/or material such as salt brine or deicers as well as their increased frequency will adversely affect the performance of pavements that have been subjected to preservation treatments.

Information on the snow removal and deicing practices used by the state highway agencies at the SPS-12 projects is detailed in the data sheet contained in appendix A.4. Individual data elements for each SPS-12 project include:

- Type(s) of snow removal equipment used.
- Frequency of snow removal on a monthly basis.
- Type(s) of deicing chemicals used.
- Frequency of application of deicing chemicals on a monthly basis.

It is recommended that the LTPP RSCs work with the SHAs so that the data sheet is:

- Completed on a monthly (or more frequent) basis during the winter months in freeze areas by participating State DOTs.

- Submitted by the SHAs to the LTPP RSCs within 2 weeks after the end of the reporting period.

As long as the project stays within the LTPP program, completion and submission of the data sheet is desired for those SPS-12 projects where snow removal and/or deicing are used, even if not a routine activity, but only for those months where actual snow removal and/or deicing was required. As stated earlier, the data sheet to be used for recording snow removal and deicing information and supporting information is contained in appendix A.4.

CHAPTER 7. SUMMARY AND CONCLUSIONS

The objective of the project documented in this report, as stated in the introductory chapter, was to design and implement a pavement preservation experiment within the LTPP program operational structure. Working closely with FHWA staff and the project ETG, the SPS-12 experiment design was formulated. This experiment was designed to capture information necessary to establish the impact of the timing of preservation treatments through a field study of in-service pavements starting from construction of the preservation treatment being studied. One of the analysis concepts for development of the experiment is to examine the effect of preservation treatments on pavement distress propagation rates, which will enable determination of their impact on pavement life extension and performance. In turn, this information and understanding will enable determination of the right timing, cost-effectiveness and benefits of preservation treatments.

An innovative experimental approach that segregates treatment types and project locations into discrete groups was adopted for the LTPP pavement preservation studies. The underlying concept is to apply the same preservation treatment, at different times, on the same pavement structure to determine the effectiveness of a single application of a treatment as a function of pavement condition and time. This concept is designed to try and capture the most appropriate time to perform a treatment and discover factors related to treatment timing. The vision of the experimental design is to choose pavements that have recently been constructed, reconstructed, or received a structural overlay. Starting with relatively new pavement structures at each project site, six or seven test sections are established along a uniform road segment before any other preservation or maintenance treatments are applied. Over time (and hence change in pavement condition), the same preservation treatment is applied to different test sections. The length of the treatment application time span is intended to start before preservation treatments would normally be placed, and extend past the time they would not normally be placed.

On completion of the experimental design, a series of guidelines were developed to facilitate the deployment of the experiments. They include:

- Construction guidelines, construction data collection guidelines, and construction report preparation guidelines.
- Guidelines or preparation of material sampling and testing plans, including new sampling and testing protocols.
- Performance monitoring guidelines.
- Guidelines for the collection of other data elements.

It is anticipated that the data collected using the above guidelines will help gain an understanding of how pavement preservation impacts the performance of pavements and why. In turn, this information and understanding will enable accomplishment of the stated objective for the LTPP pavement preservation experiments – determination of the right timing and cost-effectiveness of preservation treatments.

In addition to the various guidelines detailed above, dozens of presentations were prepared and delivered at conferences and meeting throughout the country, technical articles were also prepared and published in relevant magazines, and other technical materials were prepared in support of the SPS-12 experiment. Technical support to FHWA, State DOTS and other LTPP stakeholders was also provided.

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APPENDIX A. DATA SHEETS

A.1 PROJECT NOMINATION FORMS

The purpose of this section of appendix A is to provide information, guidelines and forms for nominating candidate projects for acceptance in the LTPP SPS-12 experiment. The following instructions should be used to complete a set of three SPS-12 candidate project nomination forms. They are:

- Sheet A. General Project Information
- Sheet B. Existing Pavement Structure Information
- Sheet C. Test Sections

One set of forms is required for each SPS-12 project site being nominated. Tables containing layer material class codes, which are required for completion of Sheet B, are included at the end of this appendix section.

Sheet A. General Project Information

This sheet includes information on project location, significant dates, a general project description, and design traffic.

State/Province. State or province in which the project is located. Enter either the two-digit LTPP STATE_CODE for the agency, or two character postal designation.

SHRP ID. This four-digit SHRP ID will be assigned by FHWA if the project is selected for inclusion in the SPS-12 experiment, and it will be used as a project reference number.

Date. Enter the date the form was filled out or submitted.

Project Location

This portion of the form provides information on the location of the candidate project. In this document, a project refers to the overall construction project. Test sections refer to 1,250 ft portions of the project in which the experimental pavement structures are constructed.

Route Designation. This is the general higher level route designation used on highway maps assigned to the route on which the project is located. Please indicate the most common designation for routes with multiple designations.

Coordinates. This is the location of the start of the project on the side of the road in the direction of travel. The latitude and longitude as determined from a convenient mapping source, such as the Google Earth or other mapping software is sufficient. The coordinates will be designated in fractions of a degree to at least 5 decimal places.

Location Description. This is a written description of the location of the start of the project referenced to a permanent landmark, such as mileposts/milepoints, signed highway intersections, road intersections, signed or labeled bridges, underpasses, overpasses, rest areas and railroad crossings. The objective is to provide a reference for field crews to easily locate the section in the field. Distances from a landmark located prior to the section, in the direction of travel and a landmark located past the start of the section should be specified. For example, “The start of the project is 1.5 mi north of overpass 20-45-43; the intersection with I-71 is located 2.1 mi north of the start of the project” (assuming the direction of travel in northbound).

Direction of Travel. Check the box that describes the direction of travel of the lane proposed for the project. The direction of travel should be as the route is signed. For example, if the lane is on I-71, only northbound or southbound should be chosen, even if route trends mostly east-west within the project limits.

Facility Type. Check the box divided if there is a median, curb, or other permanent barrier between the directions of traffic.

Number of Lanes. For an undivided road, enter the total number of lanes in both directions. For a divided road, enter the number of lanes in the project direction.

County. This is the county or county-level governmental jurisdiction unit in which the project is located. If the project is located in more than one county, indicate the county first encountered in the direction of travel.

Highway Agency District. Enter the highway agency’s district, division or region designation in which the project is located.

Experiment Type

Check the box which indicates the SPS-12 experiment type being proposed for the location. Check more than one box if the intention is to collocate multiple experiments on the same site. Note that each experiment requires 6 or 7 separate test sections to be established.

Significant Dates

Original Pavement Construction. This is the date the original pavement was constructed. Estimate to the nearest year.

Last Overlay or Reconstruction. This is the date of the placement of the most recent AC overlay.

Traffic

AADT (in project lane). This is the estimate of the annual average daily traffic (AADT) volume of all vehicles in the project lane only.

Percent Heavy Trucks and Combinations. This is the ratio of trucks and heavy combinations to total vehicles (AADT) expressed to the nearest percent. This excludes all pickups, panels, other two axle, and four tire trucks. This is for the traffic in the project lane only.

Annual 18-kip ESALs (in project lane). Provide an estimate of the current average application rate of heavy truck loadings, in 18-Kip ESAL applications, in the study lane of the proposed project. This should be the design number of ESAL applications divided by the duration of the design period.

Traffic Equipment

Permanent WIM installed that can be applied to test sections? (Y or N). Indicate if an existing permanent WIM is installed within close proximity to the proposed location. The WIM needs to be on the same route, in the same direction of travel, and have the same traffic loadings/patterns as the site location.

WIM Location. Provide the location of the existing WIM (Lat/Long).

WIM Type/Manufacturer. Provide information on the type of WIM equipment installed.

Last Calibration Date of WIM. Provide the date of the last known calibration of the WIM equipment. Leave blank if unknown.

Does Agency agree to provide a minimum of 3 years of WIM data? If a permanent, full time WIM is not currently available for the proposed location, please indicate if the agency is willing to install one.

Sheet B. Existing Pavement Structure Information

The purpose of this sheet is to provide information on the existing pavement structure at the project site.

State/Province. State or province in which the project is located. Enter either the two digit LTPP STATE_CODE for the agency, or two character postal designation.

SHRP ID. Assigned by LTPP staff.

Pavement IRI. Provide an average or most representative IRI for the existing pavement at the project site.

Pavement Condition. Provide a description of the general pavement condition using the most recent agency information. When available include Pavement Condition Index (PCI), or other condition index (or indices) used by the highway agency from the most recent survey. Note that pavements suitable for inclusion in the experiment should be in like new condition with no to minor surface distresses.

Existing Layer Structure. This is a general description of the pavement layer structure existing at the project location.

Layer No. This layer number convention starts with the naturally occurring subgrade as layer 1 and progresses to the pavement surface as the highest numbered layer. Each unique material above the subgrade is assigned a layer number, layer description, and corresponding material type code. Multiple lifts of the same material can be combined into a single layer. Fabrics, surface treatments and other thin layers should be included.

Layer Description. Describe the layer in general terms. Examples include “Select fill”, “Aggregate Base”, and “Hot-Mix”. Please use generic terms such as embankment, subbase, base, original AC layer, overlay, and avoid agency-specific descriptions.

Material Type Class Code. The two digit codes identifying the type of material in each layer of the pavement structure are shown in table 27 through table 30. The purpose of this information is to provide a general identification of materials for classification and project selection.

Thickness (inches). This is the nominal thickness of each existing layer, in inches. Enter a thickness of 0.1 for very thin layers.

Sheet C. Test Sections

This sheet includes general information on the number of proposed test sections and details on planned supplemental sections.

Number of Core Test Sections. This is the number of core test sections planned for the project. If the proposed number of test sections does not equal 6 or 7 for each experiment proposed for the project site, please provide an explanation under the site deviation comments.

Number of Planned Supplemental Test Sections. This is the number of planned supplemental test sections an agency proposes to construct on the project site in addition to the core test sections. The number of core and supplemental sections will be used to assess the suitability of the length and characteristics of the proposed site location.

Description of Supplemental Sections. Describe the general nature of the planned supplemental test sections including type(s) of preservation treatment and placement timing considerations.

Site Deviations Comments. Provide brief comments describing significant deviations from the desired site location criteria presented in this document. Include in these comments items such as traffic pattern interruptions, intersections between test sections, substructures, cut-fill changes, less than required number of core test sections, traffic control limitations, planned future construction events, etc.

Please attach additional agency documentation to these nomination forms in order to provide information that will help LTPP evaluate the suitability of the proposed project site.

Sheet A. SPS-12 Candidate Project Nomination and Information

STATE/PROVINCE ________________ Date ______________________
SHRP ID ________________ DD/MMM/YYYY

General Project Information

Project Location

Route Designation _______________
GPS Coordinates Latitude ° _ _ . _ _ _ _ _ Longitude ° -_ _ _._ _ _ _
Project Length (miles) ____
Location Description ____
____
____

Direction of Travel [ ] Northbound [ ] Southbound [ ] Westbound [ ] Eastbound
Facility Type [ ] Divided [ ] Undivided
Number of Lanes (in both directions if undivided) _______________
County _______________
Highway Agency District _______________

Experiment Type(s)

[ ] Diamond Grinding [ ] Joint Sealants [ ] Penetrating Sealers

Significant Dates

Original Pavement Construction/Reconstruction ______________________

Traffic
AADT (**in project lane**) _________________
Percent Heavy Trucks and Combinations
on project lane _________________
Annual 18-kip ESALs (**in project lane**) _________________

Traffic Equipment
Permanent WIM installed that can be applied to test sections? (Y or N) ____________________
WIM Location Latitude ° _ _ . _ _ _ _ _ Longitude ° -_ _ _._ _ _ _
WIM Type/Manufacturer ______________________________________
Last Calibration Date of WIM __________________
Does Agency agree to provide a minimum of three years of continuous
WIM data? (Y or N) _____________________

Sheet B. SPS-12 Candidate Project Nomination and Information

STATE/PROVINCE ____________________
SHRP ID ____________________

Existing Pavement Structure Information

Pavement IRI (in/mile) ____
Pavement Condition ____
____
____

Existing Layer Structure

Layer No.[1]	Layer Description	Material Code[2]	Thickness (in)
1	**Subgrade**		
2			
3			
4			
5			
6			
7			
8			
9			

Notes:

1. Layer 1 is the naturally occurring subgrade soil. The pavement surface will have the largest assigned layer number.
2. Refer to tables A-1 through A-4 for material class codes.

Sheet C. SPS-12 Candidate Project Nomination and Information

STATE/PROVINCE ____________________
SHRP ID ____________________

Test Sections

Number of Core Test Sections ________________
Number of Planned Supplemental Test Sections ________________
Describe Proposed Supplemental Test Sections ______________________________

____
____
____
____
____
____
____

Site Deviation Comments ______________________________

____
____
____
____
____
____

Table 27. Pavement surface material type classification codes.

Hot Mixed, Hot Laid, Asphalt Concrete, Dense graded	01
Hot Mixed, Hot Laid, Asphalt Concrete, Open Graded (Porous Friction Course)	02
Sand Asphalt	03
Jointed Plain Portland Cement Concrete	04
Jointed Reinforced Portland Cement Concrete…	05
Continuously Reinforced Portland Cement Concrete	06
Prestressed Portland Cement Concrete	07
Fiber Reinforced Portland Cement Concrete	08
Plant Mix, Cold Laid, Emulsified Asphalt Material	09
Plant Mix, Cold Laid, Cutback Asphalt Material	10
Single Surface Treatment	11
Double Surface Treatment…	12
Hot Recycled, Central Plant Mix, Asphalt Concrete	13
Central Plant Mix, Cold Laid, Recycled Asphalt Concrete…	14
Mixed-in-place, Cold Laid, Recycled Asphalt Concrete	15
Heater Scarification/Recompaction, Recycled Asphalt Concrete	16
Jointed Plain Recycled Portland Cement Concrete	17
Jointed Reinforced Recycled Portland Cement Concrete	18
Other	19
Warm Mix Asphalt Concrete, Dense Graded	91
Warm Mix Asphalt Concrete, Open Graded	92
Warm Mix Asphalt Concrete, Gap Graded	93

Table 28. Base and subbase material type classification codes.

No Base (Pavement Directly on Subgrade)	21
Uncrushed Gravel	22
Crushed Stone, Gravel or Slag	23
Sand	24
Soil-Aggregate Mixture, Predominately Fine-Grained Soil	25
Soil-Aggregate Mixture, Predominately Coarse-Grained Soil	26
Soil Cement	27
Bituminous Dense Graded, Hot Laid, Central Plant Mix	28
Bituminous Dense Graded, Cold Laid, Central Plant Mix	29
Bituminous Dense Graded, Cold Laid Mixed-in-place	30
Bituminous Open Graded, Hot Laid, Central Plant Mix	31
Bituminous Open Graded, Cold Laid, Central Plant Mix	32
Bituminous Open Graded, Cold Laid, Mixed-in-place	33
Recycled Asphalt Concrete, Plant Mix, Hot Laid	34
Recycled Asphalt Concrete, Plant Mix, Cold Laid	35
Recycled Asphalt Concrete, Mixed-in-place	36
Sand Asphalt	46
Cement Aggregate Mixture	37
Lean Concrete (< 3 sacks/cy)	38
Recycled Portland Cement Concrete	39
Sand-Shell Mixture	40
Limerock, Caliche (Soft Carbonate Rock)	41
Lime-Treated Subgrade Soil	42
Cement Treated Subgrade Soil	43
Pozzolanic-Aggregate Mixture	44

Table 29. Subgrade soil Description codes.

FINE-GRAINED SUBGRADE SOILS

Clay (Liquid Limit > 50)	51
Sandy Clay	52
Silty Clay	53
Silt	54
Sandy Silt	55
Clayey Silt	56

COARSE-GRAINED SOILS

Sand	57
Poorly Graded Sand	58
Silty Sand	59
Clayey Sand	60
Gravel	61
Poorly Graded Gravel	62
Clayey Gravel	63
Shale	64
Rock	65

Table 30. Material type classification codes for thin seals and interlayers.

Chip Seal Coat	71
Slurry Seal Coat	72
Fog Seal Coat	73
Woven Geotextile	74
Nonwoven Geotextile	75
Stress Absorbing Membrane Interlayer	77
Dense Grades Asphalt Concrete Interlayer	78
Aggregate Interlayer	79
Open Graded Asphalt Concrete Interlayer	80
Chip Seal with Modified Binder (Excluding Absorbing Membrane)	81
Sand Seal	82
Asphalt Rubber Seal Coat (Stress Absorbing Membrane)	83
Sand Asphalt	84
Other	85

A.2 CONSTRUCTION DATA SHEETS

The purpose of this section of appendix A is to detail the construction data collection requirements for test sections in the LTPP SPS-12 experiment. These requirements are to be completed by the LTPP RSCs, through the use of LTPP-developed data sheets, with support from the participating highway agencies in order to develop complete construction data suites for each SPS-12 project.

A set of tables containing definitions or codes, which are required for completion of several of the SPS-12 construction data sheets, are included at the end of this appendix section.

Supplemental sections may contain treatment types for which the SPS-12 data sheets are not adequate to record the necessary information about these treatments. For these sections, additional data sheets from the LTPP Maintenance and Rehabilitation Guide, issued under separate directive, should be used to supplement the SPS-12 data sheets. The Guide contains further information on which sheets are appropriate for each construction event type.

SPS-12 DATA SHEETS

SPS-12 Data Sheets for the SPS-12 experiment include items for identifying general project and section specific attributes, as well as many layer and material specific items. Under the section Data Collection and Recording there is a complete set of SPS-12 Data Sheets, along with descriptions of each data sheet.

The following LTPP SPS construction data sheets were developed for the SPS-12 experiment.

Table 31. List of LTPP data sheets and titles.

LTPP SPS-12 Construction Data Sheet Number	LTPP SPS-12 Construction Data Sheet Title
LTPP SPS-12 Data Sheet 1	Project Identification
LTPP SPS-12 Data Sheet 2	Project Stations
LTPP SPS-12 Data Sheet 3	General Information
LTPP SPS-12 Data Sheet 4	Layer
LTPP SPS-12 Data Sheet 5	Age and Major Improvements
LTPP SPS-12 Data Sheet 6	Snow Removal/Deicing
LTPP SPS-12 Data Sheet 7-8	HPMS Data Items
LTPP SPS-12 Data Sheet 9	PCC Aggregate Properties
LTPP SPS-12 Data Sheet 10	PCC Mix Design
LTPP SPS-12 Data Sheet 11	PCC Strength
LTPP SPS-12 Data Sheet 12	PCC Construction
LTPP SPS-12 Data Sheets 13-14	PCC Joint Data
LTPP SPS-12 Data Sheets 15-17	AC Aggregate Properties
LTPP SPS-12 Data Sheet 18	AC Binder
LTPP SPS-12 Data Sheets 19-20	PMA Lab Mix Design
LTPP SPS-12 Data Sheet 21	PMA Lab Mix Design Warm Mix
LTPP SPS-12 Data Sheets 22-23	PMA Mix Prop
LTPP SPS-12 Data Sheet 24	Superpave Mixture Properties
LTPP SPS-12 Data Sheets 25-26	PMA Construction
LTPP SPS-12 Data Sheets 27-28	Unbound
LTPP SPS-12 Data Sheets 29-30	Subgrade
LTPP SPS-12 Data Sheet 31	QC Measurements
LTPP SPS-12 Data Sheet 32	Field Thickness
LTPP SPS-12 Data Sheet 33	Notes and Comments
LTPP SPS-12 Data Sheet 34	Improvement Listing
LTPP SPS-12 Data Sheet 35	Diamond Grinding
LTPP SPS-12 Data Sheets 36-37	Joint Sealant Application
LTPP SPS-12 Data Sheet 38	Penetrating Sealant Application

The following table should be used to complete the SPS-12 Data Sheets for the SPS-12 project and sections.

Table 32. List of LTPP data sheets to be completed for each section.

Construction Data Sheets	SPS-12G	SPS-12S	SPS-12P	Project Level
1				X
2				X
3				X
4	X	X	X	
5				X
6				X
7	X	X	X	
8	X	X	X	
9	1*	1*	1*	
10	1*	1*	1*	
11	1*	1*	1*	
12	1*	1*	1*	
13-14	1	1	1	
15-17	2	2	2	
18	2	2	2	
19-20	2	2	2	
21	2	2	2	
22-23	2	2	2	
24	2	2	2	
25-26	2	2	2	
27-28	3	3	3	
29-30	4	4	4	
31	X	X	X	
32	X	X	X	
33	X	X	X	
34	X	X	X	
35	G			
36-37		S		
38			P	

Legend:
X Always complete this data sheet.
1 Complete data sheet for each PCC layer (existing layers).
2 Complete data sheet for each AC layer (existing ATB layers).
3 Complete data sheet for each existing unbound layer.
4 Complete data sheet for each existing subgrade layer.
G Complete data sheet for each diamond grinding activity performed for SPS-12G
S Complete data sheet for each joint sealant activity performed for SPS-12S
P Complete data sheet for each penetrating sealant activity performed for SPS-12P
* Also complete data sheet for each existing lean concrete base layer.

DATA COLLECTION AND RECORDING

Record Data

These guidelines contain the SPS-12 Data Sheets necessary for recording data activities during the construction.

While spaces are provided in the data sheets for a broad array of data elements, it is recognized that much of the data will not be available. When the data element is not applicable to or represents something that does not exist on the test section enter an "N" to indicate that the data element is not applicable. If the data element is applicable, but the value is unknown (i.e., not available in project records), enter a "U" to indicate that the value is unknown. Many data items will require codes to be entered. Unless otherwise noted in the following instructions, the codes are listed or referenced on the data sheets.

Some construction data items may apply to more than one test section. However, a large portion of the data elements will be specific to each test section. Data items common to all test sections will be referred to as “project level data” while data items specific to each test section will be referred to as “section specific data.”

Data Common for all LTPP SPS-12 Data Sheets

A common set of project identification data appears in the upper right hand corner of every data sheet. These data items are described below.

> *State Code:* The State code is a number used to identify the state or Canadian province in which the pavement section is located (see table 33 in Standard Codes Tables section).
>
> *SHRP Section ID:* The section ID is a four-digit identification number assigned by LTPP. This number is used to facilitate the computer filing of the projects and will identify the section in the field.

SHRP ID

The SHRP section ID is a four-digit identification number assigned by LTPP. This number is used to facilitate the computer filing of the projects and will identify the section in the field.

SPS-12 sections have a six-digit identifier. The first two digits represent the State Code and the next four digits represent the SHRP ID. The first digit is a designator to differentiate between multiple projects for a specific SPS experiment in the same agency. An A, B, C, etc. is assigned to the first, second, third, etc. projects selected for a SPS-12 experiment in the same agency. The second digit of the SHRP ID identifies the section is a SPS-12 experiment. This digit will always be a C. The remaining two digits identify the individual test section. The test section number is specific to the experiment design. Project level data are specified using 00 as the test section number. For SPS projects, the inventory data are expected to apply to the entire project length. Therefore, the data should be entered for the project level section ID of 00.

Example: 04AC01

Where

04 is the state code for Arizona
A is the first SPS-12 experiment assigned in Arizona
C is the designation for a SPS-12 experiment
01 is the first section at this site

Description of LTPP SPS-12 Data Sheets

The following provides a description of each data sheet used in the collection of SPS-12 data.

Project ID (SPS-12 Data Sheet 1)

A project and section identification data sheet needs to be completed for each project. This data is to be filled out from project records on SPS-12 Data Sheet 1.

Individual data elements are as follows:

Date of Data Collection or Update (Item 1): The month and year in which the "as-built" construction inventory data was collected. The number to identify the month is in numerical sequence of the months as they occur during the year (enter 03 for March, etc.). The year is identified using four digits.

Highway Agency (HA) District Number (Item 2): The number identifying the SHA district in which the pavement test section is located.

County or Parish (Item 3): Code for the county or parish where the pavement section is located. County codes come from Federal Information Processing Standards Publication 6, "Counties of the States of the United States."

Functional Class (Item 4): The number identifying the functional classification of highway for which the pavement section is a sample (see table 34 in Standard Codes Tables section).

Route Number (Item 5): The signed route number (leading zeros should not be used). E.g., Interstate 81 should be coded as '81', Interstate 35W should be coded as '35'. This should be the same route number that is identified for the route in Data Items 4 and 5 (Route Signing and Route Qualifier).

Route Signing (Item 6): The type of route signing. These codes appear in table 55 in the Standards Codes Tables section.

Route Qualifier (Item 7): The type of route signing. Codes for route signing are provided on the data sheet.

Alternate Route Name (Item 8): A familiar, non-number designation for a route. This data item is optional and can be left null if it is unknown.

Number of Through Lanes (Item 9): The number indicating the total number of through lanes in the direction of travel.

Date Open to Traffic (Item 10): The year and month the project was opened to traffic.

Construction Costs Per Lane Mile (In $1000) (Item 11): The total average construction cost (in thousands) per lane mile for the test section.

Milepoint (Item 12): The milepoint at which the project is located.

Elevation (Item 13): The elevation of the project.

Additional Location Information (Item 14): Text describing any additional location information such as landmarks. This type of information will be useful for field crews locating the project during monitoring activities.

Project Stations (SPS -12 Data Sheet 2)

A reference project station system must be established for each project. While a majority of the construction data sheets are completed in English units, this data sheet will be completed in metric. This station referencing system starts with station 0+00 assigned to the starting point of the first test section encountered on the project. The station number of the beginning and end of all test sections on the project will be referenced to this point to provide a relative distance measure of the beginning, end, and distance between test sections on the site. This continuous system is used to avoid compounding measurement. This information will be used to process profile data collected from continuous measurements over the test sections and to identify the locations of the materials sampling and testing operations on the test sections for the entire site. Additionally, this information will indicate the ordering and distance between test sections.

Field measurements should be used to locate the start and end point of each test section with an accuracy of ± 0.1 meters (0.328 feet) using a steel tape. Ideally, these measurements should be made prior to overlay construction, e.g. when the test section locations are initially marked on the pavement. This data can then be used as a check against the repositioning of the start and end of the test sections following overlay construction. Otherwise, these measurements should be performed on the as-marked sections following construction.

This data is to be filled out from project records on SPS-12 Data Sheet 2.

Individual data elements are as follows:

Test Section ID (Item 1): The four-digit test section ID number should be entered for each SPS section.

Start Station Number (Item 2): The station number of the starting point of the test section relative to the starting point of the first test section on the project, to the nearest 0.1 meter.

End Station Number (Item 3): The station number of the ending point of the test section relative to the starting point of the first test section on the project, to the nearest 0.1 meter.

Subgrade Structure Type (Item 4): Enter the code number shown under note 1 on the data sheet to indicate if the test section is located entirely on fill, cut, at-grade or is located on both cut and fill. If the test section is located on both cut and fill, the approximate location of the cut-fill transition within the test section should be entered using a test section relative station number (0+00 to 1+52.4).

Direction of Travel (Item 5): Code for signed direction of traffic flow along the entire route, which includes the test section.

Intersections Between Test Sections on the Project (Item 6): If any intersections occur between any of the test sections on the project, indicate the number or name of the intersection route, the reference project station number (referenced to the start of the first test section on the project), and check whether it is an entrance or exit ramp, or an intersection with a stop sign, traffic signal, or is un-signalized.

General Information (SPS -12 Data Sheet 3)

This data sheet provides geometric, drainage and general information on the sections throughout the entire project length. This data is to be filled out from project records on SPS-12 Data Sheet 3.

Individual data elements are as follows:

Lane Width (Item 1): The width of the lane to be monitored, to the nearest whole number of feet.

Monitoring Site Lane Number (Item 2): A number that identifies which lane is to be monitored. The lane numbering methodology is identified on the data sheet. Lanes should be numbered starting with the outside lane as lane 1 and increasing toward the centerline of the roadway.

Direction of Travel (Item 3): Code for signed direction of traffic flow along the entire route, which includes the test section.

Speed Limit (Item 4): The posted speed limit for the given section of the road.

Median Type (Item 5): The type of median. Codes for the type of median are provided on the data sheet.

Median Width (Item 6): The existing median width.

Drainage Data (Items 7-10): Spaces are provided to enter data describing subsurface drainage features. If there is not drainage, enter "N" for those spaces pertaining to drainage.

Subsurface Drainage Location (Item 7): A code indicating whether the subsurface drainage is continuous along the section or is provided at intermittent locations. Codes are provided on the data sheet.

Subsurface Drainage Type (Item 8): A code indicating the type of system used to provide subsurface drainage from no subsurface drainage provided to a well system or a drainage blanket with longitudinal drains. Codes for each type of subsurface drainage are provided on the data sheet. A code and space are provided for describing another type of subsurface drainage if different from those provided on the data sheet.

Diameter of Longitudinal Drainpipes (Item 9): The inside diameter to the nearest tenth of an inch (0.1 inch) of the longitudinal drainpipes used for subsurface drainage. If there is no longitudinal drainage, enter "N."

Spacing of Laterals (Item 10): The average spacing in feet between lateral drains from the pavement subdrainage system. Enter "N" if there are no subdrainage laterals.

Shoulder Data (Items 11-16): Spaces are provided to enter data describing both the outside and inside shoulder. If there are no shoulders, enter "N" for those spaces pertaining to shoulders.

Shoulder Surface Type (Item 11): A code indicating the type of material used for the surface of the shoulder for the outside and inside shoulders. Codes are provided on the data sheet. If the full width of the shoulder is only partially paved, enter the code for the material used in the paved portion of the shoulder.

Total Width (Item 12): The total paved and unpaved width of the outside shoulder. A separate space is provided for the total paved and unpaved width of the inside shoulder to the nearest whole number of feet.

Paved Width (Item 13): The paved widths of the outside and inside shoulders to the nearest whole number of feet.

Shoulder Base Type (Item 14): Codes identifying the types of material used as the base of the pavement structure on the shoulders. See table 38 in Standard Codes Tables section.

Shoulder Surface Thickness (Item 15): The average thicknesses of the inside and outside shoulder surfaces to the nearest tenth of an inch (0.1 inch).

Shoulder Base Thickness (Item 16): The average base thicknesses along the shoulders to the nearest tenth of an inch (0.1 inch).

Layer (SPS -12 Data Sheet 4)

The data on this data sheet provide key information as to the structure of the pavement when it is open to traffic under the LTPP study. This data is to be filled out from project records on SPS-12 Data Sheet 4. As all subsequent data sheets refer back to this one, special care should be taken in establishing the layering.

Individual data elements are as follows:

Layer Number (Item 1): Space is provided for up to 9 layers. If more than 9 layers are needed, please use an additional SPS-12 Data Sheet 4. Layer numbering begins at the bottom of the structure and increases moving to the top of the structure. Therefore, the subgrade is always layer number 1 and the last (and largest) number identifies the surface layer.

Layer Description (Item 2): A layer description code identifying the function of the layer within the pavement structure is to be entered for each of the layers in the system. Codes are provided on SPS-12 Data Sheet 4. For AC layers, separate lifts of the same mixture are not to be identified as separate layers.

Many highway agencies cover poor subgrade soils with one to three feet of select material. Such an embankment should be reported as a subbase with a layer description code 06.

Material Type Classification (Item3): A code identifying the type of material used in each layer of the pavement structure, including the subgrade should be entered for material type classification. Codes for surfacing materials, base and subbase materials, subgrade soils, and thin seals and interlayers are identified in table 37 through table 40, respectively, in Standard Codes Tables section.

Layer Thickness (Item 4): Four numbers can be provided to indicate the Mean, Minimum, Maximum, and Standard Deviation of thickness for each specific layer in inches (enter to the nearest tenth of an inch (0.1 inch)). If only a single specified design value for thickness is available from project records, enter it as the "mean value."

Age and Major Improvements (SPS -12 Data Sheet 5)

This data sheet provides information regarding dates of construction for the primary pavement structure and any major improvements or rehabilitation that has occurred since that construction. Data should be provided for any improvement events on the existing pavement structure up to the SPS-12 construction. This data is to be filled out from project records on SPS-12 Data Sheet 4 for which long-term monitoring is planned.

Individual data elements are as follows:

Date of Latest (Re)Construction (Item 1): Month and year in which construction or reconstruction (if any, not including overlay or mill and overlay, have been performed) of the pavement to be monitored has been completed. The first two digits represent the numerical sequence of the month as it occurs during the year and the remaining four digits are the year.

Date Subsequently Opened to Traffic (Item 2): The month and year that the pavement was originally opened to traffic (not the date when the project was accepted). The first two digits represent the numerical sequence of the month as it occurs during the year and the remaining four digits are the year.

Latest (Re)Construction Cost Per Lane Mile (Item 3): The total average original construction or reconstruction cost in thousands of dollars per lane-mile for the project that includes the test section, exclusive of non-pavement costs such as bridges, culverts, lighting, and guard rails. This cost is to be reported as a cost indexed to the year reported in the data entry for "Date of Latest (Re)Construction."

Major Improvements Since Latest (Re)Construction (Items 4-8): Space is provided for identifying six major improvement activities by year in which they have been accomplished. This does not include bridges, culverts, lighting, etc. Major improvements do include overlays and associated pretreatments (patching, milling, joint repair, etc.), and inlays (mill and fill).

Year (Item 4): The year in which the major improvement was constructed.

Work Type Code (Item 5): A code to identify the type of activity performed. Codes are provided in table 49 in Standard Codes Tables section.

Work Quantity (Item 6): The quantity of work applied to the section in appropriate units (refer to table 49 in Standard Codes Tables section for determining appropriate units).

Thickness (Item 7): For improvements that increase the thickness of the pavement structure (such as "surface treatment, single layer" or "surface treatment, double layer," etc.), enter the thickness of the improvement to the nearest tenth of an inch (0.1 inch).

Major Improvement Type Other (Item 8): Type of improvement performed if other than those specified.

Additional Roadway Widening Information (Items 9-12): The following data items are applicable only if the roadway has been widened.

Year When Roadway Widened (Item 9): The year when the roadway was widened. If the roadway has not been widened, enter "N."

Original Number of Lanes (Item 10): The original number of lanes in the survey direction prior to roadway widening. If the roadway has not been widened, enter "N."

Final Number of Lanes (Item 11): The final number of lanes after the roadway has been widened. If the roadway has not been widened, enter "N."

Lane Number of Lane Added (Item 12): Lane number added when roadway has been widened. The outside lane is Lane 1; the next lane is Lane 2, etc. If the roadway has not been widened, enter "N."

Snow Removal/Deicing (SPS -12 Data Sheet 6)

This data sheet provides information on the snow removal and deicing practices used by the SHA at the test section location. This data is to be filled out from project records on SPS-12 Data Sheet 6.

Individual data elements are as follows:

Are Snow Plows Used on the Section (Item 1): A yes/no code indicating whether the section is subject to snow plow use or not. No may be used on sections that may occasionally get plowed, but do not have activity in a normal year (i.e. item 3 is zero).

Snow Plow Edge Type (*Item 2*): For sections that typically are plowed, indicate the most common blade edge type. Codes are provided on the data sheet.

Typical Number of Passes per Year (Item 3): Indicate the number of times in a typical year that the section is plowed – each pass of the plow should be counted individually. When Item 1 is 'N', this should be zero.

