LTPP Seasonal Monitoring Program

Site Installation and Initial Data Collection

Section 040215

Phoenix, Arizona

Report No. FHWA-04-0215

May 1997

Notice

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

The contents of this report reflect the views of the contractor who is responsible for the accuracy of the data presented herein. The contents do not necessarily reflect the official policy of the Department of Transportation.

This report does not constitute a standard, specification, or regulation.

The United States Government does not endorse products or manufacturers. Trade or manufacturer's names appear herein only because they are considered essential to the object of this document.

LTPP Seasonal Monitoring Program

Site Installation and Initial Data Collection
Section 040215, Kingman, Arizona

Report No. FHWA-04-0215

Prepared by

Nichols Consulting Engineers, Chtd.
1885 S. Arlington Ave., Suite 111
Reno, Nevada 89509

Prepared for

Federal Highway Administration
LTPP-Division, HNR-40
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, Virginia 22101

May 1997

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-04-0215	N/A	N/A

4. Title and Subtitle	5. Report Date
LTPP Seasonal Monitoring Program Site Installation and Initial Data Collection Section 040215, Phoenix, Arizona.	November 1996.
	6. Performing Organization Code

7. Author(s)	8. Performing organization Report No.
Srikanth S. Holikatti, Sirous H. Alavi, Douglas J. Frith, Mark A. Potter	

9. Performing Agency Name and Address	10. Work Unit No. (TRAIS)
Nichols Consulting Engineers, Chtd. 1885 S. Arlington Avenue, Suite 111 Reno, Nevada 89503	N/A
	11. Contract or Grant No. DTFH61-96-C-00010

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered.
Federal Highway Administration LTPP-Division, HNR-40 Turner Fairbanks Highway Research Center 6300 Georgetown Pike McLean, Virginia 22101	Final Report, August 1995.
	14. Sponsoring Agency Code.

15. Supplementary Notes

Contracting Officer's Technical Representative (COTR) - Monte Symons, HNR-30

16. Abstract

This report contains a description of the instrumentation installation activities and initial data collection for test section 040215 which is a part of the LTPP Core Seasonal Monitoring Program. This is a Jointed Portland Cement Concrete (JPCP) surfaced pavement test section, located on eastbound outside lane of Interstate Route 10, near Phoenix, Arizona. The section was instrumented on August 24, 1995. The instruments installed included TDR probes for moisture content, thermistor probes for subsurface temperature, tipping bucket rain gauge for precipitation, piezometer to monitor ground water table, and an on-site datalogger. Initial data was collected on August 25, 1995. This included FWD and precipitation data, elevation , air and subsurface temperature and TDR measurements. This report also contains description of site location, characteristics of installed equipment and the location of installed equipment within the test section and a summary of initial data collection.

17. Key Words: Seasonal Monitoring, TDR Probes, Thermistor Probes, CR10 Datalogger, Temperature Gauge, Initial Data.	18. Distribution Statement No restrictions		
19. Security Classification. (of this report) Unclassified	20. Security Classification. (Of this page) Unclassified	21. No. Of Pages	22. Price

Form DOT F 1700.7(8-72)

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 yards	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)			
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
	ILLUMINATION			
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
	FORCE and PRESSURE or STRESS			
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
	AREA			
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
	VOLUME			
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.71	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)			
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
	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 September 1993)

Table of Contents

List of Tables

SITE INSTALLATION AND INITIAL DATA COLLECTION ARIZONA SECTION 040215

INTRODUCTION

This report describes the equipment installation activities and initial data collection for test section 040215 near Phoenix, Arizona. The equipment installation activities were carried out on August 24, 1995 and initial data was collected on August 25, 1995.

Section Location

Section 040215 is a Specific Pavement Studies (SPS) section selected for SMP. This section is located on the outside lane of eastbound Interstate Route 10, a multi-lane highway facility in the State of Arizona. The closest city to the section is Phoenix, Arizona. The beginning of the section is at milepost 105.95, 3.90 miles east of 339 Avenue. This section is also a SPS-2, "Strategic Study of Structural Factors for Rigid Pavements" section, meeting the seasonal monitoring program core experimental design cell number 21 requirements. Figure A1 in appendix A contains a map showing the location of the section.

Section Details

The pavement section consists of 282 mm of Jointed Portland Cement Concrete (JPCC) with 152 mm aggregate base (AB) over silty sand with gravel subgrade. The test section has a 3.70m travel lane with a 3.10m wide Jointed Portland Cement Concrete shoulder. Additional details are summarized in table 1.

Table 1. Details of section 040215 in Arizona.

Functional Classification of Roadway	Interstate Highway, Rural Arterial
Number of Lanes/Direction	Two
Pavement Type	Jointed Portland Cement Concrete
Estimated Annual ESAL Applications on the Test Lane	718.6 KESALs
Climatic Classification	Dry, No-Freeze, SMP Cell #21

Pre-installation FWD testing was carried out on the test section on March 2, 1995. FWD data was analyzed using the FWDCheck program. The results are presented in figures A2 through A6 in appendix A. The material properties of individual pavement layers are presented in table 2. Figures A7 and A8 in the appendix present the construction sampling and boring log of the instrumentation hole, respectively. Appendix A also contains the distress survey summary of the section.

Table 2. Material properties.

Description	Surface Layer	Base Layer	Subgrade
Material	JPCC	AB	Silty Sand w/Gravel
Thickness (mm)	282*	152*	N/A
Proctor Dry Density (kg/m^3)	----	----	2160**
Proctor Moisture Content (%)	----	----	15.1**
Field Measured Density	----	2144@3.0%MC***	2143@5.6%MC***
Laboratory Maximum Dry Density (kg/m^3)	----	2286@6%MC	2490@14.9%MC
Liquid Limit	----	NP	22
Plastic Limit	----	NP	19
Plastic Index	----	NP	3
Percent Passing #200	----	8.0%	25.6%

* Layer thickness from construction records.
** Proctor dry density and moisture content as on the day of instrument installation.
*** Density in the field was measured using nuclear gauge.
MC Moisture Content
AC Asphalt Concrete
AB Aggregate Base
NP Non-Plastic

According to LTPP weather database information, the following climatic conditions exist in the region:

Freezing Index	:	0	No. of Days Below 0° C	:	10
Precipitation	:	229mm	No. of Wet Days	:	39
No. of Days Above 32° C	:	174	No. of Freeze/Thaw Cycles	:	13

Installation of instrumentation was carried out on August 24, 1995 and initial data collection was performed on August 25, 1995. Instrument installation was a cooperative effort between Arizona Department of Transportation (ADOT) and Nichols Consulting Engineers (NCE) LTPP Western Region Coordination Office staff. The following personnel participated in the installation.

William Nichols	:	NCE	Coby Rowe	:	NCE
Mark A. Potter	:	NCE	Larry Scofield	:	ADOT
Michael E. Esposito	:	NCE	Estomih Combe	:	ADOT
Richard Danham	:	Traffic control	Stacy Perry	:	Traffic control
Terry Dempsey	:	Traffic control	M. Mejia	:	Drilling crew

INSTRUMENT INSTALLATION

Meeting With Highway Agency

A planning meeting between NCE and ADOT was held in Phoenix, Arizona on July 21, 1995 to discuss the SMP instrumentation, required equipment, the installation schedule, and installation team responsibilities. ADOT agreed to provide traffic control, equipment, and personnel to achieve instrument and piezometer hole auguring and also to carry out post installation