Typical Speed of Plowing Operation (Item 4): For sections that are typically plowed, indicate the common travel speed of the plow while plowing, in MPH.

Are Pre-Treatments Used on the Section (Item 5): A yes/no code indicating whether the section is subject to anti-icing pre-treatments. No may be used on sections that may occasionally get treated, but do not have activity in a normal year (i.e. item 7 is zero).

Type of Pre-Treatment Used (*Item 6*): For sections that typically are treated, indicate the most common treatment type. Codes are provided on the data sheet.

Typical Number of Applications per Year (Item 7): Indicate the number of times in a typical year that the section is treated. When Item 5 is 'N', this should be zero.

Are De-Icers Used on the Section (Item 8): A yes/no code indicating whether the section is subject to application of de-icing chemicals. No may be used on sections that may occasionally get treated, but do not have activity in a normal year (i.e. item 10 is zero).

Type of De-Icers Used (*Item 9*): For sections that typically receive de-icing, indicate the most common treatment type. Codes are provided on the data sheet.

Typical Number of Applications per Year (Item 10): Indicate the number of times in a typical year that de-icing agents are applied. When Item 8 is 'N', this should be zero.

Is the Section Subject to Chain Controls (Item 11): A yes/no code indicating whether the section is subject to chain controls. If the agency has provisions for chain controls on the section, regardless of how often they are applied, then this item should be 'Y.'

Typical Number of Applications per Year (Item 12): Indicate the number of times in a typical year that the section is subject to some type of chain requirement. When Item 11 is 'N', this should be zero.

HPMS Data Items (Project Level) (SPS -12 Data Sheet 7)

This data sheet provides project level HPMS data item information on the entire project length. This data is to be filled out from project records on SPS-12 Data Sheet 7.

Individual data elements are as follows:

HPMS Sample Number (Item 1): 12 digit "Section/Grouped Data Identification" assigned to any section of highway in the HPMS.

HPMS Section Subdivision (Item 2): Code used to identify a further subdivision of an original HPMS section. This code is generally included as a 13th digit of the HPMS sample number.

Urban Code (Item 3): The U.S. Census Urban Area Code. Enter up to five digits. Leading zeros are not required. Default codes for Urban Code are provided on SPS-12 Data Sheet 7.

Facility Type (Item 4): The operational characteristic of the roadway. Codes for each type of facility are provided on SPS-12 Data Sheet 7.

Access Control (Item 5): The degree of access control for the given section of the road. Codes for each type of access control are provided on SPS-12 Data Sheet 7.

Ownership (Item 6): The entity that has legal ownership of a roadway. If more than one code applies, code the lowest numerical value. These codes appear in table 56 in the Standard Codes Tables section.

HOV Type (Item 7): The type of HOV (High Occupancy Vehicle Operations Type) operations. Codes for each type of HOV are provided on SPS-12 Data Sheet 7.

HOV Lanes (Item 8): The maximum number of lanes in both directions designated for HOV operations.

Peak Lanes (Item 9): The number of lanes in the peak direction of flow during the peak period.

Counter Peak Lanes (Item 10): The number of lanes in the counter-peak direction of flow during the peak period.

Right Turn Lanes (Item 11): The presence of right turn lanes at a typical intersection. These codes appear in table 57 in Standard Codes Tables section.

Left Turn Lanes (Item 12): The presence of right turn lanes at a typical intersection. These codes appear in table 57 in Standard Codes Tables section.

HPMS Data Items (Project Level) (Continued) (SPS -12 Data Sheet 8)

The data on this data sheet is a continuation of the information from SPS-12 Data Sheet 7.

Individual data elements are as follows:

Toll Charged (Item 1): Identify if the site is a toll facility regardless of whether or not a toll is charged. Codes for each type of toll charge are provided on SPS-12 Data Sheet 8.

Toll Type (Item 2): Indicate if this site has the presence of special tolls (i.e. High Occupancy Toll (HOT) or other managed lanes. Codes for each type of toll charge are provided on SPS-12 Data Sheet 8.

Widening Obstacles (Item 3): Obstacles that prevent widening of the existing roadway for additional through lanes. Code all conditions that apply in either direction on either side of the section and leave blank for unreported data. Enter any combination of the codes (e.g. if there are Historic and Dense development obstacles, code "EA" or "AE" for this Data Item). There is no requirement for the ordering of the codes; a code should not be used more than once in a sequence of codes (e.g. "AEA"). Code "X" cannot be used with other codes (e.g. "XE"). This item provides for the coding of obstacles which may prevent or limit the ability to widen the roadway surface within approximately 100 feet of the outer edge of the through lanes that are present in either direction of the section. Codes for widening obstacles are provided in table 58 in Standard Codes Tables section.

Widening Potential (Item 4): The number of through lanes that could be potentially added. Code the number of lanes (0-9) for which it is feasible to widen the existing road, in both directions. Code a '9,' if it is possible to add nine or more lanes. Code this item based on how feasible it is to widen the existing road based on the presence of obstacles as identified in Data Item 13 (Widening Obstacles), and the proximity of the obstacle to the roadway.

Terrain Type (Item 5): The type of terrain. Codes for the type of terrain are provided on the data sheet.

Curve Classification (Item 6): The curve classification data, using the degree of curvature ranges provided on SPS-12 Data Sheet 8.

Grade Classification (Item 7): The grade classification, using the percent grade ranges provided on SPS-12 Data Sheet 8.

Percent Passing Sight Distance (Item 8): The percent of the section length that is striped for passing.

PCC Aggregate Properties (SPS -12 Data Sheet 9)

This data sheet provides information regarding asphalt aggregate properties. This data is to be filled out from project records on SPS-12 Data Sheets 9, 11 and 11. Agency records should be used to complete this data sheet to the extent possible for all existing PCC layers

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this sheet is being provided (from SPS-12 Data Sheet 4).

Composition of Coarse Aggregate (Items 2, 3 and 4): When more than one coarse aggregate is used, the type code as provided on the data sheet and percentage by total weight of coarse aggregate should be indicated for each coarse aggregate. Space is provided for up to three different types of coarse aggregate. If only one type of coarse aggregate is used, enter its type and 100 percent in the top set of the data spaces, leaving the others blank. Space is provided for identifying another type of material if one was used other than those for which codes are provided. Coarse aggregate is considered to be that portion retained on the No. 8 (2.36-mm) sieve.

Geologic Classification of Coarse Aggregate (Item 5): The geologic classification of the natural stone used as coarse aggregate in the concrete. These codes appear in table 41 in in Standard Codes Tables section and provide identification as to which of the three major classes of rock the coarse aggregate belongs to and the type of rock within those classes. If a "blend" was used, enter the code for the geologic classification for the material representing the majority of the coarse aggregate. If a "crushed slag", "manufactured lightweight", or "recycled concrete" was used, enter "N."

Composition of Fine Aggregate (Items 6, 7, and 8): When more than one fine aggregate is used, the type code as provided on the data sheet and percentage by total weight of fine aggregate should be indicated for each fine aggregate. Fine aggregate is defined as that passing the No. 8 (2.36-mm) sieve and retained on the No. 200 (75-µm) sieve. Space is provided for up to three different fine aggregate types. If only one type of fine aggregate is used, enter its type code and 100 percent in the top set of the data spaces, leaving the others blank.

Insoluble Residue (Item 9): Enter the percentage of insoluble residue (non-carbonate material) as determined using ASTM D3042.

Aggregate Durability Test Results (Items 11-13): The type of tests used to evaluate the durability of the aggregate used in the mix and the results in thousandths (0.001) recorded in units specified for the test. Three of these sets are for coarse (Items 11, 12, and 13) and one (Item 14) for the combination of coarse and fine aggregates. The durability test type codes appear in table 45 in Standard Codes Tables section.

Bulk Specific Gravities (Items 14 and 15): The bulk specific gravities (to the nearest thousandth (0.001)) for coarse aggregate (Item 14) and fine aggregate (Item 15). The bulk specific gravities for the aggregate fractions are measured using the laboratory procedures indicated on the data sheet. The bulk specific gravity for the aggregate combination (usually called "bulk specific gravity of aggregate") is calculated as follows:

$$G_{sb} = \frac{P_1 + P_2 + P_3}{\frac{P_1}{G_1} + \frac{P_2}{G_2} + \frac{P_3}{G_3}}$$

Figure 15. Equation. Bulk specific gravity for the total aggregate.

where:

G_{sb} = Bulk specific gravity for the total aggregate

P_1,P_2,P_3	=	Percentages by weight of coarse aggregate, fine aggregate, and mineral filler
G_1,G_2,G_3	=	Specific gravities of coarse aggregates, fine aggregates, and mineral filler

Gradation of Aggregates (Items 16 and 17): The percent passing various standard sieve sizes to the nearest one percent of the coarse and fine aggregates. It is not expected that values will be available for all sieve sizes shown; the objective is to provide sufficient sieve sizes to accommodate testing and specification practice for most agencies.

PCC Mix Design (SPS-12 Data Sheet 10)

This data sheet provides information regarding the mix proportions used in the PCC layer mixture.

Individual data elements are as follows.

Layer Number (Item 1): The number of the layer for which the data on this sheet is being provided (from SPS-12 Data Sheet 4).

Mix Design (Items 2 thru 5): The oven dry weights in pounds of Coarse Aggregate, Fine Aggregate, Cement, and weight of Water provided by the mix design for a cubic yard of concrete.

Cement Type Used (Item 6): Type of cement used in the slab concrete. These cement type codes appear in table 43 in Standard Codes Tables section. Additionally, if none of the codes provided are applicable to the type used, space is provided for identifying another type.

Alkali Content of Cement (Item 7): The alkali content of the cement to the nearest tenth of a percent (0.1 percent), expressed as sodium oxide equivalent.

Entrained Air Content (Items 8, 9, and 10): The Mean, Minimum, and Maximum values of entrained air (percent of mixture volume) as measured (by Test Methods AASHTO T121 (ASTM C138), AASHTO T152 (ASTM C231), and AASHTO T196 (ASTM C173)) during construction to the nearest tenth of a percent (0.1 percent).

Admixtures (Items 11, 12, and 13): The types and amounts (in percent by weight of cement to the nearest thousandth (0.001)) of admixtures used in the concrete. The codes for concrete admixtures appear in table 44 in Standard Codes Tables section.

Slump (Items 14 thru 18): The Mean of the slump measurements made, the Minimum and Maximum values, the Standard Deviation from the mean to the nearest tenth of an inch (0.1 inch) and the Number of Tests from which the values are obtained. The slump test is described in AASHTO T119 (ASTM C143). The maximum and minimum values and standard deviation of slump should be left blank if only one test result is available.

PCC Strength (SPS-12 Data Sheet 11)

This data sheet is used to provide strength data on cylinders or beams molded from plastic concrete during construction.

Individual data elements are as follows.

Layer Number (Item 1): The number of the layer for which the data on this sheet is being provided (from SPS-12 Data Sheet 4).

Flexural Strength (Items 2 thru 8): The Type of Test (third-point or center-point loading, as coded on the data sheet), the Age of the samples at the time of testing, the Number of Tests performed, and the Mean, Minimum, Maximum, and Standard Deviation of flexural strength tests, in psi. The preferred type of test for LTPP test sections is the third-point loading (AASHTO T97 (ASTM C78)).

Compressive Strength (Items 9 thru 14): The Age of the samples at the time of testing, the Number of Tests performed, and the Mean, Minimum, Maximum, and Standard Deviation of compressive strength in psi, measured according to AASHTO T22 (ASTM C39).

Splitting Tensile Strength (Items 15 thru 20): The Age of the samples at the time of testing, the Number of Tests, and the Mean, Minimum, Maximum, and Standard Deviation of splitting tensile strength in psi, measured according to AASHTO T198 (ASTM C496).

Elastic Modulus (Items 21 thru 26): The Mean, Minimum, Maximum, and Standard Deviation of elastic moduli of the concrete in kips per square inch and the Number of Tests performed. The elastic moduli can be obtained either through compression testing of cylindrical samples collected and tested during construction, or through relationships published by the American Concrete Institute (ACI) and others relating elastic modulus to compressive strength. The ACI formula in general use (ACI 318-83, Section 8.5) is:

$$E_c = 57{,}000 \sqrt{f_c}$$

Figure 16. Equation. Modulus of Elasticity.

where:
E_c = Modulus of Elasticity, psi
f_c = 28-Day Compressive Strength, psi

In the event that only one test result is available, enter it as the "mean value." The standard deviation should be left blank unless at least four test results are available. Space is also provided to record the Method for Determination of Elastic Modulus, the test method used for measuring the elastic modulus of the mix; whether the test was conducted upon a sample of the concrete prepared during construction, by some other test procedures, or calculated using the equation above.

PCC Construction Data (SPS-12 Data Sheet 12)

This data sheet includes information regarding the construction of the PCC layer.

Individual data elements are as follows.

Layer Number (Item 1): The number of the PCC overlay layer for which a description is being provided (from Sheet 2).

Date Paving Began (Item 2): The date the paving operation was started.

Date Paving Complete (Item 3): The date the paving operation was ended

Type of Paver Used (Item 4): Record whether a slip-form or side-form paver was used to place the concrete. The codes appear on the data sheet along with space for identifying another type of paver, if needed. Enter "N" if a paver was not used (i.e., roller compacted concrete).

Paver Manufacturer/Model (Item 5): Enter the manufacturer of the paver and the manufacturer's model designation.

Air Temperatures During Placement (Items 6, 7, and 8): The Mean air temperature at the time the overlay concrete was placed (in degrees Fahrenheit) and the range of air temperatures (Minimum and Maximum) occurring during placement.

Curing Period Before Opening to Any Traffic (Item 9): The number of days the concrete was allowed to cure before opening the pavement to traffic (including construction traffic).

Time Before Sawing Joints (Item 10): The number of hours between the time the concrete was placed and the joints were sawed.

Consolidation of Materials (Item 11): The method used to consolidate the concrete. Space is provided for identifying another method if none of those with codes was used.

Finishing (Item 12): The method used to finish the concrete. Space is provided for identifying another method if none of those with codes was used.

Method Used to Cure Concrete (Item 13): The method used to cure the concrete pavement. Codes are provided on the data sheet. Space is provided for identifying another curing method if none of those with codes was used.

Method Used to Texture Concrete (Item 14): The method used to provide texture to the concrete surface. Codes are provided on the data sheet.

PCC Joint Data (SPS-12 Data Sheet 13)

This data sheet provides information on the joints used in an existing PCC layer.

Individual data elements are as follows.

Layer Number (Item 1): The number of the PCC overlay for which a description is being provided (from Sheet 2).

Average Contraction Joint Spacing (Item 2): The average spacing in feet (to the nearest tenth of a foot (0.1 ft)) between consecutive contraction joints (length of the concrete slab) of the pavement under survey. A space is provided to write in a description of any Random Joint Spacing (Item 3).

Built-in Expansion Joint Spacing (Item 4): The average spacing in feet between consecutive expansion joints of the pavement under survey. If there are no expansion joints in the original construction, enter "N."

Skewness of Joints (Item 5): The average distance in feet of the contraction joint from a normal (right-angled) joint at the opposite side of the lane. If not skewed, enter "N."

Transverse Contraction Joint Load Transfer System (Item 6): The mechanism by which a portion of the moving load is transferred across the transverse contraction joint to the adjacent slab. A space is provided to write in a description of another load transfer system if different from those for which codes are provided. Where dowels or other mechanical load transfer devices are not provided at joints, enter "N" in the spaces for describing these devices.

Round Dowel Diameter (Item 7): The outer diameter of the round dowel bars used as the load transfer device across a contraction joint of the pavement under survey. This number is entered to the nearest one-tenth of an inch (0.1 inch).

Dowel or Mechanical Load Transfer Device Spacing (Item 8): The average center-to-center distance in inches between mechanical load transfer devices (round or I-beam dowels, star lugs, etc.) across the contraction joint of the PCC layer being described.

Average Intermediate Sawed Joint Spacing (Item 9): The average distance between joints that have been sawed at intervals between contraction joints (called "warping joints" by some agencies). If no intermediate sawed joints have been provided, enter "N".

Dimensions for I-Beams or Keyways (Items 10 and 11): The Height and Width of I-beams or keyways (if used) to the nearest hundredth of an inch (0.01 inch).

Distance of Nearest Dowel (or Mechanical Load Transfer Device) From Outside Lane-Shoulder Edge (Item 12): The distance from the outside lane-shoulder edge to the center of the nearest dowel or mechanical load transfer device, measured to the nearest tenth of an inch (0.1 inch).

Dowel Length (Item 13): The length in inches of the round or I-beam dowel bars across contraction joints in the PCC layer being described.

Dowel Coating (Item 14): The material covering the dowel bar surfaces when installed in the concrete slab. A space is provided to write in a description if some dowel coating has been used other than those for which codes are provided on the data sheet.

Method Used to Install Mechanical Load Transfer Devices (Item 15): Whether the devices were installed by placing them on baskets, installed mechanically, or by other means. Space is provided for describing some method of installing dowels if the method used differs from those for which codes are provided on the data sheet.

PCC Joint Data (Continued) (SPS-12 Data Sheet 14)

This data sheet is a continuation of the data provided on Sheet 13.

Individual data elements are as follows.

Layer Number (Item 1): The number of the PCC overlay for which a description is being provided (from Sheet 2).

Method Used to Form Transverse Joints (Item 2): Whether the contraction joints were constructed by sawing the hardened slab at the proper time, or by placing an insert in the slab surface while the concrete is plastic, or by any other construction method used to form the joint. Codes are provided on the data sheet. Space is provided for describing another method if none of those for which codes were provided was used.

Type of Longitudinal Joint (Item 3): How the longitudinal joint between the lanes was formed. Codes are provided on the data sheet.
Type of Shoulder-Traffic Lane Joint (Item 4): A code indicating how the joint between the shoulder and the traffic lane was formed. "Tied concrete curb" indicates that a curb was provided in lieu of a shoulder. Codes are provided on the data form.

Transverse Joint Sealant Type (Item 5): Type of joint sealant used in the transverse joints. Codes are provided on the data sheet.

Transverse Joint Sealant Reservoir Width (Item 6): The as-constructed width of the transverse joint sealant reservoir to the nearest hundredth of an inch (0.01 inch).

Transverse Joint Sealant Reservoir Depth (Item 7): The as-constructed depth of the transverse joint sealant reservoir to the nearest hundredth of an inch (0.01 inch).

Longitudinal Joint Sealant Reservoir Width (Item 8): The width of the as-built longitudinal joint sealant reservoir to the nearest hundredth of an inch (0.01 inch). If butt or keyed joints have been used without a sealant reservoir, enter "0.00."

Longitudinal Joint Sealant Reservoir Depth (Item 9): The depth of the as-built longitudinal joint sealant reservoir to the nearest hundredth of an inch (0.01 inch). If butt or keyed joints were used without a sealant reservoir, enter "0.00."

Joint Sealant Backer Material Type (Item 10): A code to indicate the type of blocking material used (placed prior to the joint sealant). Codes are provided on the data sheet.

Joint Sealant Backer Dimension (Item 11): If the joint sealant backer material type is a rod or rope, enter the diameter, in inches to the nearest tenth of an inch (0.1 inch). If the joint sealant backer material type is tape, enter the width, in inches to the nearest hundredth of an inch (0.01 inch).

Between Lane Tie Bar Diameter (Item 12): The diameter of the tie bars used across longitudinal joints between lanes entered to the nearest one hundredth of an inch (0.01 inch).

Between Lane Tie Bar Length (Item 13): The length in inches of the tie bars used across the longitudinal joint between the lanes.

Between Lane Tie Bar Spacing (Item 14): The center-to-center spacing between consecutive tie bars across the longitudinal joint between the lanes to the nearest tenth of an inch (0.1 inch).

Shoulder-Traffic Lane Joint Sealant Reservoir (Items 15 and 16): The Width and Depth of the as-built joint sealant reservoir between the shoulder and traffic lane. If butt or keyed joints have been used without a sealant reservoir, enter "0.00" in both of the spaces provided.

Shoulder-Traffic Lane Joint Tie Bars (Items 17, 18, and 19): The outer Diameter of the tie bars across the joint between the shoulder and the traffic lane to the nearest one hundredth of an inch (0.01 inch), the Length of the tie bars to the nearest inch, and the center-to-center distance (Spacing) in inches between consecutive tie bars across the concrete shoulder-traffic lane joint. If no concrete shoulder exists, enter "N" for these data entry spaces.

AC Aggregate Properties (SPS-12 Data Sheet 15)

This data sheet provides information regarding asphalt aggregate properties. This data is to be filled out from project records on SPS-12 Data Sheets 15, 16 and 17. This data sheet should be completed for all asphalt treated base layers.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this sheet is being provided (from SPS-12 Data Sheet 4).

Type of Aggregate (Item 2): The type of aggregate used as identified by one of the codes appearing on the data sheet.

Composition of Coarse Aggregate (Items 3,4 and 5): When more than one coarse aggregate is used, the type code as provided on the data sheet and percentage by total weight of coarse aggregate should be indicated for each coarse aggregate. Space is provided for up to three different types of coarse aggregate. If only one type of coarse aggregate is used, enter its type and 100 percent in the top set of the data spaces, leaving the others blank. Space is provided for identifying another type of material if one was used other than those for which codes are provided. Coarse aggregate is considered to be that portion retained on the No. 8 (2.36-mm) sieve.

Geologic Classification of Coarse Aggregate (Item 6): The geologic classification of the natural stone used as coarse aggregate in the concrete. These codes appear in table 41 in Standard Codes Tables section and provide identification as to which of the three major classes of rock the coarse aggregate belongs to and the type of rock within those classes. If a "blend" was used, enter the code for the geologic classification for the material representing the majority of the coarse aggregate. If a "crushed slag", "manufactured lightweight", or "recycled concrete" was used, enter "N."

Composition of Fine Aggregate (Items 7, 8, and 9): When more than one fine aggregate is used, the type code as provided on the data sheet and percentage by total weight of fine aggregate should be indicated for each fine aggregate. Fine aggregate is defined as that passing the No. 8 (2.36-mm) sieve and retained on the No. 200 (75-µm) sieve. Space is provided for up to three different fine aggregate types. If only one type of fine aggregate is used, enter its type code and 100 percent in the top set of the data spaces, leaving the others blank.

Type of Mineral Filler (Item 10): The type of mineral filler as identified by one of the codes appearing on the data sheet.

Aggregate Durability Test Results (Items 11-14): The type of tests used to evaluate the durability of the aggregate used in the mix and the results in thousandths (0.001) recorded in units specified for the test. Three of these sets are for coarse (Items 11, 12, and 13) and one (Item 14) for the combination of coarse and fine aggregates. The durability test type codes appear in table 45 in Standard Codes Tables section.

AC Aggregate Properties (Continued) (SPS-12 Data Sheet 16)

This data sheet is a continuation of the data on SPS-12 Data Sheet 15.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

Type of Aggregate (Item 2): The type of aggregate used as identified by one of the codes appearing on the data sheet.

Polish Value of Coarse Aggregates (Item 3): The accelerated polish value of the coarse aggregates used in the surface layer, as determined by AASHTO T279 (ASTM D3319).

Angularity Coarse One Face (Item 4): The coarse aggregate angularity for aggregates with one or more faces.

Angularity Coarse Two Faces (Item 5): The coarse aggregate angularity for aggregates with two or more faces.

Angularity Fine (Item 6): The angularity for fine aggregate.

Soundness Coarse (Item 7): The coarse aggregate soundness.

Soundness Fine (Item 8): The fine aggregate soundness.

Coarse Aggregate Toughness (Item 9): The toughness of coarse aggregate.

Deleterious Materials (Item 10): The estimate of percentage of deleterious materials.

Clay Content (Item 11): The clay content determined by the use of the Sand Equivalent.

Thin Elongated Particles (Item 12): The percentage by weight of aggregate that have a maximum to minimum dimension of greater than 5.

Gradation of Combined Aggregates (Item 13): The percent passing (of coarse and fine aggregates) on various standard sieve sizes to the nearest one percent. It is not expected that values will be available for all eighteen sieve sizes; the objective is to provide a sufficient number of sieve sizes to accommodate testing and specification practice for most highway agencies.

AC Aggregate Properties (Continued) (SPS-12 Data Sheet 17)

This data sheet is a continuation of the data on SPS-12 Data Sheets 15 and 16.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

Type of Aggregate (Item 2): The type of aggregate used as identified by one of the codes appearing on the data sheet.

Absorption of Aggregate (Items 3 and 4): The absorption of aggregates (to the nearest thousandth (0.001)) for coarse aggregate (Item 3) and fine aggregate (Item 4). The absorption of aggregates can be determined using AASHTO T85 and ASTM C127 (coarse aggregate) or AASHTO T84 and ASTM C128 (fine aggregate).

Bulk Specific Gravities (Items 5-8): The bulk specific gravities (to the nearest thousandth (0.001)) for coarse aggregate (Item 5), fine aggregate (Item 6), mineral filler (Item 7), and the aggregate combination (Item 8). The bulk specific gravities for the aggregate fractions are measured using the laboratory procedures indicated on the data sheet. The bulk specific gravity for the aggregate combination (usually called "bulk specific gravity of aggregate") is calculated using figure 15.

Effective Specific Gravity of Aggregate Combination (Item 9): The calculated effective specific gravity to the nearest thousandth (0.001). This calculation requires the maximum specific gravity (no air voids) of the paving mixture, which is obtained by Test Method AASHTO T209 or ASTM D2041. The effective specific gravity of the aggregate is calculated as follows:

$$G_{se} = \frac{100 - P_b}{\frac{100}{G_{mm}} - \frac{P_b}{G_b}}$$

Figure 17. Equation. Effective specific gravity of aggregate.

where:

G_{se}	=	Effective specific gravity of aggregate
P_b	=	Asphalt cement, percent by total weight of mixture
G_b	=	Specific gravity of asphalt
G_{mm}	=	Maximum specific gravity of paving mixtures (no air voids)

Theoretical Maximum Specific Gravity of the RAP/RAS (Item 10): The theoretical maximum specific gravity for the aggregate combination of the reclaimed asphalt shingles.

AC Binder (SPS-12 Data Sheet 18)

A new data sheet should be filled out for each type of binder that is used in the layer (Virgin, RAP, RAS and Combined.) This sheet should be completed for all asphalt treated base layers.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

Type of Binder (Item 2): The type of binder used as identified by one of the codes appearing on the data sheet.

Asphalt Grade (Item 3): The Performance Grade (PG) of performance graded binders. If a PG Binder was not used, enter "N."

Asphalt Grade (Item 4): The grade of asphalt cement used (see table 48 in Standard Codes Tables section) prior to addition of WMA technology. Space is provided on the data sheet for identifying another grade of asphalt cement not appearing in table 48.

Source (Item 5): The refinery that produced the asphalt cement used in the WMAC layer being described. If PG Grading was not used, leave this field null. A list of asphalt refiners and processors is provided in table 46 in Standard Codes Tables section. Space is provided to specify other sources which may not be included in the table provided.

Specific Gravity of Asphalt Cement (Item 6): The specific gravity of the asphalt cement (to the nearest thousandth (0.001)) when it is available. If unavailable, a typical specific gravity for asphalt cements produced at the source refinery may be entered. This specific gravity is measured as specified by AASHTO T228 (ASTM D70).

Viscosity of Asphalt at 140°F (Item 7): The result in poises from absolute viscosity testing using Test Method AASHTO T202 (ASTM D2171) on samples of the original asphalt cement prior to its use in construction of the pavement section and prior to addition of WMA technology.

Viscosity of Asphalt at 275°F (Item 8): The results in centistokes (to the nearest hundredth (0.01)) from kinematic viscosity testing using Test Method AASHTO T201 (ASTM D2170) on samples of the original asphalt cement and prior to addition of WMA technology.

Penetration at 77°F (Item 9): The penetration (in tenths of a millimeter (0.1 mm)) at 77°F (25°C) with a 100-gram load and a five-second load duration using Test Method AASHTO T49 (ASTM D5) on the original asphalt cement in the mixture and prior to addition of WMA technology.

Asphalt Modifiers (Items 10 and 11): Space is provided to list the type and quantity of up to two modifiers added to the asphalt cement for whatever purpose. A list of possible asphalt cement modifiers and codes for data entry are provided in table 47 in Standard Codes Tables section. The quantities of modifier should be provided in percent of asphalt cement weight. Some modifiers (such as lime) may be specified in terms of "percent of aggregate weight," but they must be converted to percent of asphalt cement weight for uniformity. WMA technologies are not to be considered modifiers.

Ductility at 77°F (Item 12): The ductility in centimeters at 77°F (25°C) using Test Method AASHTO T51 (ASTM D113) and prior to addition of WMA technology.

Ductility at 39.2°F (Item 13): The ductility in centimeters at 39.2°F (4°C), using the procedures of Test Method AASHTO T51 (ASTM D113) and prior to addition of WMA technology.

Test Rate for Ductility Measurement at 39.2°F (Item 14): The test speed in centimeters per minute for the ductility measurement taken at 39.2°F (4°C) and prior to addition of WMA technology.

Penetration at 39.2°F (Item 15): The penetrating (in tenths of a millimeter (0.1 mm)) at 39.2°F (4°C), with a 200-gram load and a 60-second load duration using Test Method AASHTO T49 (ASTM D5) on samples of the original asphalt cement, prior to its use as a construction material and prior to addition of WMA technology.

Ring and Ball Softening Point (Item 16): The softening point of the asphalt cement in degrees Fahrenheit as measured with the ring-and-ball apparatus used in Test Method

AASHTO T53 (ASTM D36), on samples of the original asphalt cement prior to its use as a construction material and prior to addition of WMA technology.

PMA Laboratory Mix Design (SPS-12 Data Sheet 19)

This data sheet provides information regarding laboratory mixture design. This data is to be filled out from project records on SPS-12 Data Sheets 19 and 20 for which long-term monitoring is planned.

This data sheet should be completed for all asphalt treated base layers.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

Maximum Specific Gravity (Item 2): The maximum specific gravity (to the nearest thousandth (0.001)), calculated using figure 17 and figure 18.

$$G_{mm} = \frac{100}{\dfrac{P_s}{G_{se}} + \dfrac{P_b}{G_b}}$$

Figure 18. Equation. Maximum specific gravity of paving mixture.

where:

G_{mm}	=	Maximum specific gravity of paving mixture (no air voids)
P_s	=	Aggregate, percent by total weight of mixture
G_{se}	=	Effective specific gravity of aggregate
P_b	=	Asphalt, percent by total weight of mixture
G_b	=	Specific gravity of asphalt

Bulk Specific Gravity (Item 3): The bulk specific gravity (to the nearest thousandth (0.001)) of the recycled mixture compacted in the laboratory at the optimum asphalt content selected and by appropriate procedures for Marshall or Hveem stability. Test Method ASTM D1188 is to be used for establishing the bulk specific gravity.

Optimum Asphalt Content (Item 4): The optimum amount of asphalt cement as obtained from Marshall or Hveem Stability testing that is added to the recycled mixture to the nearest one-tenth of a percent (0.1 percent).

Percent Air Voids (Item 5): The calculated air voids (to the nearest tenth of a percent (0.1 percent)) in the recycled mixture, compacted in the laboratory to the optimum asphalt content and by appropriate procedures for Marshall or Hveem stability. Figure 19 may be used for calculating the percent air voids.

$$P_a = 100\,\frac{G_{mm} - G_{mb}}{G_{mm}}$$

Figure 19. Equation. Air voids in compacted mixture.

where:

P_a	=	Air voids in compacted mixture, percent of total volume
G_{mm}	=	Maximum specific gravity of paving mixture (zero air voids) as determined by ASTM D2041
G_{mb}	=	Bulk specific gravity of compacted mixture

Marshall Stability (Item 6): The Marshall Stability (Test Method AASHTO T245, (ASTM D1559)) of the mixture at optimum asphalt content in pounds.

Number of Blows (Item 7): The number of blows of the compaction hammer that were applied to each end of the specimen to compact it for Marshall Stability and flow testing.

Marshall Flow (Item 8): The Marshall Flow (Test Method AASHTO T245 (ASTM D1559)) of the mixture at optimum asphalt content. This item is to be entered as the whole number of the measured hundredth of an inch (i.e., if 0.15 is measured, enter "15").

Hveem Stability (Item 9): The Hveem Stability or "stabilometer value" of the mixture at optimum asphalt content as measured with the Hveem apparatus using Test Method AASHTO T246 (ASTM D1560).

Hveem Cohesiometer Value (Item 10): The cohesiometer value of the mixture at optimum asphalt content, in grams per 25-mm (1-inch) width (or diameter) of specimen, obtained by Test Method AASHTO T246 (ASTM D1560).

Voids in Mineral Aggregate (Item 11): Enter the design void space between the aggregate particles of a compacted AC mixture, which includes the air voids and the effective asphalt content, to the nearest tenth of a percent (0.1 percent). Percent of voids in mineral aggregate (VMA) is calculated as follows:

$$VMA = 100 - \frac{G_{mb} P_s}{G_{sb}}$$

Figure 20. Equation. Voids in mineral aggregate.

where:

VMA	=	Voids in mineral aggregate (percent of bulk volume)
G_{sb}	=	Bulk specific gravity of aggregate
G_{mb}	=	Bulk specific gravity of compacted mixture (ASTM D2726)
P_s	=	Aggregate, percent by total weight of mixture
	=	100 - (percent of asphalt cement by total weight of mixture)

Effective Asphalt Content (Item 12): The design effective asphalt content (total asphalt content of the paving mixture minus the portion of asphalt that is lost by absorption onto the aggregate particles as a percentage of the total mixture, to the nearest tenth of a percent (0.1 percent). The asphalt absorption may be calculated as a percent of total weight of mixture as follows:

$$P_{ab} = P_{ba} P_s = \frac{G_{se} - G_{sb}}{G_{sb} G_{se}} G_b P_s$$

Figure 21. Equation. Percent absorbed asphalt.

where:

P_{ab}	=	Absorbed asphalt, percent by weight of total mixture
P_{ba}	=	Absorbed asphalt, percent by weight of aggregate
P_s	=	Aggregate, percent by total weight of mixture
G_{se}	=	Effective specific gravity of aggregate
G_{sb}	=	Bulk specific gravity of aggregate
G_b	=	Specific gravity of asphalt

Superpave Gyratory Compaction N_{DESIGN} (Item 13): Enter the number of revolutions of the Superpave gyratory compactor to achieve 4 percent air voids.

Gyration Ratio: (Item 14): The gyration ratio measured. The recommended compactability criterion is the gyration ratio should be less than or equal to 1.25. The gyration ratio is calculated as follows:

$$Ratio = \frac{(N_{92})_{T-30}}{(N_{92})_T}$$

Figure 22. Equation. Gyration ratio.

where:

Ratio	=	Gyration ratio
$(N_{92})_{T-30}$	=	Gyrations to 92 percent relative density at 30°C below the planned field compaction temperature
$(N_{92})_T$	=	Gyrations to 92 percent relative density at the planned field compaction temperature

Asphalt Grade (Item 15): Enter the code for the asphalt grade used in asphalt mixtures, if available. (See asphalt code sheet table 48 in Standard Codes Tables section).

Hamburg Wheel Tracking Test Conditioning (Item 16): The condition of the Hamburg Wheel Tracking Test.

Deformation at 20,000 passes (Item 17): The deformation measurement at 20,000 passes during the Hamburg Wheel Tracking Test measured in inches.

Test Temperature (Item 18): The temperature used during the Hamburg Wheel Tracking Test in degrees of Fahrenheit.

Tensile Strength Ratio (AASHTO T283) (Item 19): Percentage of Tensile Strength Ratio using AASHTO T283.

PMA Laboratory Mix Design (Continued) (SPS-12 Data Sheet 20)

The data on this data sheet is a continuation of the information from SPS-12 Data Sheet 19.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

Flow Number (AASHTO TP-79) (Item 2): The number of cycles corresponding to the minimum rate of change.

Flow Number Temperature (Item 3): The flow number temperature in degrees Fahrenheit.

Planned Production Temperature (Item 4): The planned production temperature of the asphalt mixture in degrees Fahrenheit.

Planned Field Compaction Temperature (Item 5): The planned field compaction temperature in degrees Fahrenheit.

Design Asphalt Binder Content of Mix Without RAS/RAP (Item 6): The percentage of asphalt binder content without RAS or RAP.

Percent RAS in Mixture (Item 7): The percentage of reclaimed asphalt shingles in the mixture.

Percent Shingle Asphalt Binder in RAS (Item 8): The percentage of shingle asphalt binder in the reclaimed asphalt shingles.

Percent RAP in Mixture (Item 9): The percentage recycled asphalt cement in the mixture.

Percent Asphalt in RAP (Item 10): The percentage of asphalt in the recycled asphalt cement mixture.

Percent of RAP/RAS Binder in the Mix by Mass (Binder Replacement) (Item 11): The amount of binder from RAP/RAS as a percentage of total binder in the mixture (from the mix design).

Amount of New Untreated Aggregate Added (Item 12): The amount of new untreated aggregate added, to the nearest tenth of a percent (0.1 percent) of the combined weight of the aggregates in the recycled mixture.

Recycling Agent (Item 13): Codes to identify the Type and Quantity of recycling agent used. The codes for type appear in table 52 in Standard Codes Tables section. The amount of recycling agent should be provided by weight added to the reclaimed (aged) asphalt, to the nearest tenth of a percent (0.1 percent) of the reclaimed asphalt cement weight. As an example, if the weight of the recycling agent to be added to the aged asphalt cement was 41.5 percent of the weight of the aged asphalt in the reclaimed mixture, "41.5" would be entered on the data sheet.

Amount of New Asphalt Cement Added (Item 14): The quantity of new asphalt cement to the nearest tenth of a percent (0.1 percent) of total recycled mixture weight (includes reclaimed AC and untreated aggregate and asphalt cement/recycling agent added).

PMA Laboratory Mix Design (Warm Mix) (SPS-12 Data Sheet 21)

The data on this data sheet is a continuation of the information from SPS-12 Data Sheets 19 and 20. The sheet only needs to be filled out for sections that use warm mix asphalt.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

Type of Warm Mix Technology (Item 2): The type of warm mix technology that was used. If a technology other than those provided is used, space is provided to specify technology used and a brand name. If the mix is HMA, enter the code for none.

Form of WMA Additive (Item 3): The type of WMA technology, as identified on the data sheet, used in the mixture. If the mix is HMA, enter the code for none.

Dosage Rate (Item 4): The percent by total weight of the binder. If the binder is HMA, leave this field null.

Method of Introducing Additive to the Mix (Item 5): The method used to introduce the WMA technology to the mix. If a method other than those provided is used, space is provided to specify the method used. If the mix is HMA, enter the code for none.

PMA Mix Prop (SPS-12 Data Sheet 22)

This data sheet provides information regarding mixture properties as placed. This data is to be filled out from project records on SPS-12 Data Sheets 22 and 23 for which long-term monitoring is planned.

This data sheet should be completed for all asphalt treated base layers.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

Type of Samples (Item 2): Whether the test samples were sampled in the field and compacted in the laboratory, or removed from the compacted pavement. The codes appear on the data sheet.

Maximum Specific Gravity (Item 3): The Maximum Specific Gravity (no air voids) of a mixture sampled during or soon after construction according to AASHTO T209 or ASTM D2041. Where possible, several samples should be tested and the average entered. Use the resulting maximum specific gravity and the design asphalt content for the mixture to calculate the effective specific gravity of the aggregate using figure 17. Once the effective specific gravity of the aggregate is established, it may be used to calculate other maximum specific gravities for the mixture at other measured asphalt contents using figure 18.

Bulk Specific Gravity (Item 4): The Number of Tests and the Mean, Minimum, Maximum, and Standard Deviation of bulk specific gravities (to the nearest thousandth (0.001)) of compacted mixtures measured on cores removed from the pavement during or right after construction. While the test method specified in ASTM D1188 is preferable, the results from nuclear density tests (ASTM D2950), appropriately calibrated to measurements on cores, may also be used.

Asphalt Content (Item 5): The Number of Tests and the Mean, Minimum, Maximum, and Standard Deviation of percentages by weight of the total asphalt cement (including that absorbed by the aggregate) in the asphalt mixture to the nearest one-tenth of a percent (0.1 percent). Asphalt contents measured by extraction tests (AASHTO T164 (ASTM D2172)) on field samples are preferred, but results from nuclear test methods may also be used. If no such test results are available, enter the specified asphalt content as the mean, and leave the other spaces blank.

Percent Air Voids (Item 6): The Number of Tests and the Mean, Minimum, Maximum, and Standard Deviation of calculated air voids (to the nearest tenth of a percent (0.1 percent)) as a percent of the material volume. These data are frequently not available, but can be calculated using other available data from reports on mix design and density measurements on samples from the pavement. Percent air voids is calculated as shown in figure 19.

Voids in Mineral Aggregate (Item 7): The Number of Tests and the Mean, Minimum, Maximum, and Standard Deviation of mean void space between the aggregate particles of a compacted mixture, which includes air voids and the effective asphalt content, to the nearest one-tenth of one percent (0.1 percent). Percent of VMA is calculated as shown in figure 20.

Effective Asphalt Content (Item 8): The Number of Tests and the Mean, Minimum, Maximum, and Standard Deviation of effective asphalt content (total asphalt content of the paving mixture minus the portion of asphalt that is lost by absorption into the aggregate particles), expressed by weight of total mixture to the nearest tenth of a percent (0.1 percent). The asphalt absorption may be calculated as a percent of total weight of mixture as shown in figure 21.

PMA Mix Prop (Continued) (SPS-12 Data Sheet 23)

The data on this data sheet is a continuation of the data from SPS-12 Data Sheet 22.

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

Type of Samples (Item 2): Whether the test samples were sampled in the field and compacted in the laboratory, or removed from the compacted pavement. The codes appear on the data sheet.

Type of Asphalt Plant (Item 3): The type of plant that produced the asphalt concrete mixture. Codes are provided on the data sheet.

Type of Antistripping Agent (Item 4): The type of antistripping agent used in the mixture. The codes are provided in table 53 in Standard Codes Tables section.

Antistripping Agent Liquid or Solid Code (Item 5): A code to indicate whether the antistripping agent used is a liquid or solid. Codes are provided on the data sheet.

Amount of Antistripping Agent (Item 6): The amount of antistripping agent used in the mixture by weight to the nearest tenth of a percent of weight of asphalt if the agent is liquid and weight of aggregate if it is solid.

Moisture Susceptibility Test Type (Item 7): The type of test used to evaluate the moisture susceptibility of the asphalt mixture. Codes are provided on the data sheet.

Moisture Susceptibility Test Results (Item 8): Space is provided to record the Hveem Stability Number or Percent Stripped and the Tensile Strength Ratio or Index of Retained Strength, depending on the test procedure used.

Superpave Mixture Properties (SPS-12 Data Sheet 24)

This data sheet provides information regarding Superpave properties of the mixture as placed. This data is to be filled out from project records on SPS-12 Data Sheet 24 for which long-term monitoring is planned.

This data sheet should be completed for all asphalt treated base layers.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

Type of Samples (Item 2): Whether the test samples were sampled in the field and compacted in the laboratory, or removed from the compacted pavement. The codes appear on the data sheet.

Frequency Sweep (Item 3): The mean Complex Modulus and Phase SHRP Designation M-002 in PSI and to the nearest tenth of a degree (0.1°) for Phase Angle for each of the three temperatures (39.2°F, 68°F, 104°F (4°C, 20°C, and 40°C, respectively)). (Test method ASTM D7312.)

Uniaxial Strain (Item 4): The Axial Stress and percent Strain (SHRP Designation M-003) for each of the three temperatures (39°F, 68°F and 104°F) in kPa and the nearest hundredth of a percent strain (0.01 percent).

Volumetric Strain (Item 5): The Confining Pressure and percent Strain (SHRP Designation M-003) for each of the three temperatures (39°F, 68°F and 104°F) in kPa and the nearest hundredth of a percent strain (0.01 percent).

Simple Shear (Item 6): The Axial Stress, Shear Stress and percent Strain (SHRP Designation M-003) for each of three temperatures (preferred 39°F, 68°F and 104°F in PSI and the nearest hundredth of a percent strain (0.01 percent).

PMA Construction (SPS-12 Data Sheet 25)

This data sheet provides information regarding construction, roller and compaction data. This data is to be filled out from project records on SPS-12 Data Sheets 25 and 26.

This data sheet should be completed for all asphalt treated base layers.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

Date Operations Began (Item 2): The date paving operations began.

Date Paving Complete (Item 3): The date paving was completed.

Mixing Plant Type (Item 4): The type of mixing plant used. Codes are provided on the data sheet.

Mixing Plant Name (Item 5): Name of the mix plant.

Type of Materials Transfer Equipment Used (Item 6): A code to indicate the type of materials transfer equipment used. Space is also provided to describe some other type of equipment used if none of those for which codes are provided are used. Additionally, there is a space provided to list the brand name of the equipment used.

Tack Coat (Y/N) (Item 7): A yes or no field indicating whether a tack coat was applied.

Tack Coat Type (Item 8): The type of tack coat that was applied. The codes appear in table 48 in Standard Codes Tables section. Space is provided on the data sheet for identifying another type of tack coat if the types identified in table 48 are not applicable.

Tack Coat Dilution (Item 9): The dilution of the tack coat in percent asphalt as part of the total.

Application Rate (Item 10): The number to record the gallons per square yard(gal/yd^2) of the application rate.

Haul Distance and Time (Item 11): The distance from the plant to the site in miles, and the time from the plant to site in minutes.

Single Pass Laydown Width (Item 12): With of pavement (in feet) the paver lays down in a single pass.
Transverse Joint Location (Item 13): Location in meters from the start of the section to a transverse paving joint.

Longitudinal Surface Joint (Item 14): Code indicating whether the longitudinal surface joint is between lanes (1) or within the LTPP test lane (2).

Longitudinal Joint Offset (Item 15): Location (in feet) of the longitudinal joint from the outside shoulder.

Significant Events (Item 16): Note any significant events that may have impacted the paving operations. Include information such as disruptions, weather events, equipment issues, etc.

PMA Construction (Continued) (SPS-12 Data Sheet 26)

The data on this data sheet is a continuation of the data from SPS-12 Data Sheet 25.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

Mixing Temperature (Item 2): The temperature of the mixture during mixing at the plant (i.e., the mix as discharged) in degrees Fahrenheit.

Plant Exhaust Temperature (Item 3): The plant exhaust temperature in degrees Fahrenheit.

Mean Delivery Temperature (Item 4): The average temperature of mixture during delivery to the site in degrees Fahrenheit.

Laydown Temperatures (Item 5): The Number of Tests taken and the Mean, Minimum, Maximum, and Standard Deviation of temperatures measured. The temperature should be measured just behind the screed. Three to five measurements should be made.

Roller Data (Items 6-22): Codes appear on the data sheet for steel-wheeled tandem, pneumatic-tired, single-drum vibratory, and double-drum vibratory rollers. For each type of roller, spaces are provided to describe significant characteristics for up to four different rollers. Steel-wheeled tandem rollers are described by their gross weights to the nearest tenth of a ton (0.1 ton). Pneumatic-tired rollers are described by their gross weight and tire pressure in psi. Vibratory rollers are described by their gross weight in tons to the nearest tenth (0.1 ton), frequency in vibrations per minute, amplitude in inches to the nearest thousandth (0.001 inch), and roller speed in miles per hour to the nearest tenth (0.1 mph).

Compaction Data (Items 23-31): Spaces are provided to enter the compaction data up to four lifts.
Description of the Roller (Items 23-28): Descriptive data to identify the type of roller used (code from data sheet) and Number of Coverages for breakdown, intermediate, and final compactions for up to four lifts. A "coverage" in this case is defined as one trip of the roller across the pavement.

Air Temperature (Item 29): The ambient temperature measured in degrees Fahrenheit while compaction is accomplished.

Compacted Thickness (Item 30): The thickness of the compacted mat measured in inches to the nearest tenth (0.1 inch). If coring is not performed, the planned thickness should be recorded.

Curing Period (Item 31): Enter the number of days before a new lift is placed or the layer is opened to traffic.

Unbound (SPS-12 Data Sheet 27)

This data sheet provides information regarding the unbound or stabilized base or subbase material and should be filled out for each unbound base layer. This data is to be filled out from project records on SPS-12 Data Sheets 27 and 28 for which long-term monitoring is planned.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

AASHTO Soil Classification (Item 2): The AASHTO soil classification for the base or subbase material (prior to any stabilization). The code numbers appear in table 42 in Standard Codes Tables section for the various AASHTO classifications.

Atterberg Limits (Item 3): The plasticity index (PI), liquid limit (LL), and plastic limit (PL) determined by AASHTO T90 and T89 or ASTM D4318.

Maximum Lab Dry Density (Item 4): The maximum laboratory dry density in pounds per cubic foot for the base or subbase material in the layer of interest.

Optimum Lab Moisture Content (Item 5): The optimum moisture content obtained in the laboratory to the nearest one-tenth of a percent (0.1 percent) for the base or subbase layer.

Test Used to Measure Maximum Dry Density (Item 6): The test method used to establish the maximum dry density and optimum moisture content. Codes are provided on the data sheet for the most commonly used test methods. Space is also provided for identifying another test method used, if different from the test methods listed.

Compactive Energy for "Other" Method (Item 7): The compactive energy in foot-pounds per cubic inch applied if some test method was used other than those for which codes were provided under Item 6. If the test method used already had a code under Item 6, this space is to be left blank.

In Situ Dry Density (Item 8): The Number of Samples tested, and the Mean, Minimum, Maximum, and Standard Deviation of field measurements of the in-place dry density in pounds per cubic foot for the base or subbase layer.

In Situ Moisture Content (Item 9): The Number of Samples tested, and the Mean, Minimum, Maximum, and Standard Deviation of field measurements of the base or subbase in-place moisture content in percent of dry weight of the material. This moisture content data is to be based on the same tests as the dry density data in Item 8.

Compressive Strength (Item 10): The Number of Tests performed and the Mean, Minimum, Maximum, and Standard Deviation of the compressive strength in psi of the stabilized or un-stabilized material.

Type of Compression Test (Item 11): The type of test used to evaluate the compressive strength of the material. Codes are provided on the data sheet along with space to identify the test type if the appropriate type is not listed.

Confining Pressure (Item 12): The confining pressure applied during the compressive strength testing. If the test was unconfined, enter "0.0."

Calcium Carbonate Content (Item 13): The percent by weight of the base or subbase material that is composed of calcium carbonate, as determined by ASTM D4373.

Unbound (Continued) (Sps-12 Data Sheet 28)

The data on this data sheet is a continuation of the information from SPS-12 Data Sheet 27.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

California Bearing Ratio (CBR) (Item 2): The mean CBR-value of the material as determined by Test Method AASHTO T193 or ASTM D1883.

Resistance (R-Value) (Item 3): The mean R-Value as determined by Test Method AASHTO 190 (ASTM D2844).

Modulus of Subgrade Reaction (k-Value) (Item 4): The mean k-Value in pci (pounds per square inch per inch of deflection) measured at the top of the base or subbase after it is compacted in place.

Type of Test (Item 5): The Type of Test used. Either the repeated load test (AASHTO T221 (ASTM D1195)) or the static load test (AASHTO T222 or ASTM D1196) may be used and codes for these are provided on SPS-12 Data Sheet 25.

Type and Percent Stabilizing Agent (for Stabilized Layers Only) (Items 6 and 7): The types of stabilizing agents and the average percent of each by dry weight of soil mixed into the base or subbase material in the layer of interest. Codes are provided on the data sheet for stabilizing agents commonly in use and space is provided to identify an agent not listed. An average of measured percentages is used whenever available. If percentages have not been measured, the specified percentage should be entered. If neither measured nor specified data are available, but the layer is known to have been stabilized, a percentage should be estimated based on practice at the time the stabilized base or subbase layer was constructed. If only one stabilizing agent is used, leave the spaces for "Stabilizing Agent 2" blank. If the base or subbase material is not stabilized, enter "N."

Gradation of Base or Subbase Material (Coarse and Fine Aggregates) (Item 8): The percentage of material passing various standard sieve sizes to the nearest one percent. It is not expected that values will be available for all seventeen sieve sizes; the objective is to provide space for a sufficient number of sieve sizes to accommodate testing practices for most agencies.

Subgrade (Sps-12 Data Sheet 29)

The properties of the predominant subgrade type encountered on the project should be entered on this data sheet. In cases where a known variation in the subgrade occurs along the project, SPS-12 Data Sheets 29 and 30 should be completed for each test section.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

AASHTO Soil Classification (Item 2): The AASHTO Soil Classification for the subgrade material. These codes are provided in table 42 in Standard Codes Tables section.

California Bearing Ratio (Item 3): The CBR for the subgrade soil (Test Method AASHTO T193 or ASTM D1883).

Resistance (R-Value) (Item 4): The mean resistance R-value as determined by test method AASHTO T190 (ASTM D2844).

Modulus of Subgrade Reaction (k-Value) (Items 5 and 6): The mean modulus of subgrade reaction in pci (pounds per square inch per inch of deflection) for the in situ subgrade, and the Type of Test used. Either the repeated load test (AASHTO T221 (ASTM D1195)) or the static load test (AASHTO T222 or ASTM D1196) may be used as coded on SPS-12 Data Sheet 26.

Plasticity Index (Item 7): The average of plasticity indices measured for samples from the first five feet (1.5 m) of the subgrade (Test Methods AASHTO T90 or ASTM D4318).

Liquid Limit (Item 8): The average of the liquid limits measured for samples from the first five feet (1.5 m) of subgrade (Test Methods AASHTO T89 or ASTM D4318).

Maximum Laboratory Dry Density (Item 9): The maximum laboratory dry density in pounds per cubic foot for the subgrade material.

Optimum Laboratory Moisture Content (Item 10): The optimum moisture content obtained in the laboratory to the nearest tenth of a percent for the subgrade (0.1 percent).

Test Used to Measure Maximum Dry Density (Item 11): A code, provided on Data Sheet 22, to indicate whether standard AASHTO, modified AASHTO, or some other test method is used to establish the maximum dry density and optimum moisture content.

Compactive Energy for "Other" Method (Item 12): The compactive energy in foot-pounds per cubic inch applied if some test method is used other than the standard AASHTO or modified AASHTO. If standard or modified AASHTO is used, leave this space blank.

In Situ Dry Density (Percent of Optimum) (Item 13): The Number of Tests conducted, and the Mean, Minimum, Maximum, and Standard Deviation of field measurements of in-place dry density for the subgrade as a percentage of the maximum lab dry density. In situ dry density may be measured successfully by several procedures; including the "rubber-balloon method" (AASHTO T205 (ASTM D2167)), the "sand cone method" (AASHTO T191 (ASTM D1556)), or "nuclear methods" (AASHTO T238).

In Situ Moisture Content (Percent of Optimum) (Item 14): The Number of Tests conducted, and the Mean, Minimum, Maximum, and Standard Deviation of field measurements of in-place subgrade moisture content as a percent of the optimum moisture content obtained in the laboratory. This moisture content data is to be based on the same tests as for the dry density data above. Values should be recorded to the nearest tenth of a percent (0.1 percent).

In Situ Dry Density (pcf) (Item 15): The Number of Tests conducted, and the Mean, Minimum, Maximum, and Standard Deviation of field measurements of in-place dry density in pounds per cubic foot for the subgrade. This data item need not be entered if both the maximum laboratory dry density and the in situ dry density as a percent of maximum have been reported.

In Situ Moisture Content (Item 16): The Number of Tests conducted, and the Mean, Minimum, Maximum, and Standard Deviation of field measurements of in-place subgrade moisture in percent of dry weight of the material. This moisture content data is to be based on the same tests as for the dry density data above, and need not be entered if the optimum laboratory moisture content and the in situ moisture content as a percent of optimum have been reported. Values should be recorded to the nearest tenth of a percent (0.1 percent).

Subgrade (Continued) (SPS-12 Data Sheet 30)

The data on this data sheet is a continuation of the data from SPS-12 Data Sheet 29.

Individual data elements are as follows:

Layer Number (Item 1): The number of the layer for which the data on this data sheet is being provided (from SPS-12 Data Sheet 4).

Relative Density of Cohesionless Free-Draining Soil (Items 2 and 3): For cohesionless free-draining soils only. If the subgrade soil has more than 12 percent by weight passing the No. 200 (75-µm) sieve or is otherwise known to not be free-draining, enter "N" in these spaces. Otherwise, the following values are requested: 1) minimum and maximum densities in pcf (to the nearest tenth (0.1 pcf)) as determined by Test Method ASTM D2049 (Measured Density), 2) mean relative density in percent (to the nearest tenth (0.1 percent)) and number of tests conducted, 3) minimum and maximum mean relative densities in percent (to the nearest tenth (0.1 percent)) and 4) standard deviation of relative density in percent (to the nearest tenth (0.1 percent)). The calculated relative densities and standard deviation of relative density are related to the "in situ dry densities" in pcf recorded on SPS-12 Data Sheet 21, and are calculated using those field densities and the minimum and maximum densities from Test Method D2049.

Soil Suction (Item 4): A value for soil suction (negative pore water pressure) to the nearest tenth of a ton per square foot (0.1 tsf) determined by AASHTO T273.

Expansion Index (Item 5): The Expansion Index as determined by ASTM Test Method D4829. The "Expansion Index" has been included as a data element as it appears to offer high potential for "explaining" the effects of expansive soils on pavement performance in future predictive models.

Swell Pressure (Items 6 and 7): A value to the nearest pound per square inch for swell pressure, and a code to identify the test used. Codes are provided on the data sheet.

Percent by Weight Finer Than 0.02mm (Item 8): The percent by weight (to the nearest tenth (0.1 percent)) of the subgrade sample having soil "grains" finer in size than 0.02 millimeters. This value is generally obtained by hydrometer analysis (ASTM Test Method D422). This data item is only required in "Freeze Zones" where frost is expected to penetrate into the subgrade.

Average Rate of Heave During Standard Laboratory Freezing Test (Item 9): The average rate of heave in millimeters per day to the nearest tenth (0.1 mm/day) of the subgrade soil as measured by a standard laboratory freeze test (reference not available used by U.S.

Army Corps of Engineers). This data item is only required in "Freeze Zones" where frost is expected to penetrate into the subgrade.

Frost Susceptibility Classification Code (Item 10): The frost susceptibility classification of the subgrade soil. The codes appear on the data sheet. A value for the "Average Rate of Heave" is required for the classification, although "Percent by Weight Finer Than 0.02 mm" is indicative and significant to the heave rate. This data item is only required in "Freeze Zones" where frost is expected to penetrate into the subgrade.

QC Measurements (SPS-12 Data Sheet 31)

The purpose of this data sheet is to record the results of nuclear density tests or surface profile measurements if used for construction control or acceptance by the participating agency. For nuclear density tests, it is desired that the test section be treated as the sampling union if a random sampling technique is used. Reported Profilograph readings should be based on measurements on the test section and prorated to units of inches per mile. Measurements over 500 feet (0.1 of a mile) centered on the test section may also be used.

Individual data elements are as follows:

Nuclear Density Measurements (Item 1): Space is provided for entry of the results of nuclear density tests on the binder course and surface course layers. Enter information only for the layers on the test sections that were tested. For each layer tested, enter the measurement method (backscatter, direct transmission, air gap), the number of measurements, the average, maximum, minimum and standard deviation of the density measurements (pounds per cubic foot), and the corresponding layer number from SPS-12 Data Sheet 4.

Manufacturer of Nuclear Density Gauge (Item 2): Indicate the name of the manufacturer of the nuclear density gauge used for the reported measurements.

Nuclear Density Gauge Model Number (Item 3): Enter the manufacturer's model designation of the gauge used.

Nuclear Density Gauge Identification Number (Item 4): Enter the identification number of the nuclear density gauge used.

Nuclear Gauge Count Rate for Standardization (Item 5): Enter the gauge count rate used for standardization.

Profilograph Measurements (Item 6): Report the results of any Profilograph measurements performed on the overlay finished surface layer. For each measurement performed, report the type of Profilograph (Rainhard or California), profile index, interpretation method (manual, mechanical or computer), height of blanking band and cutoff height. Note that mechanical interpretation method refers to readings from mechanical counters located on some devices. Enter mechanical computer reading only if the profilograms are not interpreted either by manual or computer methods.

Surface Profile Used as Basis of Incentive Payment (Item 7): This is a yes or no field to indicate if the surface profile was or was not used as a contractual basis for incentive payments to the construction contractor.

Field Thickness (SPS-12 Data Sheet 32)

This data sheet is used to record the results of the layer thickness measurements within the test section from before and after elevation measurements. Results of these measurements should be provided for five offset points at every station along the project which was measured. The station number should be entered as the test section relative station number. Offset distance should be entered in inches and measured from the outside shoulder lane edge joint or edge stripe. Space is provided to enter elevation for four layers within the test section. If individual layer thicknesses are not measured, enter the layer thicknesses for the layer for which after placement surface elevation was measured. For example, if surface elevation was only measured for the surface course, then the layer thickness should be entered for the layer number corresponding to the surface. Enter the layer number of any layer for which layer thickness is shown. Use more than one data sheet as required.

Notes and Comments (SPS-12 Data Sheet 33)

This data sheet is provided for reporting miscellaneous notes and comments, further descriptions of entries on other data sheets, or construction related data that are not covered on other data sheets. Comments on this data sheet should address features or occurrences which may influence the performance of the test section. For example, comments from the site asphalt concrete inspector concerning marginal or questionable batches that were either rejected or used on the test sections may be included.

Also, this data sheet may be used to provide additional comments on items included in other data sheets. In these cases, the items and data sheet number pertaining to these comments should be indicated on this data sheet.

In addition, this data sheet can be used to report other types of quality control measurements performed on the test section which are not covered in the construction data sheets. For example, if profile or ride quality acceptance procedures are not based on Profilograph measurements, this information could be provided on this data sheet. In this case, specify the type, manufacture, model number of measurement equipment used, and a reference to the standard test procedure employed (such as ASTM, AASHTO, or Agency's test method.)

Improvement Listing (SPS-12 Data Sheet 34)

This data sheet is to be completed each time construction activities are performed on a test section.

Individual data elements are as follows:

Date Completed (Item 1): The month, day, and year that the pavement improvements were finished and the project was subsequently opened to traffic (not the date when the project was accepted).

Work Type Code (Item 2): A code to identify the type of maintenance work accomplished (table 49 in Standard Codes Tables section).

Work Quantity (Item 3): The quantity of work applied to the section in appropriate units (table 49 in Standard Codes Tables section).

Thickness (Item 4): For improvements that alter the thickness of the pavement structure (such as overlays, etc.), enter the thickness of the rehabilitation activity to the nearest tenth of an inch. For items that do not alter the thickness of the pavement structure, enter 'N' to indicate the data element is not applicable.

Cost (Item 5): The cost of the improvement is reported in thousands of dollars per lane-mile. The cost includes only pavement structure cost. Non-pavement costs such as cut and fill work, work on bridges, culverts, lighting, and guardrails should be excluded.

Diamond Grinding (SPS-12 Data Sheet 35)

SPS-12 Data Sheet 35 is for recording data from diamond grinding events placed for the SPS-12G experiment. It includes information on the design and application of the grinding, as well as the equipment used.

Individual data elements are as follows:

Date of Grinding (Item 1): The month, day and year the grinding was performed.

Design Grinding Depth (Item 2): The design grinding depth, in inches.

Design Lateral Spacing (Item 3): The design lateral spacing, in inches.

Manufacturer/Model (Item 4): The manufacturer name and the manufacturer model designation for the grinding machine.

Cutting Head Width (Item5): The width of the cutting head, in inches.

Average Spacing Between Blades (Item 6): The average spacing between the cutting blades, in inches.

Existing Pavement Surface Finish (Item 7): A code entered to indicate the surface finish of the existing pavement surface. The codes appear on the data sheet.

Existing Surface Mean Texture Depth (Item 8): The texture depth, in inches, of the existing surface using the sand patch test (ASTM E965).

Hardness of Existing Pavement Surface (Item 9): The hardness of the pavement surface using the Mohs hardness scale.

Air Temperature (Item 10): The ambient temperature measured in degrees Fahrenheit while the grinding was performed.

Surface Temperature (Item 11): The temperature of the existing pavement surface measured in degrees Fahrenheit just prior to the grinding.

Relative Humidity (Item 12): The relative humidity, in percent, at the time of grinding.

Cloud Cover (Item 13): The approximate cloud coverage, in percent, at the time of grinding.

Wind Speed (Item 14): The approximate typical wind speed, in miles per hour, at the time of grinding.

Is Concrete Slurry Adequately Removed? (Item 15): A yes/no code to indicate whether the grinding slurry was adequately vacuumed and removed.

Mean Texture Depth (Item 16): The texture depth, in inches, of the surface after grinding is performed using the sand patch test (ASTM E965).

Transverse Slope (Item 17): The deviation from flat in the transverse direction between adjacent passes.

Average Depth of Cut (Item 18): The average depth of cut, in inches, from the grinding operation.

Average Groove Width (Item 19): The average groove width, in inches.

Joint Sealant Application Data (SPS-12 Data Sheet 36)

SPS-12 Data Sheets 36 and 37 are for recording data from joint sealants applied for the SPS-12S experiment. This includes data specific to the material as well as the joint preparation and placement.

Individual data elements are as follows:

Date Sealing Began (Item 1): The month, day and year the operation began, including any surface preparation.

Date Sealing Complete (Item 2): The month, day and year the sealing was completed.

Joints Previously Sealed? (Item 3): A Y/N code indicating whether the joints were previously sealed or not.

Condition of Existing Sealant (Item 4): Space is provided for the estimation of the percent of existing sealant affected by the presence of: extrusion, hardening, adhesive failure, cohesive failure, sealant loss, foreign material intrusion, and weed growth. When the distress is no present, the value should be zero. It is possible for sealant to exhibit more than one type of failure.

Air Temperature (Item 5): The ambient temperature measured in degrees Fahrenheit while the sealant was placed.

Surface Temperature (Item 6): The temperature of the existing pavement surface measured in degrees Fahrenheit just prior to the sealant placement.

Relative Humidity (Item 7): The relative humidity, in percent, at the time of sealant placement.

Cloud Cover (Item 8): The approximate cloud coverage, in percent, at the time of sealant placement.

Wind Speed (Item 9): The approximate typical wind speed, in miles per hour, at the time of sealant placement.

Method of Removing Old Sealant (Item 10): A code entered to identify the method used for removing any old or existing joint sealant. Codes are provided on the data form.

Were Jointed Sidewalls Refaced? (Item 11): A code entered to specify whether none, one, or both sidewalls were refaced during the joint resealing process. Codes are provided on the data form.

Cleaning of Sidewalls (Item 12): A code entered to specify the means of cleaning the sidewalls prior to resealing. Codes are provided on the data form.

Width (Item 13): The width of the sealant reservoir to the nearest tenth of an inch (0.1 inch).

Depth (Item 14): The depth of the sealant reservoir to the nearest tenth of an inch (0.1 inch).

Cleanliness (Item 15): A code entered to indicate the general level of cleanliness of the reservoir prior to sealant application. Codes are supplied on the data sheet.

Wetness (Item 16): A code entered to indicate the general level of moisture in the reservoir prior to sealant application. Codes are supplied on the data sheet.

Joint Sealant Application Data (Continued) (SPS-12 Data Sheet 37)

Type of Joint Sealant (Item 1): A code entered to specify the AASHTO/ASTM designation of the type of joint sealant material used. Codes are provided on the data form. Space is also provided to include information regarding the manufacturer and the product's specific name, where a joint sealant is used for which no code is provided.

Manufacturer Name (Item 2): The manufacturer of the sealant.

Manufacturer Sealant Name (Item 3): The manufacturer’s name for the sealant.

Type of Bond Breaker Under Sealant (Item 4): A code entered to identify the material used to prevent an adhesive bond between the sealant and the bottom of the reservoir. Codes are provided on the data form.

Bond Breaker Size (Item 5): The size of the bond breaker used, to the nearest tenth of an inch (0.1 inch).

Depth from Surface to Top of Bond Breaker (Item 6): The depth from the surface of the pavement to the top of the bond breaker, to the nearest tenth of an inch (0.1 inch).

Sealant Application Temperature (Item 7): The temperature of the sealant as placed. For sealants that are not heated, no value should be entered.

Sealant Application Rate (Item 8): The design amount of bituminous material, to the nearest hundredth of a pound, to be placed per linear ft (0.01 pounds/ft) of pavement.

Depth of Top of Sealant (Item 9): The depth to the nearest tenth of an inch (0.1 inch) from the top of the slab to the top of the joint sealant material. If the sealant is above the surface of the pavement, the value should be negative.

Estimated Time Between Surface Preparation and Sealing (Item 10): The number of days between the completion of surface prep and the application of the sealant. If both are performed on the same day, enter zero.

Estimated Time Between Sealing and Vehicle Traffic (Item 11): The approximate length of time, in hours, between the completion of sealing and opening the section to vehicular traffic.

Penetrating Sealant Application Data (SPS-12 Data Sheet 38)

SPS-12 Data Sheet 39 is for recording data from penetrating sealants applied for the SPS-12P experiment. This includes data specific to the condition prior to placement, the sealant properties, and the preparation and placement.

Individual data elements are as follows:

Date Sealing Began (Item 1): The month, day and year the operation began, including any surface preparation.

Date Sealing Complete (Item 2): The month, day and year the sealing was completed.

Joints Previously Sealed? (Item 3): A Y/N code indicating whether the joints were previously sealed or not.

Air Temperature (Item 4): The ambient temperature measured in degrees Fahrenheit while the sealant was placed.

Surface Temperature (Item 5): The temperature of the existing pavement surface measured in degrees Fahrenheit just prior to the sealant placement.

Relative Humidity (Item 6): The relative humidity, in percent, at the time of sealant placement.

Cloud Cover (Item 7): The approximate cloud coverage, in percent, at the time of sealant placement.

Wind Speed (Item 8): The approximate typical wind speed, in miles per hour, at the time of sealant placement.

Preparation of Existing Pavement Surface (Item 9): A code entered to indicate the method of initial preparation for the existing pavement surface. The codes appear on the data sheet, and space is provided to describe a method not coded, where applicable. Attach a separate piece of paper if more space is needed.

Cleanliness (Item 10): A code entered to indicate the general level of cleanliness of the pavement surface prior to sealant application. Codes are supplied on the data sheet.

Wetness (Item 11): A code entered to indicate the general level of surface moisture prior to sealant application. Codes are supplied on the data sheet.

Type of Sealer (Item 12): A code entered to indicate the general type of sealer used. Codes are supplied on the data sheet.

Manufacturer Name (Item 13): The manufacturer of the sealant.

Manufacturer Sealant Name (Item 14): The manufacturer's name for the sealant.

Sealant Application Rate (Item 15): The rate of application of the sealant, in gallons per square yard.

Width of Sealant Application (Item 16): The distance between the joint and the edge of the applied sealant, in inches.

Depth of Penetration (Item 17): Depth of penetration of the sealant, in inches.

LTPP SPS-12 DATA **SHEET 1** **PROJECT IDENTIFICATION**	STATE CODE [__ __] PROJECT ID [__ __ __ __]

1. DATE OF DATA COLLECTION OR UPDATE (Month/Year) [__ __ / __ __ __ __]

2. HIGHWAY AGENCY (HA) DISTRICT NUMBER [__ __]

3. COUNTY OR PARISH [__ __ __]

4. FUNCTIONAL CLASS (See Table 34) [__ __]

5. ROUTE NUMBER [__ __ __ __ __]

6. ROUTE SIGNING (See Route Signing Codes, Table 55) [__ __]

7. ROUTE QUALIFIER [__ __]

No Qualifier or Not Signed....	1	Alternate.................	2
Business Route................	3	Bypass Business...........	4
Spur..........................	5	Loop......................	6
Proposed......................	7	Temporary.................	8
Truck Route...................	9	None of the Above........	10

8. ALTERNATE ROUTE NAME
(Specify)[____]

9. NUMBER OF THROUGH LANES (One direction) [__]

10. DATE OPEN TO TRAFFIC [__ __ / __ __ __ __]

11. CONSTRUCTION COSTS PER LANE MILE (In $1000) [__ __ __ __ __]

12. MILEPOINT (project start) [__ __ __ __ __ . __ __]

13. ELEVATION (feet) [__ __ __ __ __ __]

14. ADDITIONAL LOCATION INFORMATION (significant landmarks): [______________
____
____]

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA **SHEET 2** **PROJECT STATIONS**	STATE CODE [__ __] PROJECT ID [__ __ __ __]

ORDER	(1)TEST SECTION ID NO	REFERENCE PROJECT STATION NUMBER		(4) CUT-FILL TYPE[1]
		(2) START	(3) END	
1	__ __ __ __	0+ 0 0. 0	__ __ __+__ __.__	__
2	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
3	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
4	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
5	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
6	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
7	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
8	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
9	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
10	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
11	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
12	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
13	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
14	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
15	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
16	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
17	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
18	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
19	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__
20	__ __ __ __	__ __ __+__ __.__	__ __ __+__ __.__	__

5. DIRECTION OF TRAVEL [__]
East..... 1 West..... 2 North..... 3 South..... 4

Note 1. Indicate the type of subgrade section the test section is located on:
Cut..... 1 Fill..... 2 At-Grade..... 3 Cut and Fill..... 4
If cut-fill transition is located in a test section, enter test section station of the cut-fill transition location.

6. INTERSECTION BETWEEN TEST SECTION ON THE PROJECT

```
              RAMPS |--INTERSECTION--|
ROUTE       PROJECT STATION NO. EXIT ENT STOP SIGNAL UNSIG
_______________________ __ __ __ __+__ __ ___ ___ ___ ___ ___
_______________________ __ __ __ __+__ __ ___ ___ ___ ___ ___
_______________________ __ __ __ __+__ __ ___ ___ ___ ___ ___
_______________________ __ __ __ __+__ __ ___ ___ ___ ___ ___
```

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA **SHEET 3** **GENERAL INFORMATION**	STATE CODE [__ __] SHRP ID [__ __ __ __]

LAYOUT

1. LANE WIDTH (**feet**) [__ __]

2. LANE NUMBER MONITORED (outside lane = 1) [__]

3. DIRECTION OF TRAVEL [__]
East Bound.... 1 West Bound..... 2
North Bound... 3 South Bound.... 4 Both Directions.... 5

4. SPEED LIMIT (MPH) [__ __]

MEDIAN

5. MEDIAN TYPE [__]
None......................... 1 Unprotected..................... 2
Curbed....................... 3 Positive Barrier – Unspecified... 4
Positive Barrier – Flexible... 5 Positive Barrier – Semi-Rigid.... 6
Positive Barrier – Rigid...... 7

6. MEDIAN WIDTH (feet) [__ __]

DRAINAGE

7. SUBSURFACE DRAINAGE LOCATION [__]
Continuous Along Test Section...........1
Intermittent............................2

8. SUBSURFACE DRAINAGE TYPE [__]
No Subsurface Drainage ..1 Well System............5
Longitudinal Drains .....2 Drainage Blanket with
Transverse Drains ....3 Longitudinal Drains....6
Drainage Blanket 4
Other (Specify)____________________________________ 7

9. DIAMETER OF LONGITUDINAL DRAINPIPES (inches) [__ __ __.__]

10. SPACING OF LATERALS (feet) [__ __ __]

SHOULDER

INSIDE OUTSIDE
SHOULDER SHOULDER
11. SURFACE TYPE [__] [__]
Turf................ 1 Concrete.................. 4
Granular............ 2 Surface Treatment......... 5
Asphalt Concrete.... 3 Other(Specify)_______________________ 6
12. TOTAL WIDTH (feet) [__ __] [__ __]
13. PAVED WIDTH (feet) [__ __] [__ __]
14. SHOULDER BASE TYPE (Table 38) [__ __] [__ __]
15. SHOULDER SURFACE THICKNESS (inches) [__ __ __.__] [__ __ __.__]
16. SHOULDER BASE THICKNESS (inches) [__ __ __.__] [__ __ __.__]

PREPARER___________________EMPLOYER____________________DATE__________________

LTPP SPS-12 DATA **SHEET 4** **LAYER**	STATE CODE [__ __] SHRP ID [__ __ __ __]

LAYER DESCRIPTIONS

LAYER NUMBER[1]	LAYER DESCRIPTION[2]	MATERIAL TYPE[3]	LAYER THICKNESSES[4] (**inch**)			
			MEAN	MIN.	MAX.	STD. DEV.
1	SUBGRADE(7)	[__ __]				
2	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
3	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
4	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
5	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
6	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
7	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
8	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
9	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
10	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
11	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
12	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
13	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
14	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]
15	[__ __]	[__ __]	[_ _ _._]	[_ _ _._]	[_ _ _._]	[_ _ _._]

5. DEPTH BELOW SURFACE TO 'RIGID' LAYER (ft) [__ __.__]
(Rock, Stone, Dense Shale)

NOTES:

1. Layer 1 is subgrade soil. The highest numbered layer is the pavement surface.

2. Layer description codes:

Overlay	01	Subbase Layer	06
Seal Coat	02	Subgrade	07
Original Surface	03	Interlayer	08
HMAC Layer (Below Surface Layer)	04	Porous Friction Course	09
		Surface Treatment	10
Base Layer	05	Embankment (Fill)	11

3. The material type classification codes for surface, base or subbase, subgrade, and seal coat or interlayer materials appear in table 37 through table 40, respectively.

4. Enter the average thickness of each layer and the minimum, maximum, and standard deviation of the thickness measurements, if known.

PREPARER____________________EMPLOYER_____________________DATE___________________

LTPP SPS-12 DATA SHEET 5 AGE AND MAJOR IMPROVEMENTS	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. DATE OF LATEST (RE)CONSTRUCTION (month/year) [__ __/__ __ __ __]

2. DATE SUBSEQUENTLY OPENED TO TRAFFIC (month/year) [__ __/__ __ __ __]

3. LATEST (RE)CONSTRUCTION COST PER LANE MILE
   (thousands of dollars)[1] [__ __ __ __ __]

MAJOR IMPROVEMENTS SINCE LATEST (RE)CONSTRUCTION (Items 4 through 8)

4.	5.	6.	7.
YEAR	WORK TYPE CODE (Table 49)	WORK QUANTITY (Table 49 for units)	THICKNESS (inches)
[__ __ __ __]	[__ __]	[__ __ __ __ __]	[__ __.__]
[__ __ __ __]	[__ __]	[__ __ __ __ __]	[__ __.__]
[__ __ __ __]	[__ __]	[__ __ __ __ __]	[__ __.__]
[__ __ __ __]	[__ __]	[__ __ __ __ __]	[__ __.__]
[__ __ __ __]	[__ __]	[__ __ __ __ __]	[__ __.__]

8. MAJOR IMPROVEMENT TYPE OTHER
[____]

ADDITIONAL ROADWAY WIDENING INFORMATION (Items 9 through 12)

9. YEAR WHEN ROADWAY WIDENED[2] [__ __ __ __]

10. ORIGINAL NUMBER OF LANES (One Direction) [__]

11. FINAL NUMBER OF LANES (One Direction) [__]

12. LANE NUMBER OF LANE ADDED [__]

NOTES 1. Cost is to represent pavement structure cost. Non-pavement costs such as cut and fill work, work on bridges, culverts, lighting, and guard rails are to be excluded.

2. A lane created by roadway widening should not be used for LTPP unless the pavement structure under the entire lane was constructed at the same time and is uniform.

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 6 SNOW REMOVAL / DEICING	STATE CODE [__ __] SHRP ID [__ __ __ __]

SNOW PLOW

1. ARE SNOW PLOWS USED ON THE SECTION? (Y/N) [__]

2. MOST COMMON SNOW PLOW EDGE TYPE [__]
   Steel.................. 1   Rubber 3
   Carbide................ 2   Polyurethane..........4
   Other (Specify) [____________________________________] 5

3. TYPICAL NUMBER OF PASSES PER YEAR [__ __ __]

4. TYPICAL SPEED OF PLOWING OPERATION (mph) [__ __]

PRE-TREATMENT

5. ARE PRE-TREATMENTS USED ON THE SECTION? (Y/N) [__]

6. TYPE OF PRE-TREATMENT USED [__]
   NaCl................... 1 $CaCl_2$.................2
   NaCl + $CaCl_2$ 3   CMA 4
   Other (Specify) [______________________________________] 5
   KCl.................... 6 $MgCl_2$.................7
   Urea................... 8

7. TYPICAL NUMBER OF APPLICATIONS PER YEAR [__ __ __]

DE-ICING

8. ARE DE-ICERS USED ON THE SECTION? (Y/N) [__]

9. TYPE OF DE-ICER USED [__]
   NaCl................... 1 $CaCl_2$.................2
   NaCl + $CaCl_2$ 3   CMA 4
   Other (Specify) [______________________________________] 5
   KCl.................... 6 $MgCl_2$.................7
   Urea................... 8

10. TYPICAL NUMBER OF APPLICATIONS PER YEAR [__ __ __]

CHAIN CONTROLS

11. IS THE SECTION SUBJECT TO CHAIN CONTROLS? (Y/N) [__]

12. TYPICAL NUMBER OF CONTROL EVENTS PER YEAR [__ __ __]

PREPARER___________________ EMPLOYER_____________________DATE_________________

LTPP SPS-12 DATA **SHEET 7** **HPMS DATA ITEMS**	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. HPMS SAMPLE NUMBER [__ __ __ __ __ __ __ __ __ __ __ __]

2. HPMS SECTION SUBDIVISION [__]

3. URBAN CODE [__ __ __ __ __]
   Small Urban Sections 99998
   Rural Area Sections 99999

4. FACILITY TYPE [__]
   One-Way Roadway......... 1
   Two-Way Roadway......... 2

5. ACCESS CONTROL [__]
   Full Access Control..... 1
   Partial Access Control.. 2
   No Access Control....... 3

6. OWNERSHIP (See Ownership Codes, Table 56) [__]

7. HOV TYPE (High Occupancy Vehicle Operations Type) [__]
Full-Time HOV........... 1
(Site has 24-hour exclusive HOV lanes, no other use permitted)
Part-Time HOV........... 2
(Normal through lanes used for exclusive HOV during specified time periods)
Part-Time HOV........... 3
(Shoulder/parking lanes used for exclusive HOV during specified time periods)

8. HOV LANES [__]

9. PEAK LANES [__]

10. COUNTER PEAK LANES [__]

11. RIGHT TURN LANES (See Turn Lane Codes, Table 57) [__]

12. LEFT TURN LANES (See Turn Lane Codes, Table 57) [__]

PREPARER____________________ EMPLOYER______________________DATE__________________

LTPP SPS-12 DATA **SHEET 8** **HPMS DATA ITEMS (Continued)**	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. TOLL CHARGED [__]
   - Toll charged in one direction only.................. 1
   - Toll charged in both directions..................... 2
   - No toll charged..................................... 3

2. TOLL TYPE [__]
   - Toll lanes but no special tolls (e.g. HOT lanes).... 1
   - HOT lanes... 2
   - Other special tolls................................. 3

3. WIDENING OBSTACLES (See Widening Obstacles Codes, Table 58) [__ __ __]

4. WIDENING POTENTIAL [__]

5. TERRAIN TYPE [__]
   - Level.................. 1
   - Rolling................ 2
   - Mountainous............ 3

6. CURVE CLASSIFICATION [__]

Under 3.5 Degrees....... A	8.5 - 13.9 Degrees..... D
3.5 - 5.4 Degrees....... B	14.0 - 27.9 Degrees.... E
5.5 - 8.4 Degrees....... C	28 Degrees or More..... F

7. GRADE CLASSIFICATION [__]

0.0 - 0.4.............. A	4.5 - 6.4.............. D
0.5 - 2.4.............. B	6.5 - 8.4.............. E
2.5 - 4.4.............. C	8.5 or Greater......... F

8. PERCENT PASSING SIGHT DISTANCE [__ __ __]

PREPARER____________________ EMPLOYER______________________DATE_________________

LTPP SPS-12 DATA SHEET 9 PCC AGGREGATE PROPERTIES	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__ __]

COMPOSITION OF COARSE AGGREGATE (Items 2, 3, and 4)

TYPE PERCENT

Crushed Stone... 1 Crushed Slag.............. 4 2.[__][__ __ __]
Gravel.......... 2 Manufactured Lightweight... 5 3.[__][__ __ __]
Crushed Gravel.. 3 4.[__][__ __ __]
Other (Specify)[______________________________]6

5. GEOLOGIC CLASSIFICATION OF COARSE AGGREGATE [__ __]
(See Geologic Classification Codes, Table 41)

COMPOSITION OF FINE AGGREGATE (Items 6, 7, and 8)

TYPE PERCENT

Natural Sand.................................... 1 6.[__][__ __ __]
Manufactured Sand (From 7.[__][__ __ __]
Crushed Gravel or Stone)........................ 2 8.[__][__ __ __]
Recycled Concrete............................... 3
Other (Specify)[________________________________]4

9. INSOLUBLE RESIDUE (ASTM D3042)(percent) [__ __ __]

AGGREGATE DURABILITY TEST RESULTS (Items 10 through 13)
(See Durability Test Type Codes, Table 45)

TYPE OF AGGREGATE TYPE OF TEST RESULTS

10. COARSE [__ __] [__ __ __.__ __ __]
11. COARSE [__ __] [__ __ __.__ __ __]
12. COARSE [__ __] [__ __ __.__ __ __]
13. COMBINED COARSE AND FINE [__ __] [__ __ __.__ __ __]

BULK SPECIFIC GRAVITIES (Items 14 and 15)

14. COARSE AGGREGATE (AASHTO T85 OR ASTM C127) [__.__ __ __]
15. FINE AGGREGATE (AASHTO T84 OR ASTM C127) [__.__ __ __]

GRADATION OF AGGREGATES

16. COARSE AGGREGATE Sieve Size or No.	% Passing	17. FINE AGGREGATE Sieve Size or No.	% Passing
2”...........	[__ __ __]	No. 8.........	[__ __ __]
1 1/2”.......	[__ __ __]	No. 10........	[__ __ __]
1”...........	[__ __ __]	No. 16........	[__ __ __]
7/8”.........	[__ __ __]	No. 30........	[__ __ __]
3/4”.........	[__ __ __]	No. 40........	[__ __ __]
5/8”.........	[__ __ __]	No. 50........	[__ __ __]
1/2”.........	[__ __ __]	No. 80........	[__ __ __]
3/8”.........	[__ __ __]	No. 100.......	[__ __ __]
No. 4........	[__ __ __]	No. 200.......	[__ __ __]

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA **SHEET 10** **PCC MIX DESIGN**	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__]

MIX DESIGN

2. COARSE AGGREGATE (lb./cu.yd. - Oven Dried Weight) [__ __ __ __]
3. FINE AGGREGATE (lb./cu.yd. - Oven Dried Weight) [__ __ __ __]
4. CEMENT (lb./cu.yd. - Oven Dried Weight) [__ __ __ __]
5. WATER (lb./cu.yd) [__ __ __ __]

6. CEMENT TYPE USED (See Cement Type Codes, Table 43) [__ __]
   Other (Specify)[________________________________]

7. ALKALI CONTENT OF CEMENT (percent by weight of cement) [__ __.__]

ENTRAINED AIR CONTENT(AASHTO T121, T152, or T196)
8. MEAN (percent) [__.__]
9. MINIMUM (percent) [__.__]
10. MAXIMUM (percent) [__.__]

ADMIXTURES (See PCC Admixture Codes, Table 44) (percent by weight of cement)

	TYPE CODE	AMOUNT
11. ADMIXTURE #1	[__ __]	[__ __ __.__ __ __]
12. ADMIXTURE #2	[__ __]	[__ __ __.__ __ __]
13. ADMIXTURE #3	[__ __]	[__ __ __.__ __ __]

Other (Specify)[________________________________]

SLUMP (AASHTO T119 or ASTM C143)
14. MEAN (inches) [__.__]
15. MINIMUM (inches) [__.__]
16. MAXIMUM (inches) [__.__]
17. STANDARD DEVIATION (inches) [__.__]
18. NUMBER OF TESTS [__ __ __]

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 11 PCC STRENGTH	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__]

FLEXURAL STRENGTH (Modulus of Rupture) (Items 2 thru 8)

2. TYPE OF TEST [__]
   - Third-Point Loading (AASHTO T97 or ASTM C78) 1
   - Center-Point Loading (AASHTO T177 or ASTM C293) 2
3. AGE (days) [__ __ __]
4. MEAN (psi) [__ __ __ __ __]
5. MINIMUM (psi) [__ __ __ __ __]
6. MAXIMUM (psi) [__ __ __ __ __]
7. NUMBER OF TESTS [__ __]
8. STD. DEV. (psi) [__ __ __ __ __]

COMPRESSIVE STRENGTH (Items 9 thru 14) (AASHTO T22 or ASTM C39)

*9. AGE (days) [__ __ __]
*10. MEAN (psi) [__ __ __ __ __]
11. MINIMUM (psi) [__ __ __ __ __]
12. MAXIMUM (psi) [__ __ __ __ __]
13. NUMBER OF TESTS [__ __]
14. STD. DEV. (psi) [__ __ __ __ __]

SPLITTING TENSILE STRENGTH (Items 15 thru 20) (AASHTO T198 or ASTM C496)

15. AGE (days) [__ __ __]
16. MEAN (psi) [__ __ __ __ __]
17. MINIMUM (psi) [__ __ __ __]
18. MAXIMUM (psi) [__ __ __ __]
19. NUMBER OF TESTS [__ __]
20. STD. DEV. (psi) [__ __ __ __]

ELASTIC MODULUS (Items 21 thru 26)

21. MEAN (ksi) [__ __ __ __ __]
22. MINIMUM (ksi) [__ __ __ __ __]
23. MAXIMUM (ksi) [__ __ __ __ __]
24. NUMBER OF TESTS [__ __]
25. STD. DEV. (ksi) [__ __ __ __ __]
26. METHOD FOR DETERMINATION OF ELASTIC MODULUS [__]
   - Compression Test on Cores (ASTM C469) 1
   - Compression Test on Cylinders Molded During Construction (ASTM C469) 2
   - Calculated Using ACI Relation Between Elastic Modulus and Compressive Strength (ACI 318, Section 8.5) 3
   - Other (Specify)[______________________________________] 4

PREPARER___________________ EMPLOYER_____________________DATE_________________

LTPP SPS-12 DATA SHEET 12 PCC CONSTRUCTION	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__]

2. DATE PAVING BEGAN (dd/mmm/yyyy) [__ __/__ __ __/__ __ __ __]
3. DATE PAVING COMPLETE (dd/mmm/yyyy) [__ __/__ __ __/__ __ __ __]

4. TYPE OF PAVER USED [__]
   Slip-Form Paver 1   Side-Form 2
   Other (Specify) [____________________________________] 3

5. PAVER MANUFACTURER/MODEL [____]

AIR TEMPERATURES DURING PLACEMENT
6. MEAN (°F) [__ __ __]
7. MINIMUM (°F) [__ __ __]
8. MAXIMUM (°F) [__ __ __]

9. CURING PERIOD BEFORE OPENING TO ANY TRAFFIC (days) [__ __]
10. TIME BEFORE SAWING JOINTS (hours) [__ __]

11. CONSOLIDATION OF MATERIALS [__]
   Internal Vibrators 1   Rolling 4
   Vibrating Screeds 2   Tamping 5
   Troweling 3
   Other (Specify) [____] 6

12. FINISHING [__]
   Screeding 1   Machine Troweling 3
   Hand Troweling 2
   Other (Specify) [____] 4

13. METHOD USED TO CURE CONCRETE [__]
   Membrane Curing Compound ... 1   Burlap-Polyethylene Blanket .. 5
   Burlap Curing Blankets 2   Cotton Mat Curing 6
   Waterproof Paper Blankets .. 3   Hay 7
   White Polyethylene Sheeting 4
   Other (Specify) [____] 8

14. METHOD USED TO TEXTURE CONCRETE [__]
   Tine 1   Grooved Float 4
   Broom 2   Astro Turf 5
   Burlap Drag 3   None 6
   Other (Specify) [____] 7

PREPARER__________________ EMPLOYER____________________ DATE________________

LTPP SPS-12 DATA **SHEET 13** **PCC JOINT DATA**	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From Sheet 2) [__]

2. AVERAGE CONTRACTION JOINT SPACING (feet) [__ __ __.__]

3. RANDOM JOINT SPACING, IF ANY: [______________________________]

4. BUILT-IN EXPANSION JOINT SPACING (feet) [__ __ __ __]

5. SKEWNESS OF JOINTS (ft./lane) [__.__]

6. TRANSVERSE CONTRACTION JOINT LOAD TRANSFER SYSTEM [__]
   - Round Dowels 1
   - Aggregate Interlock 2
   - I-Beams 3
   - Star Lugs 4
   - Keyways 5
   - Other (Specify) [____________________________] 6

7. ROUND DOWEL DIAMETER (inches) [__.__]

8. DOWEL OR MECHANICAL LOAD TRANSFER DEVICE SPACING (inches) [__ __]

9. AVERAGE INTERMEDIATE SAWED JOINT SPACING (feet) [__ __.__]

DIMENSIONS FOR I-BEAMS OR KEYWAYS (Items 10 and 11)

10. HEIGHT (inches) [__.__ __]
11. WIDTH (inches) [__.__ __]

12. DISTANCE OF NEAREST DOWEL (OR MECHANICAL LOAD TRANSFER DEVICE) FROM OUTSIDE LANE-SHOULDER EDGE (inches) [__ __.__]

13. DOWEL LENGTH (inches) [__ __]

14. DOWEL COATING [__]
    - Paint and/or Grease 1
    - Plastic 2
    - Monel 3
    - Stainless Steel 4
    - Epoxy 5
    - Other (Specify) [____________________________] 6

15. METHOD USED TO INSTALL MECHANICAL LOAD TRANSFER DEVICES [__]
    - Preplaced on Baskets 1
    - Mechanically Installed 2
    - Other (Specify) [____________________________] 3

PREPARER____________ EMPLOYER____________ DATE____________

LTPP SPS-12 DATA **SHEET 14** **PCC JOINT DATA (CONTINUED)**	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From Sheet 2) [__]

2. METHOD USED TO FORM TRANSVERSE JOINTS [__]
   - Sawed 1
   - Plastic Insert 2
   - Metal Insert (i.e., Uni-Tube) 3
   - Other (Specify) [______________________________] 4

3. TYPE OF LONGITUDINAL JOINT (Between Lanes) [__]
   - Butt 1
   - Keyed 2
   - Sawed Weakened Plane 3
   - Insert Weakened Plane ... 4
   - Other (Specify) [______________________________] 5

4. TYPE OF SHOULDER-TRAFFIC LANE JOINT [__]
   - Butt 1
   - Keyed 2
   - Sawed Weakened Plane 3
   - Insert Weakened Plane ... 4
   - Tied Concrete Curb 5
   - Other (Specify) [______________________________] 6

5. TRANSVERSE JOINT SEALANT TYPE (As Built) [__]
   - Preformed (Open Web) 1
   - Asphalt 2
   - Rubberized Asphalt 3
   - Low-Modulus Silicone 4
   - Other (Specify) [______________________________] 5

6. TRANSVERSE JOINT SEALANT RESERVOIR WIDTH (inches) [__.__ __]
7. TRANSVERSE JOINT SEALANT RESERVOIR DEPTH (inches) [__.__ __]

8. LONGITUDINAL JOINT SEALANT RESERVOIR WIDTH (inches) [__.__ __]
9. LONGITUDINAL JOINT SEALANT RESERVOIR DEPTH (inches) [__.__ __]

10. JOINT SEALANT BACKER MATERIAL TYPE [__]
    - Foam Backer Rod ... 1
    - Tape 2
    - Rope 3
    - None 4
    - Other (Specify) [__________] 5

11. JOINT SEALANT BACKER DIMENSION (inches) [__.__ __]
    (Enter diameter of rod/rope or width of tape)

12. BETWEEN LANE TIE BAR DIAMETER (inches) [__.__ __]
13. BETWEEN LANE TIE BAR LENGTH (inches) [__ __]
14. BETWEEN LANE TIE BAR SPACING (inches) [__ __.__]

SHOULDER-TRAFFIC LANE JOINT SEALANT RESERVOIR (Items 15 and 16)

15. WIDTH (inches) [__.__ __]
16. DEPTH (inches) [__.__ __]

SHOULDER-TRAFFIC LANE JOINT TIE BARS (Items 17, 18, and 19)

17. DIAMETER (inches) [__.__ __]
18. LENGTH (inches) [__ __]
19. SPACING (inches) [__ __]

PREPARER__________________ EMPLOYER____________________ DATE________________

LTPP SPS-12 DATA SHEET 15 AC AGGREGATE PROPERTIES	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__ __]

2. TYPE OF AGGREGATE [__]
Untreated....... 1 RAP....................... 2
RAS............. 3 Combined.................. 4

COMPOSITION OF COARSE AGGREGATE (Items 3, 4, and 5)
TYPE PERCENT
Crushed Stone... 1 Crushed Slag.............. 4 3.[__][__ __ __]
Gravel.......... 2 Manufactured Lightweight... 5 4.[__][__ __ __]
Crushed Gravel.. 3 5.[__][__ __ __]
Other (Specify)[______________________________]6

6. GEOLOGIC CLASSIFICATION OF COARSE AGGREGATE [__ __]
(See Geologic Classification Codes, Table 41)

COMPOSITION OF FINE AGGREGATE (Items 7, 8, and 9)
TYPE PERCENT
Natural Sand................................... 1 7.[__][__ __ __]
Manufactured Sand (From 8.[__][__ __ __]
Crushed Gravel or Stone)....................... 2 9.[__][__ __ __]
Recycled Concrete.............................. 3
Other (Specify)[________________________________]4

10. TYPE OF MINERAL FILLER [__]
Stone Dust..... 1 Portland Cement........... 3
Hydrated Lime.. 2 Fly Ash................... 4
None........... 5
Other (Specify)[______________________________]6

AGGREGATE DURABILITY TEST RESULTS (Items 13 through 16)
(See Durability Test Type Codes, Table 45)

	TYPE OF AGGREGATE	TYPE OF TEST	RESULTS
11.	COARSE	[__ __]	[__ __ __.__ __ __]
12.	COARSE	[__ __]	[__ __ __.__ __ __]
13.	COARSE	[__ __]	[__ __ __.__ __ __]
14.	COMBINED COARSE AND FINE	[__ __]	[__ __ __.__ __ __]

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 16 AC AGGREGATE PROPERTIES (Continued)	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__ __]
2. TYPE OF AGGREGATE [__]
Untreated....... 1 RAP....................... 2
RAS............ 3 Combined.................. 4

3. POLISH VALUE OF COARSE AGGREGATES [__ __]
(Surface Layer Only) (AASHTO T279, ASTM D3319)

4. ANGULARITY COARSE ONE FACE [__ __ __.__]

5. ANGULARITY COARSE TWO FACES [__ __ __.__]

6. ANGULARITY FINE [__ __ __.__]

7. SOUNDNESS COARSE [__ __ __.__]

8. SOUNDNESS FINE [__ __ __.__]

9. COARSE AGGREGATE TOUGHNESS [__ __ __.__]

10. DELETERIOUS MATERIALS [__ __ __.__]

11. CLAY CONTENT [__ __ __.__]

12. THIN ELONGATED PARTICLES [__ __.__]

13. GRADATION OF COMBINED AGGREGATES

Sieve Size or No.	% Passing	Sieve Size or No.	% Passing
2″..........	[__ __ __]	No. 4.........	[__ __]
1 1/2″......	[__ __ __]	No. 8.........	[__ __]
1″..........	[__ __ __]	No. 10........	[__ __]
7/8″........	[__ __ __]	No. 16........	[__ __]
3/4″........	[__ __ __]	No. 30........	[__ __]
5/8″........	[__ __ __]	No. 40........	[__ __]
1/2″........	[__ __ __]	No. 50........	[__ __]
3/8″........	[__ __ __]	No. 80........	[__ __]
No. 100.......	[__ __]		
No. 200.......	[__ __]		

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 17 AC AGGREGATE PROPERTIES (Continued)	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__ __]
2. TYPE OF AGGREGATE [__]
Untreated....... 1 RAP....................... 2
RAS............. 3 Combined.................. 4

ABSORPTION OF AGGREGATE (Items 2 and 3)

3. COARSE AGGREGATE (AASHTO T85 OR ASTM C127) [__.__ __ __]

4. FINE AGGREGATE (AASHTO T84 OR ASTM C128) [__.__ __ __]

BULK SPECIFIC GRAVITIES (Items 4 through 7)

5. COARSE AGGREGATE (AASHTO T85 OR ASTM C127) [__.__ __ __]

6. FINE AGGREGATE (AASHTO T84 OR ASTM C127) [__.__ __ __]

7. MINERAL FILLER (AASHTO T100 OR ASTM D854) [__.__ __ __]

8. AGGREGATE COMBINATION [__.__ __ __]

9. EFFECTIVE SPECIFIC GRAVITY OF AGGREGATE
COMBINATION [__.__ __ __]

10. THEORETICAL MAXIMUM SPECIFIC GRAVITY OF THE RAP/RAS [__.__ __]

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 18 AC BINDER	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__ __]

2. TYPE OF BINDER [__]
Untreated....... 1 RAP....................... 2
RAS............. 3 Combined.................. 4

3. ASPHALT GRADE (Specify Design SUPERPave PG Grading) PG[__ __]-[__ __]

4. ASPHALT GRADE (If not PG grade)
(See Asphalt Code Sheet, Table 48) [__ __]
Other (Specify) [_________________________________]

5. SOURCE (See Supply Code Sheet, Table 46) [__ __]
Other (Specify) [_________________________________]

6. SPECIFIC GRAVITY OF ASPHALT CEMENT [__.__ __ __]
(AASHTO T228, ASTM D70)

7. VISCOSITY OF ASPHALT AT 140°F (poises) [__ __ __ __ __ __]
(AASHTO T202, ASTM D2171)

8. VISCOSITY OF ASPHALT AT 275°F (centistokes) [__ __ __ __.__ __]
(AASHTO T201, ASTM D2170)

9. PENETRATION AT 77°F, 100 g, 5 sec. (tenths of a mm) [__ __ __]
(AASHTO T49, ASTM D5)

ASPHALT MODIFIERS (See Type Code, Table 47) (Items 11 and 12)
TYPE QUANTITY(%)
10. MODIFIER #1 [__ __] [__ __.__]
11. MODIFIER #2 [__ __] [__ __.__]
Other (Specify) [_________________________________]

12. DUCTILITY AT 77°F (cm) [__ __ __]
(AASHTO T51, ASTM D113

13. DUCTILITY AT 39.2°F (cm) [__ __ __]
(AASHTO T51, ASTM D113

14. TEST RATE FOR DUCTILITY MEASUREMENT AT 39.2°F (cm/min) [__ __ __]

15. PENETRATION AT 39.2°F, 200 g, 60 sec. (tenths of a mm) [__ __ __]
(AASHTO T49, ASTM D5)

16. RING AND BALL SOFTENING POINT (°F) [__ __ __]
(AASHTO T53, ASTM D36)

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 19 PMA LABORATORY MIX DESIGN	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__ __]

2. MAXIMUM SPECIFIC GRAVITY (No Air Voids) [__.__ __ __]

3. BULK SPECIFIC GRAVITY (ASTM D1188) [__.__ __ __]

4. OPTIMUM ASPHALT CONTENT (**% by weight of total mix**) [__ __.__]

5. PERCENT AIR VOIDS [__ __ __.__]

6. MARSHALL STABILITY (**pounds**) (AASHTO T245, ASTM D1559) [__ __ __ __]

7. NUMBER OF BLOWS [__ __]

8. MARSHALL FLOW (hundredths of an inch) [__ __ __ __]
(AASHTO T245, ASTM D1559)

9. HVEEM STABILITY (AASHTO T246, ASTM D1560) [__ __ __]

10. HVEEM COHESIOMETER VALUE (**grams/25 mm of width**) [__ __ __ __]
(AASHTO T246, ASTM D1560)

11. VOIDS IN MINERAL AGGREGATE (%) [__ __.__]

12. EFFECTIVE ASPHALT CONTENT (%) [__ __.__]

13. SUPERPAVE GYRATORY COMPACTION N_{DESIGN} [__ __ __]

14. GYRATION RATIO [__.__ __]

15. ASPHALT GRADE (Specify Design SUPERPave PG Grading) PG[__ __]-[__ __]
Other (Specify)[________________________________]

HAMBURG WHEEL TRACKING TEST

16. CONDITIONING (AASHTO T324) Wet... 1 Dry... 2 [__]

17. DEFORMATION AT 20,000 PASSES (**inches**) [__.__ __ __]

18. TEST TEMPERATURE [__ __.__]

19. TENSILE STRENGTH RATIO (AASHTO T283) [__ __.__]

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 20 PMA LABORATORY MIX DESIGN (Continued)	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__ __]

2. FLOW NUMBER (AASHTO TP79) [__.__ __]

3. FLOW NUMBER TEMPERATURE [__ __ __]

4. PLANNED PRODUCTION TEMPERATURE [__ __ __.__]

5. PLANNED FIELD COMPACTION TEMPERATURE [__ __ __.__]

RECYCLED DESIGN INFORMATION

6. DESIGN ASPHALT BINDER CONTENT OF MIX WITHOUT RAS/RAP (%) [__ __.__]

7. PERCENT RAS IN MIXTURE (%) [__ __.__]

8. PERCENT OF SHINGLE ASPHALT BINDER IN THE RAS BY MASS (%) [__.__ __]

9. PERCENT RAP IN MIXTURE (%) [__ __.__]

10. PERCENT ASPHALT IN RAP BY MASS (%) [__ __.__]

11. PERCENT OF RAP/RAS BINDER IN THE MIX BY MASS (%) [__.__ __]
(binder replacement)

12. AMOUNT OF NEW UNTREATED AGGREGATE ADDED (%) [__ __.__]
(percent by weight of combined aggregate in recycled mix)

TYPE QUANTITY(%)
13. RECYCLING AGENT (See Type Code, Table 52) [__ __] [__ __]
Other (Specify)[______________________________________]

14. AMOUNT OF NEW ASPHALT CEMENT ADDED (%) [__ __.__]
(percent by weight of recycled mixture)

PREPARER___________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 21 PMA LABORATORY MIX DESIGN WARM MIX	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__ __]

2. TYPE OF WARM MIX TECHNOLOGY [__]
Foaming Process.................................... 1
Foaming Additive................................... 2
Chemical Additive.................................. 3
Organic Additive................................... 4
None... 5
Other (Specify)[_________________________________] 6

Name Brand (Specify)[____]

3. FORM OF WMA ADDITIVE [__]
Liquid.............. 1 Water Injection........... 3
Solid............... 2 None...................... 4
Other (Specify)[_________________________________] 5

4. DOSAGE RATE (Percent by total weight of binder) [__ __]

5. METHOD OF INTRODUCING ADDITIVE TO THE MIX [__]
Terminal... 1
Storage Tank at Plant.............................. 2
In-Line.. 3
Conveyor/Vane/Collar Feed System................... 4
Water Injection.................................... 5
None... 6
Other (Specify)[_________________________________] 7

PREPARER__________________ EMPLOYER____________________ DATE________________

LTPP SPS-12 DATA SHEET 22 PMA MIX PROP	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__ __]

2. TYPE OF SAMPLES [__]
   Mixed in Field, Compacted in Laboratory 1
   Mixed and Compacted in Field 2

3. MAXIMUM SPECIFIC GRAVITY (No Air Voids) [__.__ __ __]

4. BULK SPECIFIC GRAVITY (ASTM D1188)

MEAN	[__.__ __ __]	NUMBER OF TESTS	[__ __]
MINIMUM	[__.__ __ __]	MAXIMUM	[__.__ __ __]
STD. DEV.	[__.__ __ __]		

5. ASPHALT CONTENT (% by weight of total mix)
   (AASHTO T164, ASTM D2172)

MEAN	[__ __.__]	NUMBER OF TESTS	[__ __]
MINIMUM	[__ __.__]	MAXIMUM	[__ __.__]
STD. DEV.	[__ __.__]		

6. PERCENT AIR VOIDS

MEAN	[__ __.__]	NUMBER OF TESTS	[__ __]
MINIMUM	[__ __.__]	MAXIMUM	[__ __.__]
STD. DEV.	[__ __.__]		

7. VOIDS IN MINERAL AGGREGATE (%)

MEAN	[__ __.__]	NUMBER OF TESTS	[__ __]
MINIMUM	[__ __.__]	MAXIMUM	[__ __.__]
STD. DEV.	[__ __.__]		

8. EFFECTIVE ASPHALT CONTENT (%)

MEAN	[__ __.__]	NUMBER OF TESTS	[__ __]
MINIMUM	[__ __.__]	MAXIMUM	[__ __.__]
STD. DEV.	[__ __.__]		

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 23 PMA MIX PROP (Continued)	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__ __]

2. TYPE OF SAMPLES [__]
   Mixed in Field, Compacted in Laboratory 1
   Mixed and Compacted in Field 2

3. TYPE ASPHALT PLANT [__]
   Batch Plant............ 1 Drum Mix Plant.......... 2
   Other (Specify) [_________________________________]3

4. TYPE OF ANTISTRIPPING AGENT (See Type Codes, Table 53) [__ __]
   Other (Specify) [__________________________________]

5. ANTISTRIPPING AGENT LIQUID OR SOLID CODE [__]
   Liquid.................. 1 Solid 2

6. AMOUNT OF ANTI-STRIPPING AGENT [__ __ __.__]
   (If liquid, enter amount as percent of asphalt cement weight. If solid, enter amount as percent of aggregate weight.)

7. MOISTURE SUSCEPTIBILITY TEST TYPE [__]
   AASHTO T165 (ASTM D1075).............................1
   Texas Freeze-Thaw Pedestal Test (Ref 21).............2
   Texas Boiling Test (Ref 22)..........................3
   Revised Lottman Procedure (AASHTO T283)..............4
   Other (Specify)[_________________________________] 5

8. MOISTURE SUSCEPTIBILITY TEST RESULTS
   HVEEM STABILITY NO. [__ __]
   PERCENT STRIPPED [__ __]
   TENSILE STRENGTH RATIO (AASHTO T283) [__.__ __]
   INDEX OF RETAINED STRENGTH (AASHTO T165) [__ __ __]

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 24 SUPERPAVE MIXUTRE PROPRERTIES	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__ __]

2. TYPE OF SAMPLES [__]
   Mixed in Field, Compacted in Laboratory 1
   Mixed and Compacted in Field 2

3. FREQUENCY SWEEP (COMPLEX MODULUS, MPa % PHASE ANGLE, δ)
   4°C[__ __ __][__ __.__] 20°C[__ __ __][__ __.__] 40°C[__ __ __][__ __.__]

4. UNIAXIAL STRAIN (AXIAL STRESS, kPa & STRAIN, mm/mm)
   4°C[__ __ __][__.__ __] 20°C[__ __ __][__.__ __] 40°C[__ __ __][__.__ __]

5. VOLUMETRIC STRAIN (CONFINING PRESSURE, kPa & AXIAL STRAIN, mm/mm)
   4°C[__ __ __][__.__ __] 20°C[__ __ __][__.__ __] 40°C[__ __ __][__.__ __]

6. SIMPLE SHEAR

	4°C	20°C	40°C
AXIAL STRESS, kPa	[__ __ __]	[__ __ __]	[__ __ __]
SHEAR STRESS, kPa	[__ __ __]	[__ __ __]	[__ __ __]

PREPARER____________________ EMPLOYER______________________DATE_________________

LTPP SPS-12 DATA SHEET 25 PMA CONSTRUCTION	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__]

2. DATE OPERATIONS BEGAN(dd/mmm/yyyy) [__ __ /__ __ __ /__ __ __ __]

3. DATE PAVING COMPLETE(dd/mmm/yyyy) [__ __ /__ __ __ /__ __ __ __]

EQUIPMENT

4. MIXING PLANT TYPE [__]
Batch... 1 Drum Mix... 2 Other... 3(specify)[________________________]

5. MIXING PLANT NAME [____]

6. TYPE OF MATERIALS TRANSFER EQUIPMENT USED [__]
   None... 1
   Windrow Elevator............................... 2
   Surge Volume/Remixing MTV...................... 3
   Other (Specify) [__________________________________] 4
   BRAND [____]

TACK COAT

7. TACK COAT USED (Y/N) [__]

8. TACK COAT TYPE (See Table 48) [__ __]
   Other (Specify) [__________________________________]

9. TACK COAT DILUTION (%) [__ __]

10. APPLICATION RATE (gal/yd^2) [__.__ __]

PLACEMENT INFO

11. HAUL DISTANCE (miles)[__ __ __] HAUL TIME (minutes)[__ __ __]

12. SINGLE PASS LAYDOWN WIDTH (ft) [__ __.__]

13. TRANSVERSE JOINT LOCATION (station in meters) [__+__ __.__]

14. LONGITUDINAL SURFACE JOINT LOCATION [__]
    Between Lanes.... 1 Within Lane.... 2

15. LONGITUDINAL JOINT OFFSET FROM OUTSIDE SHOULDER (ft) [__ __.__]

16. SIGNIFICANT EVENTS (disruptions, rain, equipment problems, etc.)
    [____]

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 26 PMA CONSTRUCTION (Continued)	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__]

TEMPERATURE DATA (Items 2. to 5.)

2. MIXING TEMPERATURE (°F) [__ __ __]
3. PLANT EXHAUST TEMPERATURE (°F) [__ __ __]
4. MEAN DELIVERY TEMPERATURE (°F) [__ __ __]
5. LAYDOWN TEMPERATURES (°F)
   MEAN [__ __ __] NUMBER OF TESTS [__ __ __]
   MINIMUM [__ __ __] MAXIMUM [__ __ __]
   STD. DEV. [__ __ __. __]

ROLLER DATA (Items 6. to 22.)

```
 ROLLER ROLLER GROSS WGT TIRE PRES. FREQ. AMPLITUDE SPEED
 CODE DESCRIPTION (tons) (psi) (vibr/min) (in) (mph)
 6. A    STEEL-WHL TANDEM __ __.__
 7. B    STEEL-WHL TANDEM __ __.__
 8. C    STEEL-WHL TANDEM __ __.__
 9. D    STEEL-WHL TANDEM __ __.__
10. E    PNEUMATIC-TIRED __ __.__ __ __ __.
11. F    PNEUMATIC-TIRED __ __.__ __ __ __.
12. G    PNEUMATIC-TIRED __ __.__ __ __ __.
13. H    PNEUMATIC-TIRED __ __.__ __ __ __.
14. I    SINGLE-DRUM VIBR. __ __.__ __ __ __ __. .__ __ __ __ __.__
15. J    SINGLE-DRUM VIBR. __ __.__ __ __ __ __. .__ __ __ __ __.__
16. K    SINGLE-DRUM VIBR. __ __.__ __ __ __ __. .__ __ __ __ __.__
17. L    SINGLE-DRUM VIBR. __ __.__ __ __ __ __. .__ __ __ __ __.__
18. M    DOUBLE-DRUM VIBR. __ __.__ __ __ __ __. .__ __ __ __ __.__
19. N    DOUBLE-DRUM VIBR. __ __.__ __ __ __ __. .__ __ __ __ __.__
20. O    DOUBLE-DRUM VIBR. __ __.__ __ __ __ __. .__ __ __ __ __.__
21. P    DOUBLE-DRUM VIBR. __ __.__ __ __ __ __. .__ __ __ __ __.__
22. Q    OTHER ______________________________________________________________
```

COMPACTION DATA (Items 23. to 31.)

BREAKDOWN: FIRST LIFT SECOND LIFT THIRD LIFT FOURTH LIFT

23. ROLLER CODE # (A-Q) [__] [__] [__] [__]
24. COVERAGES [__ __] [__ __] [__ __] [__ __]

INTERMEDIATE:

25. ROLLER CODE # (A-Q) [__] [__] [__] [__]
26. COVERAGES [__ __] [__ __] [__ __] [__ __]

FINAL:

27. ROLLER CODE # (A-Q) [__] [__] [__] [__]
28. COVERAGES [__ __] [__ __] [__ __] [__ __]

29.AIR TEMPERATURE (°F) [__ __ __] [__ __ __] [__ __ __] [__ __ __]
30.COMPACTED THICKNESS (in [__.__] [__.__] [__.__] [__.__]
31.CURING PERIOD (days) [__ __] [__ __] [__ __] [__ __]

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 27 UNBOUND	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__]

2. AASHTO SOIL CLASSIFICATION (See Codes, Table 42) [__ __]

3. ATTERBERG LIMITS (AASHTO T90 or ASTM D4318)
   PI [__ __] LL [__ __] PL [__ __]

4. MAXIMUM LAB DRY DENSITY (pcf) [__ __ __]

5. OPTIMUM LAB MOISTURE CONTENT (percent) [__ __.__]

6. TEST USED TO MEASURE MAXIMUM DRY DENSITY [__]
   Standard AASHTO T99 ....1 ASTM D558...................4
   Modified AASHTO T180 ....2 ASTM D4223..................5
   AASHTO T134 (Soil-Cement) ..3
   Other (Specify) [____] 6

7. COMPACTIVE ENERGY FOR "OTHER" METHOD
   (foot-pounds/cubic inch) [__ __.__]

8. IN SITU DRY DENSITY (pcf)
   MEAN [__ __ __ __.__] NUMBER OF SAMPLES [__ __ __]
   MINIMUM [__ __ __ __.__] MAXIMUM [__ __ __ __.__]
   STANDARD DEVIATION [__ __ __ __.__]

9. IN SITU MOISTURE CONTENT (% of dry weight)
   MEAN [__ __ __ __.__] NUMBER OF SAMPLES [__ __ __]
   MINIMUM [__ __ __ __.__] MAXIMUM [__ __ __ __.__]
   STANDARD DEVIATION [__ __ __ __.__]

10. COMPRESSIVE STRENGTH (psi)
    MEAN [__ __ __ __.__] NUMBER OF TESTS [__ __ __]
    MINIMUM [__ __ __ __.__] MAXIMUM [__ __ __ __.__]
    STANDARD DEVIATION [__ __ __ __.__]

11. TYPE OF COMPRESSION TEST [__]
    AASHTO T167 (ASTM D1074) . 1 AASHTO T220 3
    AASHTO T24 (ASTM D1633) .. 2 AASHTO T234 (ASTM D2850) . 4
    Other (Specify) [___________________________________] 5

12. CONFINING PRESSURE (psi)[1] [__ __.__]

13. CALCIUM CARBONATE CONTENT (%) (ASTM D4373) [__ __ __]

Note 1: If the test is unconfined, enter "0.0"

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 28 UNBOUND (Continued)	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__]

2. CALIFORNIA BEARING RATIO (CBR) [__ __ __]
   (AASHTO T193 OR ASTM D3668)

3. RESISTANCE (R-VALUE) (AASTHO T190 (ASTM D2844)) [__ __ __]

4. MODULUS OF SUBGRADE REACTION (K-VALUE) (psi/sq.in.) [__ __ __]

5. TYPE OF TEST [__]
   AASHTO T221 (ASTM D1195) .... 1 AASHTO T222 2

6. STABILIZING AGENT 1 TYPE CODE [__] PERCENT [__ __.__]

7. STABILIZING AGENT 2 TYPE CODE [__] PERCENT [__ __.__]

   STABILIZING AGENT TYPE CODES
   Asphalt Cement .... 1 Lime 5
   Emulsified Asphalt .... 2 Fly Ash, Class C 6
   Cutback Asphalt .... 3 Fly Ash, Class N 7
   Portland Cement 4
   Other (Specify) [____________________________________]8

8. GRADATION OF COMBINED AGGREGATES

Sieve Size or No.	% Passing	Sieve Size or No.	% Passing
2″..........	[__ __ __]	No. 4.........	[__ __]
1 1/2″.......	[__ __ __]	No. 8.........	[__ __]
1″..........	[__ __ __]	No. 10........	[__ __]
7/8″.........	[__ __ __]	No. 16........	[__ __]
3/4″.........	[__ __ __]	No. 30........	[__ __]
5/8″.........	[__ __ __]	No. 40........	[__ __]
1/2″.........	[__ __ __]	No. 50........	[__ __]
3/8″.........	[__ __ __]	No. 80........	[__ __]
No. 100.......	[__ __]		
No. 200.......	[__ __]		

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 29 SUBGRADE	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__]

2. AASHTO SOIL CLASSIFICATION (See Table 42) [__ __]

3. CALIFORNIA BEARING RATIO (CBR) (AASHTO T193 or ASTM D1883) [__ __ __]

4. RESISTANCE (R-VALUE) (AASHTO T190 (ASTM D2844)) [__ __ __]

5. MODULUS OF SUBGRADE REACTION (K-VALUE) (psi/sq. in.) [__ __ __]

6. TYPE OF TEST [__]
   AASHTO T221 (ASTM D1195) ...1 AASHTO T222 or ASTM D1196.. 2

7. PLASTICITY INDEX (AASHTO T90 or ASTM D4318) [__ __]

8. LIQUID LIMIT (AASHTO T89 or ASTM D4318) [__ __]

9. MAXIMUM LABORATORY DRY DENSITY (pcf) [__ __ __]

10. OPTIMUM LABORATORY MOISTURE CONTENT (%) [__ __.__]

11. TEST USED TO MEASURE MAXIMUM DRY DENSITY [__]
    Standard AASHTO (T-99) ... 1 Modified AASHTO (T-180) .. 2
    Other (Specify)____3

12. COMPACTIVE ENERGY FOR "OTHER" METHOD (ft.-lbs./cu. in.) [__ __.__]

13. IN SITU DRY DENSITY (% of optimum)
    MEAN [__ __ __ __.__] NUMBER OF TESTS [__ __ __]
    MINIMUM [__ __ __ __.__] MAXIMUM [__ __ __ __.__]
    STANDARD DEVIATION[__ __ __ __.__]

14. IN SITU MOISTURE CONTENT (% of optimum)
    MEAN [__ __ __ __.__] NUMBER OF TESTS [__ __ __]
    MINIMUM [__ __ __ __.__] MAXIMUM [__ __ __ __.__]
    STANDARD DEVIATION[__ __ __ __.__]

15. IN SITU DRY DENSITY (pcf)
    MEAN [__ __ __ __.__] NUMBER OF TESTS [__ __ __]
    MINIMUM [__ __ __ __.__] MAXIMUM [__ __ __ __.__]
    STANDARD DEVIATION[__ __ __ __.__]

16. IN SITU MOISTURE CONTENT (% of dry weight)
    MEAN [__ __ __ __.__] NUMBER OF TESTS [__ __ __]
    MINIMUM [__ __ __ __.__] MAXIMUM [__ __ __ __.__]
    STANDARD DEVIATION[__ __ __ __.__]

PREPARER___________________ EMPLOYER_____________________DATE________________

LTPP SPS-12 DATA SHEET 30 SUBGRADE (Continued)	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. LAYER NUMBER (From LTPP Data Sheet 4) [__]

RELATIVE DENSITY OF COHESIONLESS FREE-DRAINING SOILS (ASTM D2049)

2. MEASURED DENSITIES FROM LABORATORY TESTS (pcf):

   MINIMUM [__ __ __ __.__]
   MAXIMUM [__ __ __ __.__]

3. RELATIVE DENSITIES (percent):

   MEAN [__ __ __ __.__] NUMBER OF TESTS [__ __ __]
   MINIMUM [__ __ __ __.__] MAXIMUM [__ __ __ __.__]
   STANDARD DEVIATION [__ __ __ __.__]

4. SOIL SUCTION (tons/sf) (AASHTO T273) [__ __ __ __.__]

5. EXPANSION INDEX (ASTM D4829) [__ __ __]

   SWELL PRESSURE (psi)
6. TEST VALUE [__ __ __]

7. TEST CODE [__]
   AASHTO T190 or ASTM D2844 ..1   AASHTO T258, Method 1... 2
   Other ____3

8. PERCENT BY WEIGHT FINER THAN 0.02 MM[1] [__ __ __.__]

9. AVERAGE RATE OF HEAVE DURING STANDARD
   LABORATORY FREEZING TEST (mm/day)[1] [__ __ __.__]

10. FROST SUSCEPTIBILITY CLASSIFICATION CODE[1] [__]

   Negligible 1   Medium 4
   Very Low 2   High 5
   Low 3   Very High 6

NOTE 1: This data is only required in "Freeze Zones" where frost may be expected to penetrate into the subgrade.

PREPARER__________________ EMPLOYER____________________DATE________________

LTPP SPS-12 DATA SHEET 31 QC MEASUREMENTS	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. NUCLEAR DENSITY MEASUREMENTS

Layer Type	Binder Course	Surface Course
Measurement Method (A, B, C)[1]	[__]	[__]
Number of Measurements	[__ __]	[__ __]
Average (pcf)	[__ __ __ __.__]	[__ __ __ __.__]
Maximum (pcf)	[__ __ __ __.__]	[__ __ __ __.__]
Minimum (pcf)	[__ __ __ __.__]	[__ __ __ __.__]
Standard Deviation (pcf)	[__ __ __ __.__]	[__ __ __ __.__]
Layer Number	[__ __]	[__ __]

[1]Measurement Method Backscatter.. A Direct Transmission.. B Air Gap.. C

2. MANUFACTURER OF NUCLEAR DENSITY GAUGE [______________________]

3. NUCLEAR DENSITY GAUGE MODEL NUMBER [______________________]

4. NUCLEAR DENSITY GAUGE IDENTIFICATION NUMBER [______________________]

5. NUCLEAR GAUGE COUNT RATE FOR STANDARDIZATION [__ __ __ __ __]

6. PROFILOGRAPH MEASUREMENTS

   Measured Layer Number [__ __]
   Profilograph Type California...... 1 Rainhard...... 2 [__]
   Profile Index (Inches/Mile) [__ __ __.__]
   Interpretation Method Manual.. 1 Mechanical.. 2 Computer.. 3 [__]
   Height of Blanking Band (Inches) [__.__ __]
   Cutoff Height (Inches) [__.__ __]

7. SURFACE PROFILE USED AS BASIS OF INCENTIVE PAYMENT (Y/N) [__]

PREPARER__________________ EMPLOYER____________________DATE_______________

LTPP SPS-12 DATA **SHEET 32** **FIELD THICKNESS**	STATE CODE [__ __] SHRP ID [__ __ __ __]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET __ OF __

		LAYER NUMBER (From LTPP Data Sheet 4)			
STATION NUMBER	OFFSET (Inches)	[__ __]	[__ __]	[__ __]	[__ __]
[__+__ __]	[__ __ __] [__ __ __] [__ __ __] [__ __ __] [__ __ __]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]
[__+__ __]	[__ __ __] [__ __ __] [__ __ __] [__ __ __] [__ __ __]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]
[__+__ __]	[__ __ __] [__ __ __] [__ __ __] [__ __ __] [__ __ __]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]
[__+__ __]	[__ __ __] [__ __ __] [__ __ __] [__ __ __] [__ __ __]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]
[__+__ __]	[__ __ __] [__ __ __] [__ __ __] [__ __ __] [__ __ __]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]
[__+__ __]	[__ __ __] [__ __ __] [__ __ __] [__ __ __] [__ __ __]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]
[__+__ __]	[__ __ __] [__ __ __] [__ __ __] [__ __ __] [__ __ __]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]	[__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__] [__ __ __.__]

PREPARER____________________ EMPLOYER______________________DATE________________

LTPP SPS-12 DATA SHEET 33 NOTES AND COMMENTS	STATE CODE [__ __] SHRP ID [__ __ __ __]

Provide any miscellaneous comments and notes concerning construction operations which may have an influence on the ultimate performance of the test sections or which may cause undesired performance differences to occur between test sections. Also include any quality control measurements or data for which space is not provided on other data sheets. Provide an indication of the basis for such measurements, such as an ASTM, AASHTO, or Agency standard test designation.

PREPARER____________________ EMPLOYER______________________DATE________________

LTPP SPS-12 DATA SHEET 34 IMPROVEMENT LISTING	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. DATE COMPLETE (dd/mmm/yyyy)	2. WORK TYPE CODE (Table 49)	3. WORK QUANTITY (units from Table 49)	4. THICKNESS (inches)	5. COST (thousands of dollars per lane mile)
[__ __/__ __ __ /__ __ __ __]	[__ __]	[__ __ __.__]	[__ __.__]	[__ __ __]
[__ __/__ __ __ /__ __ __ __]	[__ __]	[__ __ __.__]	[__ __.__]	[__ __ __]
[__ __/__ __ __ /__ __ __ __]	[__ __]	[__ __ __.__]	[__ __.__]	[__ __ __]
[__ __/__ __ __ /__ __ __ __]	[__ __]	[__ __ __.__]	[__ __.__]	[__ __ __]
[__ __/__ __ __ /__ __ __ __]	[__ __]	[__ __ __.__]	[__ __.__]	[__ __ __]
[__ __/__ __ __ /__ __ __ __]	[__ __]	[__ __ __.__]	[__ __.__]	[__ __ __]
[__ __/__ __ __ /__ __ __ __]	[__ __]	[__ __ __.__]	[__ __.__]	[__ __ __]
[__ __/__ __ __ /__ __ __ __]	[__ __]	[__ __ __.__]	[__ __.__]	[__ __ __]
[__ __/__ __ __ /__ __ __ __]	[__ __]	[__ __ __.__]	[__ __.__]	[__ __ __]
[__ __/__ __ __ /__ __ __ __]	[__ __]	[__ __ __.__]	[__ __.__]	[__ __ __]
[__ __/__ __ __ /__ __ __ __]	[__ __]	[__ __ __.__]	[__ __.__]	[__ __ __]

PREPARER____________________ EMPLOYER______________________DATE________________

LTPP SPS-12 DATA SHEET 35 DIAMOND GRINDING	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. DATE OF GRINDING (dd/mmm/yyyy) [__ __/__ __ __/__ __ __ __]

DESIGN INFORMATION

2. DESIGN GRINDING DEPTH (inches) [__.__ __]
3. DESIGN LATERAL SPACING (inches) [__ __ __]

EQUIPMENT INFORMATION

4. MANUFACTURER/MODEL [____]
5. CUTTING HEAD WIDTH (inches) [__ __ __.__]
6 AVERAGE SPACING BETWEEN BLADES (inches) [__.__]

GENERAL CONDITION INFORMATION

7. EXISTING PAVEMENT SURFACE FINISH [__]
   - Longitudinal Tining.................................. 1
   - Transverse Tining.................................... 2
   - Broomed finish....................................... 3
   - Other.. 4

8. EXISTING SURFACE MEAN TEXTURE DEPTH (ASTM E965)(inches) [__.__ __ __]

9. HARDNESS OF EXISTING PAVEMENT SURFACE (MOHS SCALE) [__.__]

AMBIENT CONDITIONS AT TIME OF GRINDING

10. AIR TEMPERATURE (°F) [__ __ __]
11. SURFACE TEMPERATURE (°F) [__ __ __]
12. RELATIVE HUMIDITY (percent) [__ __ __]
13. CLOUD COVER (percent) [__ __ __]
14. WIND SPEED (mph) [__ __ __]

CONSTRUCTION INFORMATION

15. IS CONCRETE SLURRY ADEQUATELY REMOVED? (Y/N) [__]

FINISHED SURFACE INFORMATION

16. MEAN TEXTURE DEPTH (ASTM E965)(inches) [__.__ __ __]
17. TRANSVERSE SLOPE (inches) [__.__ __]
18. AVERAGE DEPTH OF CUT (inches) [__.__ __]
19. AVERAGE GROOVE WIDTH (inches) [__.__]

PREPARER___________________ EMPLOYER_____________________DATE______________

LTPP SPS-12 DATA SHEET 36 JOINT SEALANT APPLICATION DATA	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. DATE SEALING BEGAN (dd/mmm/yyyy) [__ __/__ __ __/__ __ __ __]
2. DATE SEALING COMPLETE (dd/mmm/yyyy) [__ __/__ __ __/__ __ __ __]

EXISTING CONDITION INFORMATION

3. JOINTS PREVIOUSLY SEALED? (Y/N) [__]
4. CONDITION OF EXISITNG SEALANT – APPROX % OF SEALANT LENGTH WITH
   - EXTRUSION [__ __ __]
   - HARDENING [__ __ __]
   - ADHESIVE FAILURE [__ __ __]
   - COHESIVE FAILURE [__ __ __]
   - SEALANT LOSS [__ __ __]
   - FOREIGN MATERIAL INTRUSION [__ __ __]
   - WEED GROWTH [__ __ __]

AMBIENT CONDITIONS AT TIME SEAL COAT APPLIED

5. AIR TEMPERATURE (°F) [__ __ __]
6. SURFACE TEMPERATURE (°F) [__ __ __]
7. RELATIVE HUMIDITY (percent) [__ __ __]
8. CLOUD COVER (percent) [__ __ __]
9. WIND SPEED (mph) [__ __ __]

SURFACE PREPARATION

10. METHOD OF REMOVING OLD SEALANT [__]
    - Not Removed.............1 Joint Plow - V-Shaped 2
    - Joint Plow – Rectangular.3 Water Blasting 4
    - Diamond Blade Saw........5 Carbide Blade Saw 6
    - Pull-Out Old Sealant.....7 Not Previously Sealed 8
    - Other (Specify)[____] 9

11. WERE JOINT SIDEWALLS REFACED? [__]
    - No.. 1
    - Yes -- One-Blade.................................... 2
    - Yes -- Two-Blade.................................... 3
    - Other (Specify) [____]4

12. CLEANING OF SIDEWALLS [__]
    - None.. 1
    - Sandblasting.. 2
    - Pressure Washing.................................... 3
    - Other (Specify)[____]4

RESERVIOR INFORMATION (Prior to Sealing)

13. WIDTH (inches) [__.__]
14. DEPTH (inches) [__ __.__]
15. CLEANLINESS - Clean...1 Moderately Clean...2 Dirty...3 [__]
16. WETNESS – Very Dry..1 Only Slightly Damp..3 Slightly Wet..5 [__]
    Dry.......2 Somewhat Damp.......4 Wet...........6

PREPARER___________________ EMPLOYER_____________________DATE_______________

LTPP SPS-12 DATA SHEET 37 JOINT SEALANT APPLICATION DATA (CONTINUED)	STATE CODE [__ __] SHRP ID [__ __ __ __]

SEALANT INFORMATION

1. TYPE OF JOINT SEALANT (AASHTO or ASTM Specifications) [__]

   D1850 (ASTM) Concrete Joint Sealer, Cold-Application Type....1
   D1190 (ASTM) - M173 (AASHTO) Concrete Joint Sealer Hot-Poured Elastic Type 2
   D3406 (ASTM) - M282 (AASHTO) Joint Sealants, Hot-Poured Elastomeric Type, For PCC Pavements 3
   D3405 (ASTM) - M301 (AASHTO) Joint Sealants, Hot-Poured for Concrete and Asphalt Pavements 4
   D3542 (ASTM) Preformed Polychloropropene Elastomeric Joint Seals for Bridges 5
   D2628 (ASTM) Preformed Polychloropropene Elastomeric Joint Seals for Concrete Pavements 6
   Other (Describe – If Silicone Material is Used, Federal Spec. TT-S-001543A, Georgia DOT Spec. 833.06, or Equal Applies)[____ ____] 7

2. MANUFACTURER NAME [____]
3. MANUFACTURER SEALANT NAME [____]

BOND BREAKER

4. TYPE OF BOND BREAKER UNDER SEALANT [__]
   None.. 1
   Non-Reactive Adhesive-Backed Tape 2
   Backer Rod 3
   Other (Specify)[_______________________________________] 4

5. BOND BREAKER SIZE (inches) [__.__]
6. DEPTH FROM SURFACE TO TOP OF BOND BREAKER (inches) [__.__]

SEALING INFORMATION

7. SEALANT APPLICATION TEMPERATURE (ºF) [__ __ __]
8. SEALANT APPLICATION RATE (pounds/linear foot) [__.__ __]

9. DEPTH OF TOP OF SEALANT (Below Pavement Surface) (inches) [__.__]

10. ESTIMATED TIME BETWEEN SURFACE PREPARATION AND SEALING (days) [__]

11. ESTIMATED TIME BETWEEN SEALING AND VEHICLE TRAFFIC (hours) [__ __.__]

PREPARER___________________ EMPLOYER_____________________DATE______________

LTPP SPS-12 DATA **SHEET 38** **PENETRATING SEALER APPLICATION DATA**	STATE CODE [__ __] SHRP ID [__ __ __ __]

1. DATE SEALING BEGAN (dd/mmm/yyyy) [__ __/__ __ __/__ __ __ __]
2. DATE SEALING COMPLETE (dd/mmm/yyyy) [__ __/__ __ __/__ __ __ __]

EXISTING CONDITION INFORMATION

3. JOINTS PREVIOUSLY SEALED? (Y/N) [__]

AMBIENT CONDITIONS AT TIME SEALER APPLIED

4. AIR TEMPERATURE (°F) [__ __ __]
5. SURFACE TEMPERATURE (°F) [__ __ __]
6. RELATIVE HUMIDITY (percent) [__ __ __]
7. CLOUD COVER (percent) [__ __ __]
8. WIND SPEED (mph) [__ __ __]

SURFACE PREPARATION

9. WAS JOINT PRESSURE WASHED PRIOR TO APPLICATION (Y/N) [__]

10. OTHER SURFACE PREPERATION [____
____]

11. CLEANLINESS - Clean...1 Moderately Clean...2 Dirty...3 [__]
12. WETNESS – Very Dry..1 Only Slightly Damp..3 Slightly Wet..5 [__]
Dry.......2 Somewhat Damp.......4 Wet...........6

SEALANT INFORMATION

13. MANUFACTURER NAME [____]
14. MANUFACTURER SEALANT NAME [____]

APPLICATION

15. SEALER APPLICATION RATE (gal/square yard) [__.__ __]
16. WIDTH OF APPLICATION (inches) [__ __.__]
17. DEPTH OF PENETRATION (inches) [__.__ __]

PREPARER__________________ EMPLOYER____________________DATE______________

STANDARD CODES TABLES

Table 33. Table of Standard Codes for States, District of Columbia, Puerto Rico, American Protectorates, and Canadian Provinces

State	Code
Alabama	01
Alaska	02
Arizona	04
Arkansas	05
California	06
Colorado	08
Connecticut	09
Delaware	10
District of Columbia	11
Florida	12
Georgia	13
Hawaii	15
Idaho	16
Illinois	17
Indiana	18
Iowa	19
Kansas	20
Kentucky	21
Louisiana	22
Maine	23
Maryland	24
Massachusetts	25
Michigan	26
Minnesota	27
Mississippi	28
Missouri	29
Montana	30
Nebraska	31
Nevada	32
New Hampshire	33
New Jersey	34
New Mexico	35
New York	36
North Carolina	37
North Dakota	38
Ohio	39
Oklahoma	40
Oregon	41
Pennsylvania	42

State	Code
Rhode Island	44
South Carolina	45
South Dakota	46
Tennessee	47
Texas	48
Utah	49
Vermont	50
Virginia	51
Washington	53
West Virginia	54
Wisconsin	55
Wyoming	56
American Samoa	60
Guam	66
Puerto Rico	72
Virgin Islands	78
Alberta	81
British Columbia	82
Manitoba	83
New Brunswick	84
Newfoundland	85
Nova Scotia	86
Ontario	87
Prince Edward Island	88
Quebec	89
Saskatchewan	90

Table 34. Functional Class Codes

Rural Principal Arterial – Interstate	01
Rural Principal Arterial – Other	02
Rural Minor Arterial	06
Rural Major Collector	07
Rural Minor Collector	08
Rural Local Collector	09
Urban Principal Arterial – Interstate	11
Urban Principal Arterial – Other Freeways or Expressways	12
Urban Other Principal Arterial	14
Urban Minor Arterial	16
Urban Collector	17
Urban Local	19

Table 35. Experiment Type Definitions

General Pavement Studies

(01) Asphalt Concrete Pavement with Granular Base

Acceptable pavements for this study include a dense-graded HMAC surface layer, with or without other HMAC layers, placed over untreated granular base. One or more subbase layers may also be present, but are not required. A treated subgrade is classified as a subbase layer. "Full depth" AC pavements, defined as an HMAC surface layer combined with one or more subsurface HMAC layers beneath the surface layer with a minimum total HMAC thickness of 152 mm (6 inches) placed directly upon a treated or untreated subgrade, are also allowed in this study. Two or more consecutive lifts of the same mixture design are to be treated as one layer.

Seal coats or porous friction courses are allowed on the surface, but not in combination, i.e., a porous friction course placed over a seal coat is not acceptable. Seal coats are permissible on top of granular layers. At least one layer of dense-graded HMAC is required, regardless of the existence of seal coats or porous friction courses.

(02) Asphalt Concrete Pavement with Bound Base

Acceptable pavements for this study include a dense-graded HMAC surface layer with or without other HMAC layers, placed over a bound base layer. To properly account for a variety of bound base types in the sampling design, two classifications of binder types, bituminous and non-bituminous, are defined as factor levels. Bituminous binders include asphalt cements, cutbacks, emulsions, and road tars. Non-bituminous binders include all hydraulic cements (those which harden by a chemical reaction with water and are capable of hardening under water), lime, fly ashes, and natural pozzolans, or combinations thereof. Stabilized bases with lower quality materials such as sand asphalt or soil cement are also allowed. Stabilization practices of primary concern for this study are those in which the structural characteristics of the material are improved due to the cementing action of the stabilizing agent. Thus, the description of the study actually refers to treatments improving the structural properties of the base materials. Two or more consecutive lifts of the same mixture design are to be treated as one layer. One or more subbase layers may be present but are not required.

Seal coats or porous friction courses are permitted on the surface but not in combination, i.e., a porous friction course placed over a seal coat is not acceptable. Project selection is often to those constructed on both fine and coarse subgrades.

(03) Jointed Plain Concrete Pavement – JPCP

Acceptable jointed, unreinforced PCC slab placed over untreated granular base, HMAC, or stabilized base. One or more subbase layers may also be present, but are not required. The joints may have either no load transfer devices or smooth dowel bars. A seal coat is permissible above a granular base layer. Jointed slabs with load transfer devices other than dowel bars and pavements placed directly upon a treated or untreated subgrade are also not acceptable.

Table 35. Experiment Type Definitions (continued)

(04) Jointed Reinforced Concrete Pavement – JRCP

Acceptable projects include jointed reinforced PCC pavements with doweled joints spaced between 20 and 65 feet (66 and 213 m). The slab may rest directly upon a base layer or upon unstabilized coarse-grained subgrade. A base layer and one or more subbase layers may exist, but are not required. A seal coat is also permissible over a granular base layer. JRCP placed directly upon a fine-grained soil/aggregate layer or a fine-grained subgrade will not be considered for this study. JRCP's without load transfer devices or using devices other than smooth dowel bars at the joints are not acceptable.

(05) Continuously Reinforced Concrete Pavement – CRCP

Acceptable projects include continuously reinforced PCC pavements placed directly upon a base layer or upon unstabilized coarse-grained subgrade. One or more subbase layers can exist but are not required. A seal coat (prime coat) is permissible just above a granular base layer. CRCP's placed directly upon a fine-grained soil/aggregate layer or a fine-grained subgrade is not acceptable for this study.

(06) AC Overlay of AC Pavement

Pavements in the GPS-6A, 6B, 6C, 6D, and 6S experiments include a dense-graded HMAC surface layer with or without other HMAC layers placed over an existing AC pavement.

The designation 6A refers to those sections, which were overlaid prior to acceptance in the GPS program.

The 6B, 6C, 6D, and 6S designation refers to LTPP sections on which an overlay was placed after the section had been accepted into the LTPP program.

Seal coats or porous friction courses are allowed but not in combination. Fabric interlayers and SAMIs are permitted between the original surface and the overlay. The total thickness of HMAC used in the overlay is required to be at least 25.4 mm (1.0 inch).

The 6W designates WMA mixtures as follows:

Chemical Additives are defined as water-free (non-aqueous) chemistry packages that modify the AC binder properties to enhance coating, adhesion, and workability at reduced temperatures. This includes surfactants, fatty-acid chemical additives, cationic surface-active agents, and rheology modifiers.

Organic Additives are plant-based, wax-based, or sulfur-extended materials designed to provide viscosity reduction, aid in asphaltenes dispersion, and act as a lubricant at mixing temperatures below that of standard HMA.

Table 35. Experiment Type Definitions (continued)

Foaming Additives are defined as water-containing materials added to the mixture to foam the asphalt. The most common foaming additive is synthetic zeolite. Zeolite contains 20-30 percent water that is released at temperatures above the boiling point of water. The water from the zeolite foams the asphalt binder.

The ***Foaming Process*** category includes all WMA types that utilize assemblies/modifications to the plant to foam AC binder without additives. This includes foaming nozzles, expansion chambers, vortex mixers, and shearing devices. While the other categories may be added to the mix using some type of nozzle or other addition, the key distinction between the Foaming Process category and others is the absence of additives. WMA technologies that fall into the Foaming Process category only utilize water.

(07) AC Overlay of Concrete Pavement

Pavements classified in the GPS-7A, 7B, 7C, 7D, 7F, 7R, and 7S experiments primarily consist of JPCP, JRCP, and CRCP pavements in which a dense-graded HMAC surface layer with or without other HMAC surface layers was constructed.

The exception is the 7R classification that was added to account for PCC pavement test sections rehabilitated using CPR techniques. (To date, no test sections have been classified in the 7R category.)

The designation 7A refers to sections that were overlaid prior to acceptance in the GPS program. The 7B, 7C, 7D, 7F, and 7S designation refers to those test sections on which an overlay was placed after the section had been accepted into the LTPP program.

The PCC slab may rest upon a combination of the base and/or subbase layers. The existing concrete slab can also be placed directly on lime or cement-treated fine or coarse-grained subbase or on untreated coarse-grained subgrade soil. Slabs placed directly on untreated fine-grained subgrade are not acceptable.

Seal coats or porous friction courses are permissible but not allowed in combination. Fabric interlayers and SAMIs are acceptable when placed between the original surface (concrete) and the overlay. Overlaid pavements involving aggregate interlayers and open-graded AC interlayers are not included in this study. The total thickness of HMAC used in the overlay is required to be at least 38 mm (1.5 inches).

The 6W designates WMA mixtures as follows:

Chemical Additives are defined as water-free (non-aqueous) chemistry packages that modify the AC binder properties to enhance coating, adhesion, and workability at reduced temperatures. This includes surfactants, fatty-acid chemical additives, cationic surface-active agents, and rheology modifiers.

Table 35. Experiment Type Definitions (continued)

Organic Additives are plant-based, wax-based, or sulfur-extended materials designed to provide viscosity reduction, aid in asphaltenes dispersion, and act as a lubricant at mixing temperatures below that of standard HMA.

Foaming Additives are defined as water-containing materials added to the mixture to foam the asphalt. The most common foaming additive is synthetic zeolite. Zeolite contains 20-30 percent water that is released at temperatures above the boiling point of water. The water from the zeolite foams the asphalt binder.

The ***Foaming Process*** category includes all WMA types that utilize assemblies/modifications to the plant to foam AC binder without additives. This includes foaming nozzles, expansion chambers, vortex mixers, and shearing devices. While the other categories may be added to the mix using some type of nozzle or other addition, the key distinction between the Foaming Process category and others is the absence of additives. WMA technologies that fall into the Foaming Process category only utilize water.

(09) Unbonded JCP Overlays of Concrete Pavement

Acceptable projects for this study include unbonded JPCP, JRCP, or CRCP overlays with a thickness of 129 mm (5 inches) or more placed over an existing JPCP, JRCP, or CRCP pavement. An interlayer used to prevent bonding of the existing and the overlay slabs is required. The overlaid concrete pavement can rest on a base and/or a subbase or directly upon the subgrade.

Specific Pavement Studies

(01) Structural Factors for Flexible Pavements

The experiment on Strategic Study of Structural Factors for Flexible Pavements (SPS-1) examines the performance of specific HMAC-surfaced pavement structural factors under different environmental conditions. Pavements within SPS-1 must start with the original construction of the entire pavement structure or removal and complete reconstruction of an existing pavement. The pavement structural factors included in this experiment are in-pavement drainage layer, surface thickness, base type, and base thickness. The experiment design stipulates a traffic loading level in the study lane in excess of 100,000 – 80-kN (18-kip) ESAL per year. The combination of the study factors in this experiment result in 24 different pavement structures. The experiment is designed using a fractional factorial approach to enhance implementation practicality; permitting the construction of twelve test sections at one site with the complementary twelve test sections to be constructed at another site within the same climatic region on a similar subgrade type.

Table 35. Experiment Type Definitions (Continued)

(02) Structural Factors for Rigid Pavements

The experiment on Strategic Study of Structural Factors for Rigid Pavements (SPS-2) examines the performance of specific JPCP structural factors under different environmental conditions. Pavements within SPS-2 must start with the original construction of the entire pavement structure or removal and complete reconstruction of an existing pavement. The pavement structural factors included in this experiment are in-pavement drainage layer, PCC surface thickness, base type, PCC flexural strength, and lane width. The experiment requires that all test sections be constructed with perpendicular doweled joints at 4.9-m (15-ft) spacing and stipulate a traffic loading level in the lane in excess of 200,000 ESAL/year. The experiment is designed using a fractional factorial approach to enhance implementation practicality; permitting construction of twelve test sections at one site with the complementary twelve test sections to be constructed at another site within the same climatic region on a similar subgrade type.

(03) Preventive Maintenance Effectiveness of Flexible Pavements

The experiment on Preventive Maintenance Effectiveness of Flexible Pavements (SPS-3) examines the performance of 4 preventive maintenance treatments (cracking seal, chip seal, slurry seal, and thin overlay) on AC surfaced pavement sections within the four climatic regions, on the two classes of subgrade soil. The experimental design stipulates that the effectiveness of each of the four treatments be evaluated independently. The effectiveness of combinations of treatments is not considered. Therefore, each site includes four treated test sections in addition to a control section. In most cases the control, or do nothing section, is classified as a GPS test section.

(04) Preventive Maintenance Effectiveness of Jointed Concrete Pavements

The experiment on Preventive Maintenance Effectiveness of Jointed Concrete Pavements (SPS-4) was designed to study the effects of crack/joint sealing and undersealing on jointed PCC pavement structures. Both JRCP and JPCP are included in the study. Undersealing is included as an optional factor and is only performed on a section in which the need for undersealing is indicated. The experiment design stipulates that the effectiveness of each of the two treatments be evaluated independently. The effectiveness of combinations of treatments is not considered. Each test site includes two treated test sections in addition to a control section. The treatment sections on joint/crack seal test sites consists of one section in which all joints have no sealant, and one in which a water tight seal is maintained on all cracks and joints.

(05) Rehabilitation of Asphalt Concrete Pavements

The experiment on Rehabilitation of Asphalt Concrete Pavements (SPS-5) examines the performance of 8 combinations of AC overlays on existing AC-surfaced pavements. The rehabilitation treatment factors included in the study are intensity of surface preparation, recycled vs. virgin AC overlay mixture, and overlay thickness. The experiment design includes all four climatic regions and conditions of existing pavement. The experiment design stipulates a traffic loading level in the study lane in excess of 100,000 ESALs/year.

Table 35. Experiment Type Definitions (Continued)

(06) Rehabilitation of Jointed Portland Cement Concrete Pavements

The experiment on Rehabilitation of Jointed Portland Cement Concrete Pavements (SPS-6) examines the performance of 7 rehabilitation treatment options as a function of climatic region, type of pavement (plain and reinforced), and condition of existing pavement. The rehabilitation methods include surface preparation (a limited preparation and full CPR) with a 102 mm (4 inches) thick AC overlay or without an overlay, crack/break and seat with two AC overlay thicknesses (102 and 203 mm [4 and 8 inches]), and limited surface preparation with a 102 mm (4 inches) thick AC overlay with sawed and sealed joints.

(07) Bonded Concrete Overlays of Concrete Pavements

The experiment on Bonded Concrete Overlays on Concrete Pavements (SPS-7) examines the performance of 8 combinations of bonded PCC treatment alternatives as a function of climatic region, pavement type (jointed and continuously reinforced), and condition of existing pavement. The rehabilitation treatment factors include combinations of surface preparation methods (cold milling plus sand blasting and shot blasting), bonding agents (neat cement grout or none), and overlay thickness (76 and 127 mm [3 and 5 in.]). The experiment design stipulates a traffic loading level in the study lane in excess of 200,000 ESAL/year.

(08) Environmental Effects in the Absence of Heavy Loads

The experiment on Environmental Effects in the Absence of Heavy Loads (SPS-8) examines the effect of climatic factors in the four environmental regions, subgrade type (frost-susceptible, expansive, fine, and coarse) on pavement sections incorporating flexible and rigid pavement designs that are subjected to limited traffic loading. The experiment design requires either 2 flexible pavement structures or 2 rigid pavement structures to be constructed at each site. The 2 flexible pavement sections consist of 102-mm (4-inch) AC surface on 102-mm (8-inch) thick untreated granular base, and 178-mm (7-inch) AC surface over a 305-mm (12-inch) thick granular base. Rigid pavement test sections consist of doweled JPCP with 203-mm (8-inch) and 279-mm (11-inch) PCC surface thickness on 152-mm (6-inch) thick dense-graded granular base. The pavement structures included in this study match pavement structures included in the SPS-1 and 2 experiments. The experiment design stipulates that traffic volume in the study lane be at least 100 vehicles per day but not more than 10,000 ESALs/year. The flexible and rigid pavement sections may be constructed at the same site or at different sites.

(09) Validation of SHRP Asphalt Specifications and Mix Design

The SPS-9P pilot effort started at the end of the SHRP program in order to get some experience in implementing the SuperPave™ specifications. Test sections classified as SPS-9P were constructed using a very limited set of guidelines. In some instances, specifications were based on interim SuperPave™ specifications that were changed at a later date. Many of the test sections were constructed before material sampling and testing guidelines were established.

Table 35. Experiment Type Definitions (Continued)

The SPS-9A experiment, SuperPave™ Asphalt Binder Study, requires construction of a minimum of two test sections at each project site. Construction can include new construction, reconstruction, or overlay. The minimum test sections consist of (1) Highway agencies' standard mix, (2) SuperPave™ Level 1 designed standard mix, and (3) SuperPave™ mix with alternate binder grade either higher or lower than the specified SuperPave™ binder. The minimum two test sections at some sites results from the agency's declaration that the SuperPave™ test section is the same as the standard agency mixture. This will provide the opportunity to evaluate and improve the practical aspects of implementing SuperPave™ mix design through a hands-on field trial by interested highway agencies, comparison of the performance of the SuperPave™ mixes against mixes designed with current highway agencies' asphalt specifications, asphalt-aggregate specifications, and mix design procedures, and to test the sensitivity of the SuperPave™ asphalt binder specifications relative to low temperature cracking, fatigue, or permanent deformation distress factors.

(10) Warm Mix Asphalt (WMA)

The experiment on WMA was designed to study the effects of warm mix asphalt layers on existing and newly constructed pavements. The experiment design includes all four climatic regions. The experiment design stipulates a mixture produced at or below 275°F or a mixture produced at temperatures at least 30°F below the production temperature of the HMA control.

The WMA mixture is as follows:

Chemical Additives are defined as water-free (non-aqueous) chemistry packages that modify the AC binder properties to enhance coating, adhesion, and workability at reduced temperatures. This includes surfactants, fatty-acid chemical additives, cationic surface-active agents, and rheology modifiers.

Organic Additives are plant-based, wax-based, or sulfur-extended materials designed to provide viscosity reduction, aid in asphaltenes dispersion, and act as a lubricant at mixing temperatures below that of standard HMA.

Foaming Additives are defined as water-containing materials added to the mixture to foam the asphalt. The most common foaming additive is synthetic zeolite. Zeolite contains 20-30 percent water that is released at temperatures above the boiling point of water. The water from the zeolite foams the asphalt binder.

The *Foaming Process* category includes all WMA types that utilize assemblies/modifications to the plant to foam AC binder without additives. This includes foaming nozzles, expansion chambers, vortex mixers, and shearing devices. While the other categories may be added to the mix using some type of nozzle or other addition, the key distinction between the Foaming Process category and others is the absence of additives. WMA technologies that fall into the Foaming Process category only utilize water.

Table 35. Experiment Type Definitions (Continued)

(11) AC Preservation

The SPS-11 experiment examines the effectiveness of a single application of an AC preservation treatment as a function of pavement condition and time through application of the same preservation treatment, at different times, on the same pavement structure. Three different treatments are part of the experiment, each with a different designation. SPS-11T is used for thin AC overlays, SPS-11C for chip seals, and SPS-11M for micro-surfacing. The treatments should be applied to roadways with a recent (<4 years) overlay, with no visible distress and a smooth (IRI<80) surface.

(12) PCC Preservation

The SPS-12 experiment examines the effectiveness of a single application of a PCC preservation treatment as a function of pavement condition and time through application of the same preservation treatment, at different times, on the same pavement structure. Three different treatments are part of the experiment, each with a different designation. SPS-12G is used for diamond grinding, SPS-12S for joint sealing, and SPS-12P for penetrating sealers. The treatments should be applied to recently constructed (<4 years for sealers, <10 years for grinding), dowelled JPCC surfaces in good condition.

Table 36. Pavement Type Codes

Asphalt Concrete (AC) Surfaced Pavements

AC With Granular Base	01
AC With Bituminous Treated Base	02
AC With Non-Bituminous Treated Base	07
AC Overlay on AC Pavement	03
AC Overlay on JPCP Pavement	28
AC Overlay on JRCP Pavement	29
AC Overlay on CRCP Pavement	30
Other	10

Portland Cement Concrete Surfaced Pavements

JPCP – Placed directly on Untreated Subgrade	11
JRCP – Placed directly on Untreated Subgrade	12
CRCP – Placed directly on Untreated Subgrade	13
JPCP – Placed directly on Treated Subgrade	14
JRCP – Placed directly on Treated Subgrade	15
CRCP – Placed directly on Treated Subgrade	16
JPCP Over Unbound Base	17
JRCP Over Unbound Base	18
CRCP Over Unbound Base	19
JPCP Over Bituminous Treated Base	20
JRCP Over Bituminous Treated Base	21
CRCP Over Bituminous Treated Base	22
JPCP Over Non-Bituminous Treated Base	23
JRCP Over Non-Bituminous Treated Base	24
CRCP Over Non-Bituminous Treated Base	25
JPCP Overlay on JPCP Pavement	31
JPCP Overlay on JRCP Pavement	33
JPCP Overlay on CRCP Pavement	35
JRCP Overlay on JPCP Pavement	32
JRCP Overlay on JRCP Pavement	34
JRCP Overlay on CRCP Pavement	36
CRCP Overlay on JPCP Pavement	38
CRCP Overlay on JRCP Pavement	39
CRCP Overlay on CRCP Pavement	37
JPCP Overlay on AC Pavement	04
JRCP Overlay on AC Pavement	05
CRCP Overlay on AC Pavement	06
Prestressed Concrete Pavement	40
Other	49

Table 36. Pavement Type Codes (Continued)

***Composite Pavements (Wearing Surface Included in Initial Construction:**

JPCP With Asphalt Concrete Wearing Surface	51
JRCP With Asphalt Concrete Wearing Surface	52
CRCP With Asphalt Concrete Wearing Surface	53
Other	59

Definitions

JPCP – Jointed Plain Concrete Pavement
JRCP – Jointed Reinforced Concrete Pavement
CRCP – Continuously Reinforced Concrete Pavement

* "Composite Pavements" are pavements originally constructed with an AC wearing surface over a PCC slab (1986 "AASHTO Guide for Design of Pavement Structures").

Table 37. Pavement Surface Material Type Classification Codes

Hot Mixed, Hot Laid Asphalt Concrete, Dense Graded	01
Hot Mixed, Hot Laid Asphalt Concrete, Open Graded (Porous Friction Course)	02
Sand Asphalt	03
Portland Cement Concrete (JPCP)	04
Portland Cement Concrete (JRCP)	05
Portland Cement Concrete (CRCP)	06
Portland Cement Concrete (Prestressed)	07
Portland Cement Concrete (Fiber Reinforced)	08
Plain Portland Cement Concrete (Only used for SPS-7 overlays of CRCP)	90
Plant Mix (Emulsified Asphalt) Material, Cold Laid	09
Plant Mix (Cutback Asphalt) Material, Cold Laid	10
Single Surface Treatment	11
Double Surface Treatment	12
Recycled Asphalt Concrete, Hot, Central Plant Mix	13
Recycled Asphalt Concrete, Cold Laid, Central Plant Mix	14
Recycled Asphalt Concrete, Cold Laid, Mixed-In-Place	15
Recycled Asphalt Concrete, Heater Scarification/Recompaction	16
Recycled Portland Cement Concrete, JPCP	17
Recycled Portland Cement Concrete, JRCP	18
Recycled Portland Cement Concrete, CRCP	19
Other	20
Warm Mix Dense Graded	91
Warm Mix Open Graded	92
Warm Mix Gap Graded	93

Table 38. Base and Subbase Material Type Classification Codes

Gravel (Uncrushed)	22
Crushed Stone, Gravel or Slag	23
Sand	24
Soil-Aggregate Mixture (Predominantly Fine-Grained Soil)	25
Soil-Aggregate Mixture (Predominantly Coarse-Grained Soil)	26
Soil Cement	27
Asphalt Bound Base or Subbase Materials, Dense Graded, Hot Laid, Central Plant Mix	28
Asphalt Bound Base or Subbase Materials, Dense Graded, Cold Laid, Central Plant Mix	29
Asphalt Bound Base or Subbase Materials, Dense Graded, Cold Laid, Mixed-In-Place	30
Asphalt Bound Base or Subbase Materials, Open Graded, Hot Laid, Central Plant Mix	31
Asphalt Bound Base or Subbase Materials, Open Graded, Cold Laid, Central Plant Mix	32
Asphalt Bound Base or Subbase Materials, Open Graded, Cold Laid, Mixed-In-Place	33
Asphalt Bound Base or Subbase Materials, Recycled Asphalt Concrete, Plant Mix, Hot Laid	34
Asphalt Bound Base or Subbase Materials, Recycled Asphalt Concrete, Plant Mix, Cold Laid	35
Asphalt Bound Base or Subbase Materials, Recycled Asphalt Concrete, Mixed-In-Place	36
Asphalt Bound Base or Subbase Materials, Sand Asphalt	46
Cement-Aggregate Mixture	37
Lean Concrete (<3 sacks cement/cy)	38
Recycled Portland Cement Concrete	39
Sand-Shell Mixture	40
Limerock, Caliche (Soft Carbonate Rock)	41
Lime-Treated Subgrade Soil	42
Cement-Treated Subgrade Soil	43
Pozzolanic-Aggregate Mixture	44
Cracked and Seated PCC Layer	45
Other	49

Table 39. Subgrade Soil Description Codes

Fine-Grained Subgrade Soils

Clay (Liquid Limit > 50)	51
Sandy Clay	52
Silty Clay	53
Silt	54
Sandy Silt	55
Clayey Silt	56

Coarse-Grained Subgrade Soils

Sand	57
Poorly Graded Sand	58
Silty Sand	59
Clayey Sand	60
Gravel	61
Poorly Graded Gravel	62
Clayey Gravel	63
Shale	64
Rock	65

Table 40. Material Type Codes for Thin Seals and Interlayers

Grout	70
Chip Seal Coat	71
Slurry Seal Coat	72
Fog Seal Coat	73
Woven Geotextile	74
Nonwoven Geotextile	75
Stress Absorbing Membrane Interlayer	77
Dense Graded Asphalt Concrete Interlayer	78
Aggregate Interlayer	79
Open Graded Asphalt Concrete Interlayer	80
Chip Seal with Modified Binder (Does Not Include Crumb Rubber)	81
Sand Seal	82
Asphalt-Rubber Seal Coat (Stress Absorbing Membrane)	83
Sand Asphalt	84
Other	85
Thin Seal Interlayer	86
Micro Surfacing	87
Plain Portland Cement Concrete (only used for SPS-7)	90

Table 41. Geologic Classification Codes

Igneous

Granite	01
Syenite	02
Diorite	03
Gabbro	04
Peridotite	05
Felsite	06
Basalt	07
Diabase	08

Sedimentary

Limestone	09
Dolomite	10
Shale	11
Sandstone	12
Chert	13
Conglomerate	14
Breccia	15

Metamorphic

Gneiss	16
Schist	17
Amphibolite	18
Slate	19
Quartzite	20
Marble	21
Serpentine	22

Other Rock Type (Specify if Possible or Unknown) 30

Glacial Soils

Glacial Soils	31
Boulder Clay	32
Glacial Sands and Gravels	33
Laminated Silts and Laminated Clays	34
Varved Clays	35
Ground Moraine	36
Fluvio-glacial Sands and Gravels	37
Other Glacial Soils	38

Table 41. Geologic Classification Codes (Continued)

Residual Soils	Code
Plateau Gravels	40
River Gravels	41
Alluvium	42
Alluvial Clays and / or Peat	43
Alluvial Silt	44
Other Alluvial Soils	45
Coastal Shingle and Beach Deposits	46
Wind-blown Sand	47
Loess (collapsible soil)	48
Shale, siltstone, mudstone, claystone	49
Expansive Soils	50
Residual Soils	51
Residual Soils derived from granites, gneisses, and schists	52
Residual Soils derived from limestone, sandstone, and shale	53
Other Residual Soils	54
Coquina	55
Shell	56
Marl	58
Caliche	59
Other	60

Table 42. Soil and Soil-Aggregate Mixture Type Codes, AASHTO Classification

A-1-a	01
A-1-b	02
A-3	03
A-2-4	04
A-2-5	05
A-2-6	06
A-2-7	07
A-4	08
A-5	09
A-6	10
A-7-5	11
A-7-6	12

Table 43. Portland Cement Type Codes

Table 44. Portland Cement Concrete Admixture Codes

Water-Reducing (AASHTO M194, Type A) 01

Retarding (AASHTO M194, Type B) 02

Accelerating (AASHTO M194, Type C) 03

Water-Reducing and Retarding (AASHTO M194, Type D) 04

Water-Reducing and Accelerating (AASHTO M194, Type E) 05

Water-Reducing, High Range (AASHTO M194, Type F) 06

Water-Reducing, High Range and Retarding (AASHTO M194, Type G) 07

Air-Entraining Admixture (AASHTO M154) 08

Natural Pozzolans (AASHTO M295, Class N) 09

Fly Ash, Class F (AASHTO M295) 10

Fly Ash, Class C (AASHTO M295) 11

Other (Chemical) 12

Other (Mineral) 13

Table 45. Aggregate Durability Test Type Codes

Description	AASHTO	ASTM	Code
Resistance to Abrasion of Small Size Coarse Aggregate by Use of Los Angeles Machine (Percent Weight Loss)	T96	C131	01
Soundness of Aggregate by Freezing and Thawing (Percent Weight Loss)	T103	--	02
Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate (Percent Weight Loss)	T104	C88	03
Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine (Percent Weight Loss)	--	C535	04
Potential Volume Change of Cement-Aggregate Combinations (Percent Expansion)	--	C342	05
Evaluation of Frost Resistance of Coarse Aggregates in Air-Entrained Concrete by Critical Dilution Procedures (Number of Weeks of Frost Immunity)	--	C682	06
Potential Alkali Reactivity of Cement Aggregate Combinations (Average Percent Expansion)	--	C227	07
Potential Reactivity of Aggregates (Reduction in Alkalinity-mmol/L)	--	C289	08
Test for Clay Lumps and Friable Particles in Aggregates (Percent by Weight)	T112	C142	09
Test for Potential Alkali Reactivity of Carbonate Rocks for Concrete Aggregates (Percent Change in Specimen Length)	--	C586	11

Table 46. Codes for Asphalt Refiners and Processors in the United States*

Belcher Refining Co., Mobile Bay, Alabama	78
Hunt Refining Co., Tuscaloosa, Alabama	01
Chevron USA, Inc., Kenai, Alaska	02
Mapco Alaska Petroleum, North Pole, Alaska	03
Intermountain Refining Cl., Fredonia, Arizona	04
Berry Petroleum Company, Stevens, Arizona	05
Cross Oil and Refining Company, Smackover, Arizona	06
Lion Oil Company, El Dorado, Arizona	07
McMillan Ring, Free Oil Cl., Norphlet, Arizona	08
Chevron USA, Inc., Richmond, California	09
Conoco, Inc., Santa Maria, California	10
Edgington Oil Co., Inc., Long Beach, California	11
Golden Bear Division, Witco Chemical Corp., Oildate, California	12
Golden West Refining, Co., Santa Fe Springs, California	13
Huntway Refining Co., Benicia, California	14
Huntway Refining Co., Wilmington, California	15
Lunday-Thagard Co., South Gate, California	79
Newhall Refining Co., Inc., Newhall, California	16
Oxnard Refining, Oxnard, California	17
Paramount Petroleum Corp., Paramount, California	80
Powerline Oil Co., Martinez, California	81
San Joaquin Refining Cl.,Bakersfield, California	18
Shell Oil Co., Martinez, California	19
Superior Processing Co., Santa Fe Springs, California	20
Colorado Refining Co., Commerce City, Colorado	82
Conoco, Inc., Commerce City, Colorado	21
Amoco Oil, Inc., Savannah, Georgia	22
Young Refining Corp., Douglasville, Georgia	23
Chevron USA, Inc., Barber’s Point, Hawaii	24
Clark Oil and Refining Corp., Blue Island, Illinois	25
Shell Oil Co., Wood River, Illinois	26
Unacol Corp., Lemont, Illinois	27
Amoco Oil, Co., Whiting, Indiana	28
Laketon Refining Corp., Laketon, Indiana	83
Young Refining Corp., Laketon, Indiana	29
Derby Refining Co., El Dorado, Kansas	30
Total Petroleum, Inc., Arkansas City, Kansas	31
Ashland Petroleum Co., Catlettsburg, Kentucky	32
Atlas Processing Co., Shreveport, Louisiana	33
Calumet Refining Co., Princeton, Louisiana	34
Exxon Co., Baton Rouge, Louisiana	35
Marathon Petroleum Co. – Garyville, Louisiana	36
Marathon Petroleum Co. – Detroit, Michigan	37
Ashland Petroleum Co. – St. Paul, Minnesota	38
Koch Refining Co. – Rosemount, Minnesota	39

Table 46. Codes for Asphalt Refiners and Processors in the United States* (Continued)

Chevron USA, Inc. – Pascagoula, Mississippi	40
Ergon Refining Inc. – Vicksburg, Mississippi	41
Southland Oil Co. – Lumberton, Mississippi	42
Southland Oil Co. – Sanderson, Mississippi	43
Cenex – Laurel, Montana	44
Conoco, Inc. – Billings, Montana	45
Exxon Co. – Billings, Montana	46
Chevron USA, Inc. – Perth Amboy, New Jersey	47
Exxon Co. – Linden, New Jersey	48
Giant Industries, Inc. – Gallup, New Mexico	85
Navahoe Refining Co. – Artesia, New Mexico	49
Cibro Petroleum Products Co. – Albany, New York	86
Ashland Petroleum Co. – Canton, Ohio	50
Standard Oil Co. – Toledo, Ohio	51
Sohio Oil Co. (BP America) – Toledo, Ohio	87
Kerr-McGee Refining Co. – Wynnewood, Oklahoma	52
Sinclair Oil Corp. – Tulsa, Oklahoma	53
Sun Co. – Tulsa, Oklahoma	54
Total Petroleum Inc. – Ardmore, Oklahoma	55
Chevron USA, Inc. – Portland, Oregon	56
Atlantic Refining & Marketing Corp. – Philadelphia, Pennsylvania	57
United Refining Co. – Warren, Pennsylvania	58
Mapco Petroleum, Inc. – Memphis, Tennessee	59
Charter International Oil Co. – Houston, Texas	60
Chevron USA, Inc. – El Paso, Texas	61
Coastal Refining & Marketing, Inc. – Corpus Christi, Texas	88
Coastal States Petroleum Co. – Corpus Christi, Texas	62
Diamond Shamrock Corp. – Sunray, Texas	63
Exxon Co. USA – Baytown, Texas	64
Fina Oil and Chemical Co. – Big Spring, Texas	65
Fina Oil and Chemical Co. – Port Arthur, Texas	89
Hill Petroleum Co. – Houston, Texas	90
Shell Oil Co. – Deer Park, Texas	66
Star Enterprise – Port Arthur & Port Neches, Texas	91
Texaco Refining & Marketing, Inc. – Port Arthur & Port Neches, Texas	67
Trifinery – Corpus Christi, Texas	92
Unocal Corp. – Nederland, Texas	68
Valero Refining Co. – Corpus Christi, Texas	69
Phillips 66 Co. – Woods Cross, Utah	70
Chevron USA Inc. – Seattle, Washington	71
Sound Refining, Inc. – Tacoma, Washington	72
US Oil and Refining Co. – Tacoma, Washington	73
Murphy Oil USA, Inc. – Superior, Wisconsin	74
Big West Oil Co. – Cheyenne, Wyoming	75
Little America Refining Co. – Casper, Wyoming	93

Table 46. Codes for Asphalt Refiners and Processors in the United States* (Continued)

Sinclair Oil Corp. – Sinclair, Wyoming	76
Other	77
Alon Israel Oil Company LTD – Bakersfield, California	94
Alon Israel Oil Company LTD – Krotz Springs, Louisiana	95
Alon Israel Oil Company LTD – Big Spring, Texas	96
American Refining Group Inc. – Bradford, Pennsylvania	97
FJ Management Inc. – North Salt Lake, Utah	98
BP PLC – Prudhoe Bay, Alaska	99
BP PLC – Whiting, Indiana	100
BP PLC – Texas City, Texas	101
BP PLC – Los Angeles, California	102
BP PLC – Ferndale, Washington	103
BP Husky Refining LLC, Toledo, Ohio	104
Transworld Oil USA, Inc. – Lake Charles, Louisiana	105
Calumet Lubricants, Co – Cotton Valley, Louisiana	106
Calumet Lubricants, Co – Princeton, Louisiana	107
Calumet Lubricants, Co – Superior, Wisconsin	108
Calumet Lubricants, Co - Shreveport, Louisiana	109
CHS, Inc. – Laurel, Montana	110
Chalmette Refining LLC = Chalmette, Louisiana	111
Chevron Corp – El Segundo, California	112
Chevron Corp – Honolulu, Hawaii	113
Chevron Corp – Salt Lake City, Utah	114
PDV America Inc. – Lake Charles, Louisiana	115
PDV American Inc. – Corpus Christi, Texas	116
CVR Energy – Coffeyville, Kansas	117
ConocoPhillips – Prudhoe Bay, Alaska	118
ConocoPhillips – Rodeo, California	119
ConocoPhillips – Wilmington, California	120
ConocoPhillips – Belle Chasse, Louisiana	121
ConocoPhillips – Westlake, Louisiana	122
ConocoPhillips – Linden, New Jersey	123
ConocoPhillips – Ponca City, Oklahoma	124
ConocoPhillips – Sweeny, Texas	125
ConocoPhillips – Ferndale, Washington	126
Continental Refining Co. LLC – Somerset, Kentucky	127
Countrymark Coop Inc. – Mount Vernon, Indiana	128
Deer Park Refining LTD PTNRSHP – Delaware City, Delaware	129
Delek Group LTD – Tyler, Texas	130
Access Industries - Channelview, Texas	131
Ergon Inc. – Newell, West Virginia	132
Excel Paralubes – Westlake, Louisiana	133
Exxon Mobil Corp – Torrance, California	134
Exxon Mobil Corp – Joliet, Illinois	135
Exxon Mobil Corp – Beaumont, Texas	136

Table 46. Codes for Asphalt Refiners and Processors in the United States* (Continued)

Koch Industries Inc. – North Pole, Alaska	137
Koch Industries Inc. – Saint Paul, Minnesota	138
Koch Industries Inc. – Corpus Christi, Texas	139
Foreland Refining Corp – Ely, Nevada	140
Hollyfrontier Corp – El Dorado, Kansas	141
Hollyfrontier Corp – Woods Cross, Utah	142
Access Industries – Houston, Texas	143
Hovensa LLC – Kingshill, Virgin Islands	144
Hunt Consld Inc. – Tuscaloosa, Alabama	145
Hunt Consld Inc. – Sandersville, Mississippi	146
Kern Oil & Refining Co. – Bakersfield, California	147
Blue Dolphin Energy Co – Nixon, Texas	148
Husky Energy Inc. – Lima, Ohio	149
Delek Group LTD – El Dorado, Arkansas	150
Sinclair Oil Corp – Evansville, Wyoming	151
World Oil Co – South Gate, California	152
Marathon Petroleum Corp – Robinson, Illinois	153
Marathon Petroleum Corp – Catlettsburg, Kentucky	154
Marathon Petroleum Corp – Canton, Ohio	155
Marathon Petroleum Corp – Texas City, Texas	156
Martin Reseource Management Grp – Smackover, Arkansas	156
Connacher Oil & Gas LTD – Great Falls, Montana	157
Motiva Enterprises LLC – Convent, Louisiana	158
Motiva Enterprises LLC – Norco, Louisiana	159
Motiva Enterprises LLC – Port Arthur, Texas	160
Hollyfrontier Corp – Artesia, New Mexico	161
CHS Inc. – McPherson, Kansas	162
Nustar Energy LP – Savanna, Georgia	163
Nustar Energy LP – Paulsboro, New Jersey	164
Nustar Energy LP – San Antonio, Texas	165
Alon Israel Oil Company LTD – Paramount, California	166
Petroleo Brasileiro SA – Pasadena, California	167
PBF Energy Co LLC – Paulsboro, New Jersey	168
PDV American Inc. – Lemont, Illinois	169
Pelican Refining Co. LLC – Lake Charles, Louisiana	170
Arctic Slope regional Corp – North Pole, Alaska	171
Arctic Slope regional Corp – Valdez, Alaska	172
Placid Oil Co – Port Allen, Louisiana	173
Vallero Energy Corp – Memphis, Tennessee	174
Vallero Energy Corp – Port Arthur, Texas	175
Greka Energy – Santa Maria, California	176
Royal Dutch/Shell Group – Saraland, Alabama	177
Royal Dutch/Shell Group – Martinez, California	178
Royal Dutch/Shell Group – Saint Rose, Louisiana	179
Royal Dutch/Shell Group – Anacortes, Washington	180

Table 46. Codes for Asphalt Refiners and Processors in the United States* (Continued)

Silver Eagle Refining Inc. – Woods Cross, Utah	181
Silver Eagle Refining Inc. – Evanston, Wyoming	182
Texas Oil & Chemical Co. –Silsbee, Texas	183
Northern Tier Energy LLC – Saint Paul, Minnesota	184
Suncor Energy Inc. – Commerce City East, Colorado	185
Sunoco Inc. – Philadelphia, Pennsylvania	186
Tesoro Corp – Kenai, Alaska	187
Tesoro Corp – Ewa Beach, Hawaii	188
Tesoro Corp – Martinez, California	189
Tesoro Corp – Wilmington, California	190
Tesoro Corp – Mandan, North Dakota	191
Tesoro Corp – Salt Lake City, Utah	192
Tesoro Corp – Anacortes, Washington	193
PBF Energy Co. LLC – Toledo, Ohio	194
Total SA – Port Arthur, Texas	195
BTB Refining LLC – Corpus Christi, Texas	196
Compagnie Nationale A Portefeuilli – Tacoma, Washington	197
Valero Energy Corp – Meraux, Louisiana	198
Valero Energy Corp – Sunray, Texas	199
Valero Energy Corp – Three Rivers, Texas	200
Valero Energy Corp – Benicia, California	201
Valero Energy Corp – Wilmington Asphalt Plant, California	202
Valero Energy Corp – Wilmington Refinery, California	203
Valero Energy Corp – Ardmore, Oklahoma	204
Valero Energy Corp – Houston, Texas	205
Valero Energy Corp – Texas City, Texas	206
Valero Energy Corp – Norco, Louisiana	207
Ventura Refining and Transmission LLC – Thomas, Oklahoma	208
Western Refining Inc. – El Paso, Texas	209
Western Refining Inc. – Bloomfield, New Mexico	210
Western Refining Inc. – Gallup, New Mexico	211
WRB Refining LP – Wood River, Illinois	212
WRB Refining LP – Borger, Texas	213
CVR Energy – Wynnewood, Oklahoma	214
Black Elk Refining LLC – New Castle, Wyoming	215

* Codes 1-93 Originally taken from Oil and Gas Journal, March 20, 1989, pp. 72-89 and updated October 1993.

Codes 94-215 taken from Energy Information Administration (EIA), Form EIA-820, "Annual Refinery Report" as of January 1, 2012.

Table 47. Asphalt Cement Modifier Codes

Stone Dust	01
Lime	02
Portland Cement	03
Carbon Black	04
Sulfur	05
Lignin	06
Natural Latex	07
Synthetic Latex	08
Block Copolymer	09
Reclaimed Rubber	10
Polyethylene	11
Polypropylene	12
Ethylene-Vinyl Acetate	13
Polyvinyl Chloride	14
Asbestos	15
Rock Wool	16
Polyester	17
Manganese	18
Other Mineral Salts	19
Lead Compounds	20
Carbon	21
Calcium Salts	22
Recycling Agents	23
Rejuvenating Oils	24
Amines	25
Fly Ash	26
Other	27

Table 48. Grades of Asphalt, Emulsified Asphalt, and Cutback Asphalt Codes

Asphalt Cements

AC-2.5 01
AC-5 02
AC-10 03
AC-20 04
AC-30 05
AC-40 06
AR-1000 (AR-10 by AASHTO Designation) 07
AR-2000 (AR-20 by AASHTO Designation) 08
AR-4000 (AR-40 by AASHTO Designation) 09
AR-8000 (AR-80 by AASHTO Designation) 10
AR-16000 (AR-160 by AASHTO Designation) 11
200-300 pen 12
120-150 pen 13
85-100 pen 14
60-70 pen 15
40-50 pen 16
Other Asphalt Cement Grade 17

Emulsified Asphalts

RS-1 18
RS-2 19
MS-1 20
MS-2 21
MS-2h 22
HFMS-1 23
HFMS-2 24
HFMS-2h 25
HFMS-2s 26
SS-1 27
SS-1h 28
CRS-1 29
CRS-2 30
CMS-2 31
CMS-2h 32
CSS-1 33
CSS-1h 34
Other Emulsified Asphalt Grades 35

Cutback Asphalts (RC, MC, SC)

30 (MC only) 36

Table 48. Grades of Asphalt, Emulsified Asphalt, and Cutback Asphalt Codes (Continued)

70	37
250	38
800	39
3000	40
Other Cutback Asphalt Grade	99

Taken from Manual Series No. 5 (MS-5), "A Brief Introduction to Asphalt," and Specification Series No. 2 (SS-2), "Specifications for Paving and Industrial Asphalts," both publications by the Asphalt Institute.

Table 49. Maintenance and Rehabilitation Work Type Codes

Crack Sealing (linear ft)	01
Transverse Joint Sealing (linear ft)	02
Lane-Shoulder, Longitudinal Joint Sealing (linear ft)	03
Full Depth Joint Repair Patching of PCC (sq. yards)	04
Full Depth Patching of PCC Pavement Other than at Joint (sq. yards)	05
Partial Depth Patching of PCC Pavement Other than at Joint (sq. yards)	06
PCC Slab Replacement (sq. yards)	07
PCC Shoulder Restoration (sq. yards)	08
PCC Shoulder Replacement (sq. yards)	09
AC Shoulder Restoration (sq. yards)	10
AC Shoulder Replacement (sq. yards)	11
Grinding/Milling Surface (sq. yards)	12
Grooving Surface (sq. yards)	13
Pressure Grout Subsealing (no. of holes)	14
Slab Jacking Depressions (no. of depressions)	15
Asphalt Subsealing (no. of holes)	16
Spreading of Sand or Aggregate (sq. yards)	17
Reconstruction (Removal and Replacement) (sq. yards)	18
Asphalt Concrete Overlay (sq. yards)	19
Portland Cement Concrete Overlay (sq. yards)	20
Mechanical Premix Patch (using motor grader and roller) (sq. yards)	21
Manual Premix Spot Patch (hand spreading and compacting with roller) (sq. yards)	22
Machine Premix Patch (placing premix with paver, compacting with roller) (sq. yards)	23
Full Depth Patch of AC Pavement (removing damaged material, repairing supporting material, and repairing) (sq. yards)	24
Patch Pot Holes – Hand Spread, Compacted with Truck (no. of holes)	25
Skin Patching (hand tools / hot pot to apply liquid asphalt and aggregate) (sq. yards)	26
Strip Patching (using spreader and distributor to apply hot liquid asphalt and aggregate) (sq. yards)	27
Surface Treatment, single layer (sq. yards)	28
Surface Treatment, double layer (sq. yards)	29
Surface Treatment, three or more layers (sq. yards)	30
Aggregate Seal Coat (sq. yards)	31
Sand Seal Coat (sq. yards)	32
Slurry Seal Coat (sq. yards)	33
Fog Seal Coat (sq. yards)	34
Prime Coat (sq. yards)	35
Tack Coat (sq. yards)	36

Table 49. Maintenance and Rehabilitation Work Type Codes (Continued)

Dust Layering (sq. yards)	37
Longitudinal Subdrains (linear ft)	38
Transverse Subdrainage (linear ft)	39
Drainage Blanket (sq. yards)	40
Well System	41
Drainage Blankets with Longitudinal Drains	42
Hot-Mix Recycled Asphalt Concrete (sq. yards)	43
Cold-Mix Recycled Asphalt Concrete (sq. yards)	44
Heater Scarification, Surface Recycled Asphalt Concrete (sq. yards)	45
Fracture Treatment of PCC Pavement as Base for New AC Surface (sq. yards)	46
Fracture Treatment of PCC Pavement as Base for New PCC Surface (sq. yards)	47
Recycled Portland Cement Concrete (sq. yards)	48
Pressure Relief Joints in PCC Pavements (linear feet)	49
Joint Load Transfer Restoration in PCC Pavements (linear ft)	50
Mill Off Existing AC Pavement and Overlay with AC (sq. yards)	51
Mill Off Existing AC Pavement and Overlay with PCC (sq. yards)	52
Other	53
Partial Depth Patching of PCC Pavement at Joints (sq. yards)	54
Mill Existing Pavement and Overlay with Hot-Mix Recycled Asphalt Concrete (sq. yards)	55
Mill Existing Pavement and Overlay with Cold-Mix Recycled Asphalt Concrete (sq. yards)	56
Saw and Seal (linear ft)	57
Mill Existing Pavement and Overlay with Warm Mix AC (sq. yards)	58
Warm Mix AC Overlay (sq. yards)	59
Warm Mix AC Overlay with RAP and/or RAS (sq. yards)	60
Mill Existing Pavement and Overlay with Warm Mix Recycled AC (sq. yards)	61
Micro Surfacing (sq. yards)	62
PCC Penetrating Sealant (sq. yards)	63

Table 50. Maintenance Location Codes

Outside Lane (Number 1)	01
Inside Lane (Number 2)	02
Inside Lane (Number 3)	03
All Lanes	09
Shoulder	04
All Lanes Plus Shoulder	10
Curb and Gutter	05
Side Ditch	06
Culvert	07
Other	08

Note: LTPP only studies outside lanes.

Table 51. Maintenance Materials Type Codes

Preformed Joint Fillers	01
Hot-Poured Joint and Crack Sealer	02
Cold-Poured Joint and Crack Sealer	03
Open Graded Asphalt Concrete	04
Hot Mix Asphalt Concrete Laid Hot	05
Hot Mix Asphalt Concrete Laid Cold	06
Sand Asphalt	07
Portland Cement Concrete (overlay replacement), Joint Plain (JPCP)	08
Portland Cement Concrete (overlay replacement), Joint Reinforced (JRCP)	09
Portland Cement Concrete (overlay replacement), Continuously Reinforced (CRCP)	10
Portland Cement Concrete (Patches)	11
Hot Liquid Asphalt and Aggregate (Seal Coat)	12
Hot Liquid Asphalt and Mineral Aggregate	13
Hot Liquid Asphalt and Sand	14
Emulsified Asphalt and Aggregate (Seal Coat)	15
Emulsified Asphalt and Mineral Aggregate	16
Emulsified Asphalt and Sand	17
Hot Liquid Asphalt	18
Emulsified Asphalt	19
Sand Cement (Using Portland Cement)	20
Lime Treated or Stabilized Materials	21
Cement Treated or Stabilized Materials	22
Cement Grout	23
Aggregate (Gravel, Crushed Stone, or Slag)	24
Sand	25
Mineral Dust	26
Mineral Filler	27
Other	28

Table 52. Recycling Agent Type Codes

RA 1	42
RA 5	43
RA 25	44
RA 75	45
RA 250	46
RA 500	47
Other	48

Note: The recycling agent groups shown in this table are defined in ASTM D4552.

Table 53. Anti-Stripping Agent Type Codes

Permatac	01
Permatac Plus	02
Betascan Roads	03
Pavebond	04
Pavebond Special	05
Pavebond Plus	06
BA 2000	07
BA 2001	08
Unichem “A”	09
Unichem “B”	10
Unichem “C”	11
Aquashield AS4115	12
Aquashield AS4112	13
Aquashield AS4113	14
Portland Cement	15
Hydrated Lime, Mixed Dry with Asphalt Cement	16
Hydrated Lime, Mixed Dry with Dry Aggregate	17
Hydrated Lime, Mixed Dry with Wet Aggregate	18
Hydrated Lime, Slurried Lime Mixed with Aggregate	19
Hydrated Lime, Hot Lime Slurry (Quick Lime Slaked and Slurried at Job Site)	20
Nostrip Chemicals A-500	21
No Strip Chemical Works ACRA RP-A	22
No Strip Chemical Works ACRA Super Conc.	23
No Strip Chemical Works ACRA 200	24
No Strip Chemical Works ACRA 300	25
No Strip Chemical Works ACRA 400	26
No Strip Chemical Works ACRA 500	27
No Strip Chemical Works ACRA 512	28
No Strip Chemical Works ACRA 600	29
Darakote	30
De Hydro H86C	31
Emery 17065	32
Emery 17319	33
Emery 17319 – 6880	34
Emery 17320	35
Emery 17321	36
Emery 17322	37
Emery 17339	38
Emery 1765 – 6860	39
Emery 6886B	40
Husky Anti-Strip	41
Indulin AS-Special	42
Indulin AS-1	43
Jetco AD-8	44
Kling	45

Table 53. Anti-Stripping Agent Type Codes (Continued)

Kling-Beta ZP-251	46
Kling-Beta L-75	47
Kling-Beta LV	48
Kling-Beta 1000	49
Kling-Beta 200	50
Nacco Anti-Strip	51
No Strip	52
No Strip Concentrate	53
Redi-Coat 80-S	54
Redi-Coat 82-S	55
Silicone	56
Super AD-50	57
Tap Co 206	58
Techni H1B7175	59
Techni H1B7173	60
Techni H1B7176	61
Techni H1B7177	62
Tretolite DH-8	63
Tretolite H-86	64
Tretolite H-86C	65
Tyfo A-45	66
Tyfo A-65	67
Tyfo A-40	68
Edoco 7003	69
Other	70
No Antistripping Agent Used	00

Table 54. Distress Types

Asphalt Concrete Pavement

Alligator Cracking	01
Block Cracking	02
Edge Cracking	03
Longitudinal Cracking	04
Reflection Cracking	05
Transverse Cracking	06
Patch Deterioration	07
Potholes	08
Rutting	09
Shoving	10
Bleeding	11
Polished Aggregate	12
Raveling and Weathering	13
Lane Shoulder Dropoff	14
Water Bleeding	15
Pumping	16
Other	17

Portland Cement Concrete Pavement

Corner Breaks	20
Durability Cracking	21
Longitudinal Cracking	22
Transverse Cracking	23
Joint Seal Damage	24
Spalling	25
Map Cracking / Scaling	26
Polished Aggregate	27
Popouts	28
Punchouts	29
Blowouts	30
Faulting	31
Lane / Shoulder Dropoff	32
Lane / Shoulder Separation	33
Patch Deterioration	34
Water Bleeding / Pumping	35
Slab Settlement	36
Slab Upheaval	37
Other	38

Table 55. Route Signing Codes

Not Signed	1
Interstate	2
U.S.	3
State	4
Off-Interstate Business Marker	5
County	6
Township	7
Municipal	8
Parkway Marker or Forest Route Marker	9
None of the Above	10

Table 56. Ownership Codes

State Highway Agency	1
County Highway Agency	2
Town or Township Highway Agency	3
City or Municipal Highway Agency	4
State Park, Forest, or Reservation Agency	11
Local Park, Forest or Reservation Agency	12
Other State Agency	21
Other Local Agency	25
Private (other than Railroad)	26
Railroad	27
State Toll Road	31
Local Toll Authority	32
Other Public Instrumentality (i.e., Airport)	40
Indian Tribe Nation	50
Other Federal Agency	60
Bureau of Indian Affairs	62
Bureau of Fish and Wildlife	63
U.S. Forest Service	64
National Park Service	66
Tennessee Valley Authority	67
Bureau of Land Management	68
Bureau of Reclamation	69
Corps of Engineers	70
Air Force	72
Navy/Marines	73
Army	74
Other	80

Table 57. Turn Lane Codes

Description	Code
No intersection where a right turning movement is permitted exists on the section	1
Turns permitted; multiple exclusive right turning lanes exist. Through movements are prohibited in these lanes. Multiple turning lanes allow for simultaneous turns from all turning lanes	2
Turns permitted; a continuous exclusive right turning lane exists from intersection to intersection. Through movements are prohibited in this lane	3
Turns permitted; a single exclusive right turning lane exists	4
Turns permitted; no exclusive right turning lanes exist	5
No right turns are permitted during the peak period	6

Table 58. Widening Obstacles Codes

No obstacles	X
Dense development	A
Major transportation facilities	B
Other public facilities	C
Terrain restrictions	D
Historic and archaeological sites	E
Environmentally sensitive areas	F
Parkland	G

No obstacles - No obstacles to widening.

Dense development - Refers to the density and size of buildings to be acquired, the number of people that would need to be relocated, and the number of businesses that would need to be acquired. (Realizing dense development may be higher in urban areas; this should not be used as on obstacle for all urban areas and should be evaluated relative to the conditions in the area where the section is located).

Major transportation facilities - Includes major rail lines, canals, airports, major natural gas and oil pipe lines whose location relative to the roadway section would limit expansion of the existing roadway.

Other public facilities - Includes hospitals, museums, libraries, major public office buildings, schools, and universities.

Terrain restrictions - Relates to geographic features that would make it very difficult to add lanes, requiring significant excavation, fill, or tunneling. This applies to both horizontal and vertical terrain restrictions.

Historic and archaeological sites - Includes such things as historic buildings, historic land, large monuments, cemeteries, and known archaeological sites.

Environmentally sensitive areas - Includes such areas as scenic landmarks, wetlands, bodies of water, areas inhabited or used by protected species. Scenic routes and byways are included in the category and are those national and State routes that have been identified and listed as official designations.

Parkland - Includes National, State, and local parks.

A.3 FIELD MATERIALS SAMPLING AND TESTING DATA FORMS

The SPS-12 field materials sampling and testing should be performed following the guidelines in the *Long-Term Pavement Performance Project: Laboratory Material Testing and Handling Guide*. [19] Field data forms and data sheets have been revised to report SPS-12 data for bulk sampling of subgrade, granular material, and asphalt concrete materials performed during construction; they are included in this section of appendix A. The changes and/or additions have been made to accommodate the specific needs of the SPS-12 experiment.

MATERIAL SAMPLING AND FIELD TESTING DATA SHEETS

Material sampling and field testing data sheets used in the SPS-12 experiment include Sampling Data Sheets and Field Operations Information Forms. The SPS-12 experiment requires completion of the following sheets and forms:

Table 59. Sampling Data Sheets.

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 and Emulsion
21	Sampling Bulk Aggregate

Table 60. Field operations information sheets.

Field Operations Information Form No.	Description
1	Laboratory Shipment Samples Inventory

Most of the LTPP SPS-12 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.

<u>SHEET NO</u>. Because 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.

<u>STATE</u>. Indicate the name of the state, District of Columbia, Puerto Rico, or the Canadian province the project is located.

<u>STATE CODE</u>. Enter the two-digit numeric code corresponding to the state or province.

SHRP ID. Enter the four character SHRP_ID assigned to the test section.

FIELD SET NO. The field set number is a sequentially assigned number to indicate the different time periods in which material samples and field testing were conducted on the project. These time periods usually refer to different stages in the pavement construction or life, such as prior to overlay construction, after overlay construction, etc. A field set number can apply to more than one day since sampling may require more than one day. As a general rule, the same field set number should be applied to all material samples and field tests conducted in a continuous 30 day period, unless a construction event occurs between the two sampling sessions. Enter 1 for the first time that material sampling and field testing conducted on the project. Enter 2, 3, etc. for the 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 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 is used to log data from the 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, date, and year the core was taken.

CORE BARREL SIZE. Record the rated inside diameter of the core barrel to the nearest tenth of an inch.

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.

STATION. This is the station number of the sampling area, relative to the test section specified 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.

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 tenth of a foot.

LATITUDE. Record the latitude of the center of the core location in degrees (North).

LONGITUDE. Record the longitude of the center of the core location in degrees (West).

CORE SIZE. Circle the appropriate response to indicate the diameter of recovered core.

CORE RECOVERED. Circle the appropriate response to indicate if an intact and suitable core was recovered from the indicated core ho1e.

REPLACEMENT CORE HOLE NO. Record the sample number of the core that will replace a core which was 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.

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 1 for the subgrade and increase towards 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 tenth of an inch.

MATERIAL DESCRIPTION. Enter the appropriate material description based on the generic material type. These material descriptions are contained in table C.2, appendix C, of the *Long-Term Pavement Performance Project: Laboratory Material Testing and Handling Guide*. [2]

MATERIAL CODE. Enter the appropriate material code number from table C.2 in the *Long-Term Pavement Performance Project: Laboratory Material Testing and Handling Guide* corresponding to the described type of material. [19]

Sampling Data Sheet 4. Pavement Bore Hole Log at A-Type Auger Locations

This is designed to record logs of A-Type auger sampling. The following data is 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, date, and year the operation was performed.

LOCATION: STATION. This is the station number of the sampling area, relative to the test section specified 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 tenth of a foot.

LATITUDE. Record the latitude of the center of the sampling location in degrees (North).

LONGITUDE. Record the longitude of the center of the sampling location in degrees (West).

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 tenth of an inch. The depth of strata changes should always be measured from the top of the pavement surface. Draw a horizontal line across the form which 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 from 18 inches to 36 inches, a line should be drawn at the 18 inch mark and the 36 inch mark along with the appropriate sample code number, material description, etc. See example data sheets in the SHRP-LTPP Guide for Field Materials Sampling, Testing and Handling for further clarification.

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 towards the surface.

MOISTURE SAMPLE NO. 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, appendix C, of the *Long-Term Pavement Performance Project: Laboratory Material Testing and Handling Guide*. (19)

MATERIAL CODE. Enter the appropriate material code number for each strata from table C.2 in the *Long-Term Pavement Performance Project: Laboratory Material Testing and Handling Guide* corresponding to the described type of material. (19)

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 is recorded on this form.

<u>OPERATOR</u>. Record nuclear density gauge operator's name.

<u>TEST DATE</u>. Record the month, date, and year the test was performed.

<u>NUCLEAR DENSITY GAUGE I.D</u>. Record the identification number of the nuclear density gauge.

<u>DATE OF LAST MAJOR CALIBRATION</u>. Record the date of the last major calibration of the nuclear density gauge. 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. Daily calibrations performed in the field do not constitute a major calibration.

<u>LOCATION NUMBER</u>. Enter the sampling location number shown in the material sampling plan developed for the project.

<u>STATION</u>. This is the station number of the sampling area, relative to the test section specified 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.

<u>OFFSET</u>. 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 tenth of a foot.

<u>LATITUDE</u>. Record the latitude of the center of the sampling location in degrees (North).

<u>LONGITUDE</u>. Record the longitude of the center of the sampling location in degrees (West).

<u>DEPTH FROM SURFACE TO THE TOP OF THE LAYER</u>. This information is obtained from Sampling Data Sheet 4 for each unbound granular layer. Record to the nearest tenth of an inch and measure from the top of the pavement surface for each test performed.

<u>LAYER NUMBER</u>. Write in the project specified layer number for the layer being tested.

<u>MATERIAL TYPE</u>. 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.

<u>IN SITU DENSITY</u>. 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 to one decimal place in pounds per cubic foot (pcf).

AVERAGE. Calculate and record the average in situ densities for each unbound layer. Record 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. 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 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. Record 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 (asphalt concrete and asphalt-treated materials) for LTPP material testing purposes.

PERSON PERFORMING SAMPLING. Record the name and affiliation of the person performing the sampling.

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 prior to compaction, indicate the station and offset of the sample.

LATITUDE. Record the latitude of the sampling location in degrees (North).

LONGITUDE. Record the longitude of the sampling location in degrees (West).

MIX TYPE. Enter the code number corresponding to the generic type of material (virgin asphalt concrete, recycled asphalt concrete).

LAYER NUMBER Write in the project specified layer number for which the sampled bulk material is applicable.

LOCATION NUMBER. Enter the sampling location number as specified in the materials sampling plan developed for the project.

SAMPLE NUMBER. Enter the sample number as specified in the materials sampling plan developed for the project.

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 should be the laboratory which 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 or Emulsion

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

PERSON PERFORMING SAMPLING. Record the name and affiliation of the person performing the sampling.

SAMPLING LOCATION. Enter the code number shown on the data form corresponding to the location from which the sample was taken.

LATITUDE. Record the latitude of the sampling location in degrees (North).

LONGITUDE. Record the longitude of the sampling location in degrees (West).

LAYER NUMBER Write in the project specified layer number for which the sampled bulk material is applicable.

LOCATION NUMBER. Enter the sampling location number as specified in the materials sampling plan developed for the project.

SAMPLE NUMBER. Enter the sample number as specified in the materials sampling plan developed for the project.

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 should be the laboratory which 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 be otherwise of use during the data entry and QC processes.

Sampling Data Sheet 21. Sampling Bulk Aggregate

This data sheet is used to record information concerning sampling of bulk aggregate used in AC mixes, thin seal coats, and other bound layers.

PERSON PERFORMING SAMPLING. Record the name and affiliation of the person performing the sampling.

SAMPLING LOCATION. Enter the code number shown on the data form corresponding to the location from which the sample was taken.

LATITUDE. Record the latitude of the sampling location in degrees (North).

LONGITUDE. Record the longitude of the sampling location in degrees (West).

LAYER NUMBER Write in the project specified layer number for which the sampled bulk material is applicable.

LOCATION NUMBER. Enter the sampling location number as specified in the materials sampling plan developed for the project.

SAMPLE NUMBER. Enter the sample number as specified in the materials sampling plan developed for the project.

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 should be the laboratory which 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 that may be of use to the office data handler, or be otherwise of use during the data entry and QC 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 willow excavations.
4. Bulk Samples of constituent materials.

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, PCC, 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: good, poor, fractured; bulk samples: satisfactory, wet, insufficient quantity, contaminated.

Since more than one laboratory may be used to test samples in the SPS-12 experiment, room is provided on this form to indicate up to three laboratories to receive samples. Enter the laboratory number, as noted at the bottom of the form, each sample is sent to under the “Lab” column.

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING
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 __ __ -__ __ __-__ __ __ __
(dd-mmm-yyyy)

EQUIPMENT USED ___________________
CORE BARREL:
Size ______________________________
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 NUMBER			
STATION (feet)			
OFFSET (feet from O/S)	__ __ . __	__ __ . __	__ __ . __
Latitude (degrees North)	__ __.__ __ __ __ __	__ __.__ __ __ __ __	__ __.__ __ __ __ __
Longitude (degrees West	__ __ __.__ __ __ __ __	__ __ __.__ __ __ __ __	__ __ __.__ __ __ __ __
Core Size (inch diameter)	4" / 6"	4" / 6"	4" / 6"
Core Recovered?	Yes / No	Yes / No	Yes / No
Replacement Core Hole No.			
Core Sample Number			
Layer Number			
Depth (inch)	__ __ . __	__ __ . __	__ __ . __
Material Description			
Material Code			
Core Sample Number			
Layer Number			
Depth (inch)	__ __ . __	__ __ . __	__ __ . __
Material Description			
Material Code			
Core Sample Number			
Layer Number			
Depth (inch)	__ __ . __	__ __ . __	__ __ . __
Material Description			
Material Code			
Core Sample Number			
Layer Number			
Depth (inch)	__ __ . __	__ __ . __	__ __ . __
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
PAVEMENT BORE HOLE LOG AT A-TYPE AUGER LOCATIONS
SAMPLING DATA SHEET 4

SHEET NO. _____ OF _____
STATE ________________
STATE CODE [ ][ ]
SHRP ID. [ ][ ][ ][ ]
FIELD SET NO. [ ][ ]
SAMPLE/TEST LOCATION:
☐ **Before Section**
☐ **After Section**

OPERATOR ________________________
BORING DATE __ __-__ __ __- __ __ __ __
(dd-mmm-yyyy)
LOCATION:
STATION ______________________
OFFSET ____________ feet from O/S

EQUIPMENT USED __________________
BORE HOLE NUMBER: _______________
BORE HOLE ID: _____________________
BORE HOLE SIZE: _________ inch diameter
LATTITUDE: __ __ . __ __ __ __ __ ° N
LONGITUDE: __ __ __ . __ __ __ __ __ ° W

Scale (inches)	Strata Change (inches)	Layer Number	Sample Number	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

____
Field Crew Chief
Affiliation ______________________

VERIFIED AND APPROVED

____
RSC Personnel
Affiliation ______________________

DATE

_______ – _______ – _______
Month – Day – Year

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING
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 __ __-__ __ __-__ __ __ __ (dd-mmm-yyyy)
NUCLEAR DENSITY GAUGE I.D.__________________
DATE OF LAST MAJOR CALIBRATION __ __-__ __ __-__ __ __ __ (dd-mmm-yyyy)

Note: Use additional sheets if necessary

LOCATION NUMBER				
STATION				
OFFSET(feet from O/S)				
LATTITUDE ° N		__ __.__ __ __ __ __	__ __.__ __ __ __ __	__ __.__ __ __ __ __
LONGITUDE ° W		__ __ __.__ __ __ __ __	__ __ __.__ __ __ __ __	__ __ __.__ __ __ __ __
DEPTH FROM SURFACE TO THE TOP OF THE LAYER (inches from plans)				
LAYER NUMBER				
MATERIAL TYPE: (Unbound=G and Other=T)				
IN SITU DENSITY (pcf) (*AASHTO T310-11*)	1			
	2			
	3			
	4			
AVERAGE				
METHOD (A, B, or C)				
ROD DEPTH (inches)				
IN SITU MOISTURE CONTENT (%) (*AASHTO T310-11*)	1			
	2			
	3			
	4			
AVERAGE				

GENERAL REMARKS ____

CERTIFIED ______________________
Field Crew Chief
Affiliation ______________________

VERIFIED AND APPROVED ______________________
RSC Personnel
Affiliation ______________________

DATE ______ – ______ – ______
Month – Day – Year

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING
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____

SAMPLING LOCATION .... [ ]
Conveyor Belt = 1, Stockpile = 2, Haul Truck = 3, Funnel Device = 4,
Roadway Prior to Compaction = 5 (Specify: Station ________________ Offset_______________ feet from O/S),
Other = 6 (Specify:____),
Bins = 7, RAP Stockpile = 8.

Latitude ....[ ][ ].[ ][ ][ ][ ][ ] ° **N**
Longitude .... [ ][ ][ ].[ ][ ][ ][ ][ ] ° **W**

LAYER NUMBER..[ ] [ ]

LOCATION NUMBER..[ ][ ][ ][ ][ ][ ]

SAMPLE NUMBER... [ ][ ][ ][ ][ ][ ][ ]

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

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

DATE SAMPLED (dd-mmm-yyyy)... [ ][ ]-[ ][ ][ ]-[ ][ ] [ ][ ]

LOCATION SAMPLE SHIPPED TO: ____

DATE SHIPPED (dd-mmm-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
SAMPLING ASPHALT CEMENT OR EMULSION
SAMPLING DATA SHEET 10-A

SHEET NO. _____ **OF** _____
STATE ________________
STATE CODE [ ][ ]
SHRP ID. [ ][ ][ ][ ]
FIELD SET NO. [ ][ ]

PERSON PERFORMING SAMPLING

NAME________________________________ AFFILIATION____

SAMPLING LOCATION .... [ ]
Storage Tank = 1, Feedline = 2, Other = 3 (Specify: ______________________________________)
Distributor = 4, Delivery Truck = 5

Latitude ....[ ][ ].[ ][ ][ ][ ][ ] **° N**
Longitude .... [ ][ ][ ].[ ][ ][ ][ ][ ] **° W**

LAYER NUMBER ....[ ][ ]

LOCATION NUMBER .... [ ][ ][ ][ ][ ][ ]

SAMPLE NUMBER .... [ ][ ][ ][ ][ ][ ][ ]

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

SAMPLE VOLUME (gal) ....[ ][ ]

DATE SAMPLED (dd-mmm-yyyy) .... [ ][ ]-[ ][ ][ ]-[ ][ ] [ ][ ]

LOCATION SAMPLE SHIPPED TO: ____

DATE SHIPPED (dd-mmm-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
SAMPLING BULK AGGREGATE
SAMPLING DATA SHEET 21

SHEET NO. _____ **OF** _____
STATE ________________
STATE CODE [ ][ ]
SHRP ID. [ ][ ][ ][ ]
FIELD SET NO. [ ][ ]

PERSON PERFORMING SAMPLING

NAME________________________________ AFFILIATION____

SAMPLING LOCATION .... [ ]
Conveyor Belt = 1, Stockpile = 2, Haul Truck = 3, Funnel Device = 4,
Other = 6 (Specify:____),
Bins = 7, Distributor = 9

Latitude ....[ ][ ].[ ][ ][ ][ ][ ] **° N**
Longitude .... [ ][ ][ ].[ ][ ][ ][ ][ ] **° W**

LAYER NUMBER..[ ][ ]

LOCATION NUMBER ....[ ][ ][ ][ ][ ][ ]

SAMPLE NUMBER.. [ ][ ][ ][ ][ ][ ][ ]

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

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

DATE SAMPLED (dd-mmm-yyyy).. [ ][ ]-[ ][ ][ ]-[ ][ ] [ ][ ]

LOCATION SAMPLE SHIPPED TO: ____

DATE SHIPPED (dd-mmm-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
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: __ __-__ __ __-__ __ __ __ (dd-mmm-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 number of laboratory, as specified below, each sample was sent to:

Lab No. (1) ________________________________

Lab No. (2) ________________________________

Lab No. (3) ________________________________

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
ROD AND LEVEL ELEVATION SURVEY
ELEVATION MEASUREMENTS FORM EM-1

SHEET NO. _____ OF _____

STATE ___________________

STATE CODE [ ][ ]

SHRP ID. [ ][ ][ ][ ]

SURVEYOR _____________________________

SURVEY DATE __ __-__ __-__ __ __ __ (MM-DD-YYYY)

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

LAYER NUMBER (use additional sheets as necessary) .... [ ]

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

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

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

	STATION 450+00		**STATION 500+00**	
	TRANSVERSE OFFSET (ft)	ELVEVATION (ft)	TRANSVERSE OFFSET (ft)	ELVEVATION (ft)
OLE	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
OWP	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
ML	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
IWP	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __
ILE	__ __.__	__ __.__ __ __	__ __.__	__ __.__ __ __

For nominal 12-ft lane use the following transverse offsets:

OLE = **0 ft**
OWP = **3 ft**
ML = **6 ft**
IWP = **9 ft**
ILE = **12 ft**

*OLE = Outside Lane Edge, OWP = Outside Wheel Path, ML = Mid Lane, IWP = Inside Wheel Path, ILE = Inside Lane Edge

GENERAL REMARKS ____
____
____

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

A.4 OTHER REQUIRED DATA SHEETS

The purpose of this section of appendix A is to provide a data sheet (and associated completion instructions) for the collection of data not covered elsewhere in the report. It includes a data sheet for the collection of information on the snow removal and deicing practices used by the SHA at SPS-12 project locations.

SNOW REMOVAL/DEICING (DATA SHEET 1)

This data sheet provides information on the snow removal and deicing practices used by the SHA at the test section location. The form should be filled out and submitted monthly (or more frequently) during the periods where applications occurred.

Individual data elements are as follows:

Were Snow Plows Used on the Section (Item 1): A yes/no code indicating whether the section was subject to snow plow use or not.

Snow Plow Edge Type (*Item 2*): For sections that have been plowed, indicate the most common blade edge type. Codes are provided on the data sheet.

Number of Passes in Period (Item 3): Indicate the number of times in the observation period that the section was plowed – each pass of the plow should be counted individually. When Item 1 is ‘N’, this should be zero.

Typical Speed of Plowing Operation (Item 4): For sections that were plowed, indicate the common travel speed of the plow while plowing, in MPH.

Were Pre-Treatments Used on the Section (Item 5): A yes/no code indicating whether the section was subject to anti-icing pre-treatments.

Type of Pre-Treatment Used (*Item 6*): For sections that received treatment, indicate the most common treatment type. Codes are provided on the data sheet.

Number of Applications in Period (Item 7): Indicate the number of times during the observation period that the section was treated. When Item 5 is ‘N’, this should be zero.

Were De-Icers Used on the Section (Item 8): A yes/no code indicating whether the section was subject to application of de-icing chemicals.

Type of De-Icers Used (*Item 9*): For sections that received treatment, indicate the most common treatment type. Codes are provided on the data sheet.

Typical Number of Applications per Year (Item 10): Indicate the number of times in the observation period that de-icing agents were applied. When Item 8 is ‘N’, this should be zero.

Is the Section Subject to Chain Controls (Item 11): A yes/no code indicating whether the section is subject to chain controls If the agency has provisions for chain controls on the section, regardless of how often they are applied, then this item should be 'Y'

Number of Control Events in Period (Item 12): Indicate the number of times during the observation period that the section was subject to some type of chain requirement. When Item 11 is 'N', this should be zero.

LTPP SPS PERFORMANCE MONITORING DATA SHEET 1 SNOW REMOVAL / DEICING	STATE CODE [__ __] SHRP ID [__ __ __ __]

OBSERVATION PERIOD

FROM (dd/mmm/yyyy) [__ __/__ __ __/__ __ __ __]
TO (dd/mmm/yyyy) [__ __/__ __ __/__ __ __ __]

SNOW PLOW

1. WERE SNOW PLOWS USED ON THE SECTION? (Y/N) [__]

2. MOST COMMON SNOW PLOW EDGE TYPE [__]
   Steel.................. 1 Rubber 3
   Carbide................ 2 Polyurethane..........4
   Other (Specify)[____________________________________] 5

3. NUMBER OF PASSES IN PERIOD [__ __ __]

4. TYPICAL SPEED OF PLOWING OPERATION (mph) [__ __]

PRE-TREATMENT

5. WERE PRE-TREATMENTS USED ON THE SECTION? (Y/N) [__]

6. TYPE OF PRE-TREATMENT USED [__]
   $NaCl$.................... 1 $CaCl_2$.................2
   $NaCl + CaCl_2$............ 3 CMA 4
   Other (Specify)[______________________________________] 5
   KCl..................... 6 $MgCl_2$.................7
   Urea.................... 8

7. NUMBER OF APPLICATIONS IN PERIOD [__ __ __]

DE-ICING

8. WERE DE-ICERS USED ON THE SECTION? (Y/N) [__]

9. TYPE OF DE-ICER USED [__]
   $NaCl$.................... 1 $CaCl_2$.................2
   $NaCl + CaCl_2$............ 3 CMA 4
   Other (Specify)[______________________________________] 5
   KCl..................... 6 $MgCl_2$.................7
   Urea.................... 8

10. NUMBER OF APPLICATIONS IN PERIOD [__ __ __]

CHAIN CONTROLS

11. IS THE SECTION SUBJECT TO CHAIN CONTROLS? (Y/N) [__]

12. NUMBER OF CONTROL EVENTS IN PERIOD [__ __ __]

PREPARER___________________ EMPLOYER_____________________DATE___________________

APPENDIX B. TREATMENT GUIDELINES AND MATERIALS TEST PROTOCOLS

B.1 GENERAL GUIDELINES FOR PENETRATING SEALERS

General

When looking for a concrete sealer, it is necessary to narrow down the choices from the initial level of surface versus penetrating sealers. Next, it is necessary to choose between non-reactive (petroleum based or silicone oils) and reactive sealants (Silane or siloxane-based concrete sealers).

Silanes and siloxanes are both derived from the silicone family. Despite being very closely related, they have significant performance differences. Because Silanes are made up of smaller molecules than siloxanes, they typically will obtain deeper penetration than siloxanes. As a result, Silanes perform well under abrasion and weathering conditions. A consequence, however, of this small molecular size is that Silanes are relatively volatile. Therefore, the solids content of a Silane product should be high enough to compensate for the loss of reactive material through evaporation during application and cure. Siloxanes, because they are less volatile, generally offer good water repellent performance at lower costs. However, for concrete surfaces subjected to abrasive wear, treatment with a Silane sealer will provide longer lasting protection. In regard to surface texture and color, treatment with Silane sealers typically cannot be detected visually. Siloxane products may slightly darken the treated surface.

Manufacturers have since realized that the disadvantages can be mitigated with a special blend of the two. While there are many Silane/siloxanes on the market, there are some high-quality ones that offer a unique blend of penetrating and surface protection. When choosing a Silane/siloxane sealer, it is important to look for a product that is water-based with a low VOC content. These will be easier and safer to apply, with fewer fumes and less flammability. It is also important to use a product that is water repellent, such that the water will bead on the surface of the concrete. If the water does not bead, then it is difficult to know if the siloxane part of the blend is properly working. If it is not properly working, it means the manufacturer has likely messed up the blend.

Materials

Sealer types should be in accordance with AASHTO M224 Standard Specification for Use of Protective Sealers for Portland Cement Concrete and be a Silane sealer for the main experiment. The effectiveness of the sealer shall be tested by the agency according to ASTM C-672 /C-672M Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals. The manufacturer’s recommendations for sealants will be followed during the application of the product.

Prior to application

All surfaces shall be cleaned using a pressure washer capable of delivering water at not less than 2,000 psi. Surfaces shall be allowed to air dry for a minimum of 48 hours.

Applications

For the horizontal application, the concrete sealer will be applied with a low pressure sprayer (10-25 psi) or roller so as to thoroughly saturate the concrete surface.

For applying in the joint, apply from the bottom up with a low pressure sprayer (10-25 psi) or roller so as to thoroughly saturate the concrete joint surface and create a uniform wet appearance

The application rates for both the concrete surface and the joint should be a minimum of 350 ft^2/gal. The concrete sealer will be applied according to the manufacturer's recommended rate.

B.2 STANDARD SPECIFICATION FOR SILANE SEALERS MICHIGAN DOT

SPECIAL
PROVISION FOR

PROTECTIVE TREATMENT FOR TRANSVERSE AND LONGITUDINAL CONCRETE PAVEMENT JOINTS

CFS:ARB APPR:EMC:EAS:02-20-15

A. Description. This work consists of providing all labor, equipment and materials necessary for the application of spray-applied penetrating sealer to concrete pavement joints including the preparation and cleaning of the joints.

B. Materials. Deliver the sealer to the project in unopened containers with the manufacturer's label identifying the product. Use one of the following 100 percent silane materials:

1. Aquanil™ Plus 100, ChemMasters, Inc., Madison, OH

2. Baracade Silane 100C, The Euclid Chemical Company, Cleveland, OH\

3. Certi-Vex® Penseal 244 BTS-100% (Fast Dry), Vexcon Chemicals, Inc., Philadelphia, PA

4. Hydrozo® 100, BASF Construction Chemicals, LLC Building Systems, Shakopee, MN

5. KlereSeal® 9100-S, Pecora Corporation, Harleysville, PA

6. Protectosil® BH-N, Evonik Degussa Corporation, Parsippany, NJ

7. Sikagard® 705L, Sika Corporation, Lyndhurst, NJ

8. SIL-ACT™ ATS-100, Advanced Chemical Technologies, Oklahoma City, OK

9. Xiameter® OFS-6403 Silane, Dow Corning Corporation, Midland, MI

C. Construction. Perform this work in accordance with the plans, standard specifications, and this special provision. Follow the selected manufacturer's recommendations for surface preparation and application, except as modified by this special provision.

1. Joint Reservoir and Surface Preparation. Ensure all surfaces to receive the concrete

sealer are dry and free from contamination such as oil, grease, laitance, and curing compounds. Surfaces must dry for a minimum of 24 hours following rain or exposure to other sources of moisture. Abrasive blasting followed by oil-free compressed air cleaning is required. Water blasting or wire brushing is prohibited.

2. Application. Use low pressure airless spray equipment with a solvent resistant hose and gaskets. Apply sealer at a minimum rate of 1 gallon per 200 feet of joint. Do not apply sealer when inclement weather is anticipated within 12 hours. Apply sealer in a single uniform application along each side of the joint to ensure saturation of both vertical faces of the joint reservoir and approximately 6 inches of the adjacent horizontal pavement surface on each side of the joint. Follow the selected manufacturer's recommendations for cure time based on temperature and humidity prior to installation of hot poured joint sealant, with a minimum delay of 1 hour.

D. Measurement and Payment. The complete work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	**Pay Unit**
Protective Conc Pavt Joint Treatment	Foot

Protective Conc Pavt Joint Treatment will be measured based on plan quantity.

No compensation will be made to the Contractor for surplus materials.

B.3 MOHS HARDNESS TEST

Determining the hardness of an unknown rock or mineral is often very useful in the identification process. Hardness is a measure of a mineral's resistance to abrasion and is measured against a standard scale - Mohs Scale of Hardness. Mohs Scale was named after Frederick Mohs (1773-1839), a German mineralogist. It consists of 10 fairly common minerals (except for the diamond) of known hardness which are numerically ordered from softest (1) to hardest (10). They are:

58. Talc (H=1).
59. Gypsum (H=2).
60. Calcite (H=3).
61. Fluorite (H=4).
62. Apatite (H=5).
63. Orthoclase (H=6).
64. Quartz (H=7).
65. Topaz (H=8).
66. Corundum (H=9).
67. Diamond (H=10).

As common sense dictates, Mohs Scale is based on the fact that a harder material will scratch a softer one. By using a simple scratch test, one can determine the relative hardness of an unknown mineral.

A Mohs Hardness test kit can be obtained from home improvement stores. Though not and ASTM or AASHTO standard, this test is often used by diamond grinding companies to develop their plan for grinding a concrete surface. The procedure used by many contractors to assess the hardness of the concrete is illustrated in the video provided at the following site: https://www.youtube.com/watch?v=d7lSC-_4vok

B.4 JOINT INSPECTION CAMERA TEST: JOINT INSPECTION SCOPE SYSTEM (JISS), EQUIPMENT & OPERATION, DRAFT (UPDATED 9-4-16)

INTENT

Development of the Joint Inspection Scope System (JISS) was based on the need for a valid, reliable, computerized technology to prevent premature Formed-In-Place, Joint-Sealant System failure. The "JISS" is designed to detect contamination on the joint face. It is believed that future variations on the Joint "Insert" approach may permit the determination of the presence of moisture, and the evaluation of the integrity of the concrete supporting the joint face. In particular, micro-fractures or fractures resulting from inadequacies in the construction of joints. Some of the equipment is ready for use now, but other parts of the equipment are still underdevelopment.

BACKGROUND

Joint-Face contamination has been, and is a principal cause of sealant adhesion failure. The underlying problem has been a total lack of an effective Quality Control technology to determine the cleanliness of the Joint-Face.

Joint systems have been failing prematurely since their inception. The current trend towards adoption of 1/8-inch (or larger) shrinkage cuts, filled or unfilled, and the elimination of joint sealing reflects a general lack of confidence in joint sealing, as practiced. It should be noted that 1/8-inch shrinkage-cut joint systems (used in the 1950s and 60) have similar failure rates, and their time to failure is similar to current systems. Agency adoption of 1/8-inch wide, shrinkage cut, joint systems is based primarily on economics.

It is important to note that not all joint systems are experiencing premature failure. Success/Failure of projects is, in-part, related to climatic zone and contractor capability.

SYSTEM OVERVIEW

Visible imagery was the initial step in the development of the JISS concept**.** Eventually visible imagery is expected be supplemented, or replaced, with digitized versions. Two parallel lines of development are under consideration: one, to evaluate selected EMF frequencies for identification of moisture; and two, Sonic's to evaluate the integrity of the concrete supporting the joint face.

Imagery is the basis of the JISS. Current versions utilize High Definition Images and video. Figure 23 is a typical photograph. It is a single frame, taken from an HD Videotaped at O'Hare International, Chicago, Illinois, in June 2015.

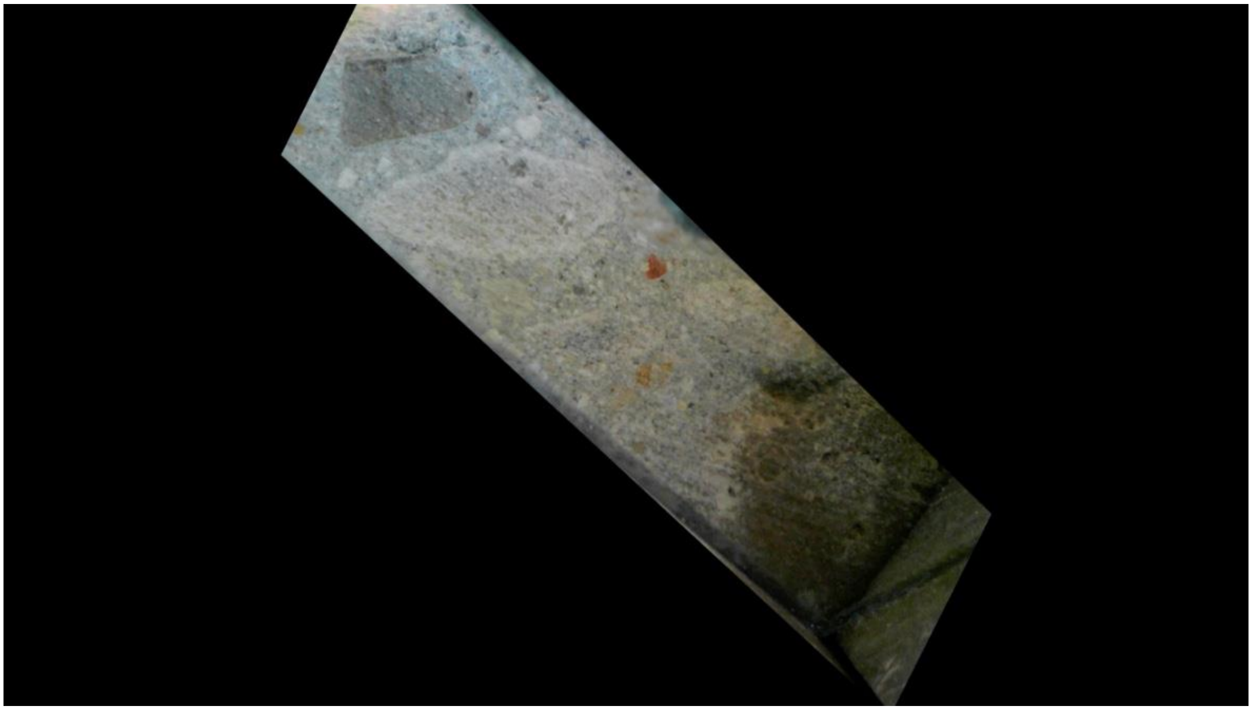

Figure 23. Photo. 1/2-inch joint face, 15 minutes after 3,500psi water blast.

There are currently two variations of the Joint Inspection Scope (JIS). The hand-held Quality Control (JIS-QC) is composed of the Handle-Smart Phone Assembly as shown in figure 24 while the Joint Inspection Unit is shown in figure 25. This system is still under development and could be ready for the LTTP program on pavement preservation by 2018.

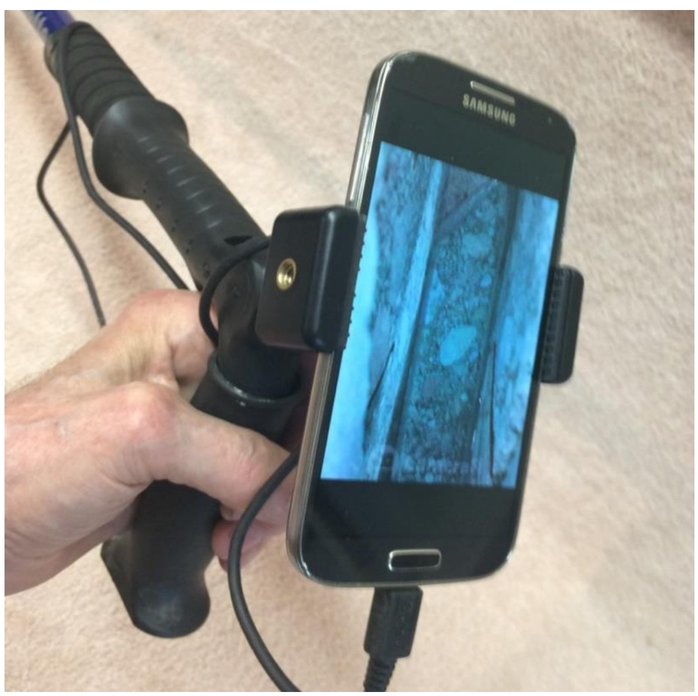

Figure 24. Photo. Handle-smart phone assembly, production prototype.

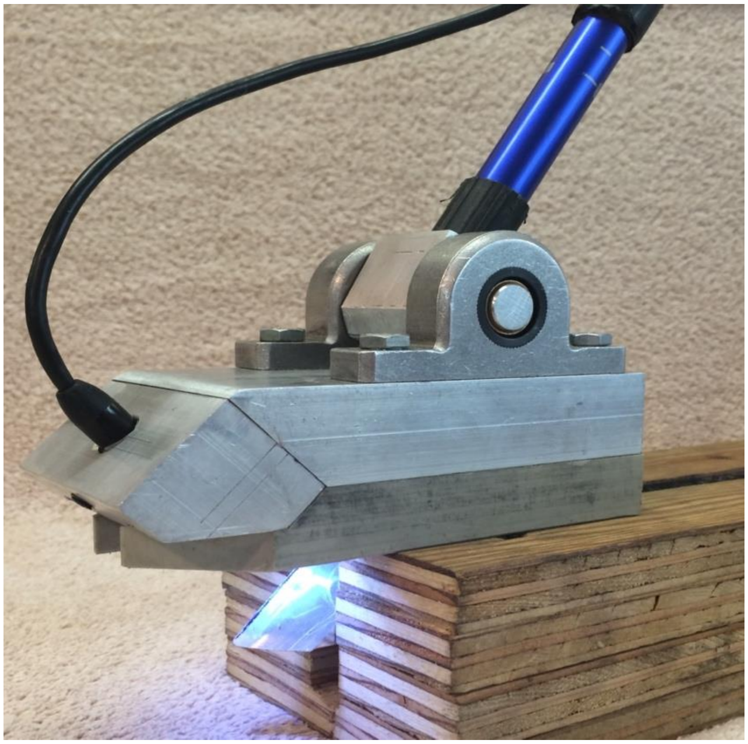

Figure 25. Photo. Joint inspection assembly - (JIS-QC), production prototype.

CARRIAGE WITH ENDOSCOPE

Figure 25 shows a 3/4 view of the “Joint Inspection Unit” in a mock-up of a 1/2-Inch joint. The reflected light is coming off of the mirror mounted on the “Insert”. The light is from the six LEDs mounted around the Endoscope camera (Black tube and wire). Figure 26 shows the lighted “Endoscope” extending out of the “Insert Slot” on the base of the “Carriage”. Note the gray-green replaceable guides on either side of the slot. They form the base of the “Carriage.”

Figure 26. Photo. Lighted “endoscope” extending through the “carriage” slot.

The “Joint Inspection Unit” was designed for heavy wear and abuse. “Endoscopes” are vulnerable, but inexpensive and easily replaceable. The Endoscope is mounted at the front of the carriage at an angle of 45º to the horizontal plane; and connected by wire to the Smart Phone. Power for the Endoscope lights and imaging is supplied by the smart phone. Note: Inexpensive “Endoscopes” may be ordered in 2m lengths and with a dimmer control. The dimmer is useful in varying ambient light conditions. Focusing of the Endoscope is accomplished by loosening the set screw (black spot just below the lens assembly figure 26); and sliding the endoscope into focus.

MIRROR INSERT

The insert shown in figure 27 is a key concept of the JISS. In the visible imaging version of the system, its primary feature is a mirror set at 45º to the horizontal plane and 45º to the joint face. The mirror reflects the light from the endoscope onto the joint face, and returns the illuminated image to the smart phone, via the endoscope. Currently, the JIS-QC Production Prototype includes seven Inserts. Four of the inserts use a single mirror to maximize the joint face image *(this requires the JIS-QC to be rotated and inserted twice in order to view both joint faces)*. And three Inserts with double mirrors that view both joint faces in the same image. Single mirrors are mounted on: 1/8 inch, 1/4 inch, 3/8 inch, and 1/2 inch inserts. Double mirrors are mounted on 1/4 inch, 3/8 inch, and 1/2 inch inserts. Mirrors are currently glass and vulnerable to damage. The production models should utilize polycarbonate mirrors. Insert sizes are equivalent to the joint to be imaged.

Figure 27. Photo. Example of an insert.

SMART PHONE AND HANDLE

The Smart Phone (shown earlier in figure 24) is the technological/computerized basis for the JIS-QC. It functions to obtain and display the joint-face imagery; store the metadata for that project; acquire, and attach, the various wireless or metadata inputs to each HD Image or HD Video file. The Smart Phone can be either Android or I-phone. Applications are being identified or developed for both. The handle and shaft shown are temporary. The final handle and shaft are still under development. *Note: The smart phone screen may be inadequate to display joint face image and a reference image at a large enough scale for the operator to differentiate clean or contaminate. A Tablet of sufficient size to permit the differentiation is under consideration. Applications for smart phones are still under development*

OPERATION OF JIS-QC

Figure 28 shows the how the JIS-QC is inserted into the joint. The rear curved portion of the "insert" is placed in the joint at the angle shown in figure 28; and the "joint inspection unit" is allowed to settle into its flat operating position shown in figure 24. The mirror (at the front of the Insert) faces away from the operator. Typically, a single image of the joint face will be taken. If a video is desired the unit is drawn towards the operator. *Note: current prototypes use a glass mirror. If the unit is pushed away from the operator the glass mirror is more vulnerable to breakage, or scratching. Identification and acquisition of polycarbonate, or other scratch and break, resistant mirrors are underway.*

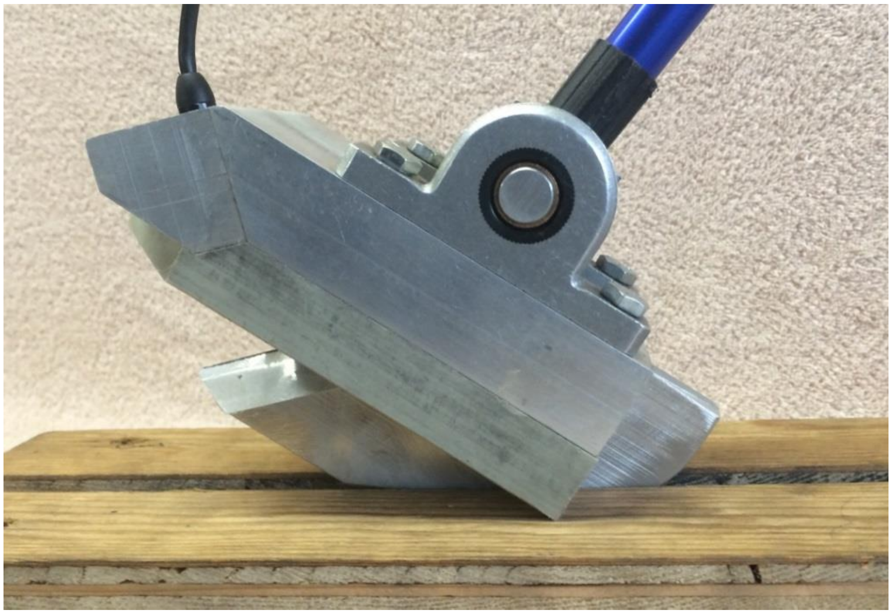

Figure 28. Photo. Insertion of the "Joint Inspection Unit."

Depending on the sampling procedure, the JIS-QC will either be withdrawn and placed at a different location or the unit will be withdrawn, rotated 180 degrees and replaced in approximately the same location. Raw GPS location data for Smart Phones are accessible by specific Apps. Whether the raw data at a given site has sufficient accuracy for a given project will have to be determined by the investigator. If more accurate location data is required, then GPS Repeater units will need to be utilized.

If the sample shows a contaminated joint-face, the operator may determine the extent of the contamination by switching to video mode and drawing the unit along the joint until the image shows an uncontaminated face. Contaminated areas can be marked for re-cleaning.

Smart phones are able to be set-up (app) to communicate with one or more computers (screen views and supplemental metadata) either on-site or at remote location. This capability permits immediate review of the imagery and functions to both improve QC and management oversight of cleaning and QC processes.

VALIDATION OF IMAGE DIFFERENTIATION

Photographic imagery is information intense. The variability and complexity of the cleaned, sawn, joint-face images may mask contaminates. Until the ability of JIS-QC users to consistently differentiate contaminated versus clean imagery has been established, utilization of the JIS-QC for contract QC is discouraged.

Analysis of photographic images is a judgment call. There are no guarantees that a given interpretation by one individual will be matched by another. However, because the images and accompanying metadata are permanently stored, and/or can be reviewed simultaneously by others; it is reasonable to believe that a Go/No-Go threshold can be established; and a legally binding differentiation between contaminated and clean defined.

Go/No-Go imagery is viable because a “Reference Image Set” can be shown in parallel with the “subject image.” Larger Smart Phones, possibly tablets, have sufficient screen size for the two images to be compared side by side. An App (to be identified or developed) will permit various Go/No-Go reference images to be displayed next to the “subject image”; and, the best comparison selected

GO/NO-GO - REFERENCE IMAGE APPROACH - VALIDATION PROTOCOL TO BE DEVELOPED

A sequence of reference joint face images, used with either JIS-QC or JIS-R, having varying levels of contamination (method of determining contamination to be established) are obtained and stored. Sets of the stored images are reviewed and evaluated by the researchers who develop criteria for evaluation. The criteria are then utilized to establish a preliminary set of Go/No-Go images. It is suggested that the preliminary set of images, and the criterion on which the selection was made, are then sent for review by selected groups of users (contractors, inspectors, and others (according to some criterion to be established. (Note: these criteria should also be sent to the Review groups for comment.). The results of the reviews are evaluated and a tentative set of Go/No-Go images are constructed. The Go/No-Go sets are then combined with another set of images having variable levels of contamination and redistributed to the initial group of reviewers. The results of the second review are evaluated for consistency. And, if necessary the process is repeated until a consistent level of Go/No-Go is established. The Delphi multiple review model, just described, is suggested as model for the Review process. Since the result of this process may become a part of binding contractual agreement, the methodology and its incorporation into a contract needs to be reviewed legally.

The development of reference imagery is complicated by the complexity of concrete and the resulting variation in concrete face imagery. Whether the perceptions of the variation are sufficient to invalidate part, or all of the reference imaging approach must be addressed in the development of this approach.

SUMMARY

As stated earlier, part of this system is ready now, but the proposed improvements should be ready by 2018. This system could be very helpful in evaluating the effectiveness of joint sealants and penetrating sealers.

B.5 TTI FLOW TEST: PROTOCOL OF STANDARD TEST METHOD FOR DETERMINING PERMEABILITY OF A CONCRETE PAVEMENT JOINT

This protocol covers the procedure for estimating partially sealed or unsealed pavement joint permeability based on the measured infiltration rates.

SUMMARY AND TEST METHOD

The infiltration test should be performed directly on a pavement surface over a joint. The point of infiltration (i.e. the joint) should be placed at the center of the apparatus with the test being performed at 5 inches and 3 inches of head (although higher heads are certainly possible to do). The option of greater heads pertains to the needs for greater volumes of water such as may be the case for testing base materials.

PREPARATION OF APPARATUS

The apparatus consists of a 6-inch diameter tube, with a wide flange glued/sealed to the end to allow for sufficient area in which to adequately seal the tube to the pavement surface (figure 29). The inner part of the pipe should be marked with a scale (as well as drilling a hole into the side of the pipe positioned at a maximum head) to allow a visible reading when the head level passes a given point. A large bucket (i.e. a 5 gallon) is recommended to use in order to place the water into the apparatus.

Figure 29. Photo. Infiltration Testing

PROCEDURE

The location area is first marked and visually examined for estimating the infiltration rate. A sealing material (in most cases a removable material is necessary such as a plumber's putty) is placed along the ring of the flange where the apparatus is placed where the sealing material is positioned and pressed firmly down. The sealing material should be less than 1/8 inch. Also in cases where infiltration flows move along the joint or in deep joint wells, ensure that the sealant material is pressed down and into the joint as far as possible. A flathead screwdriver or other tool maybe required to adequate seal the space so that the testing represents the infiltration of only the desired location.

The pipe is then filled with water to a given level to check for leaks around the sealing material. Once that check is made the tube is then filled to the point of desired head and the amount of time for the head to dissipate (to a designated ‘zero’ point) is measured. It is recommended to fill the tube to 2 to 3 inches above the starting head and begin to record the time when the head passes the desired testing point, (say 5 or 3 inches) until drained.

REPORT

The gathered information shall be recorded for each test and should follow the format under General Test and Sample Information. The following are recommended items to report if the information is readily available.

- Field/Site Location.
- Sample Number and Location.
- Test Number.
- Pavement Age, Type, and Thickness.
- Joint Type, Joint Sealant Age and Opening.
- Type, Base Type and Thickness.
- Beginning Head.
- Ending Head.
- Time of flow.

The flow data is used with the following expression to determine the hydraulic conductivity or permeability (K):

$$K = 2.303\left(\frac{L}{t}\right)\log\left(\frac{h_1}{h_2}\right)$$

Figure 30. Equation. Permeability equation.

Where

	L	= Flow length (L) (pavement thickness)
	t	= Infiltration time (t)
	h_1	= Initial hydraulic head (L)
	h_2	= Final hydraulic head (L)

The test data can also be used to determine the joint infiltration rate similar as it is used in the Ridgeway formula: [(11)]

$$q_i = I_C \left(\frac{N_C}{W_p} + \frac{W_C}{W_p C_s}\right) + k_p$$

Figure 31. Equation. Joint infiltration rate.

where

q_i = Infiltration rate per unit area, $ft^3/day/ft^2$
I_c = Joint infiltration rate per unit length (ft^3/day/ft) as a fraction of the rainfall intensity
N_c = Number of longitudinal joints
W_p = Width of pavement lane subjected to infiltration (ft)
W_c = Length of transverse joints (ft)
C_s = Joint spacing (ft)
K_p = Concrete infiltration rate, $ft^3/day/ft^2$

Sample Testing Results:

For every loading head height report:

- Head of Water, in inches.
- Time, in seconds.
- Leakage: Specify Yes/No and if so down the length of the joint or through pavement.

A sample of test results are show in the following table:

Table 61. Sample test results.

Water Head Height [in]	Time [min]	Water Head Height [in]	Time [min]	Water Head Height [in]	Time [min]
20	0:00:00	20	0:00:00	20	0:00:00
1	0:00:10	15	0:00:32	1	0:00:47
time (day)	1.16E-04		3.70E-04		5.44E-04
joint K (ft/day)	23730		712		5049

SUMMARY OF RESULTS

The raw data is essentially in the form of water height and time of dissipation can be useful to determine the permeability of partially sealed or unsealed joints. The unsealed joint condition can be particularly useful to assessing the permeability of a base layer given its drainability. The use of the test results in this manner should facilitate the assessment of moisture infiltration into a pavement sublayers and the potential for water to accumulate in a joint.

NOTICE

All figures provided in the body of the report are owned by FHWA. The information provided in appendices B.4 and B.5 including the figures are referenced in the following publications.

1. A. Joshaghani, DG Zollinger, "Concrete Pavements Curing Evaluation with Non-Destructive Tests," *Construction and Building Materials*, 154, 1250-1262, 2017.
2. Sun, Peizhi and Dan G. Zollinger, "Concepts to Enhance Specification and Inspection of Curing Effectiveness in Concrete Pavement Design and Construction," *Journal of the Transportation Research Board (2504)*, 2015, pp. 124-132, http://dx.doi.org/10.3141/2504-15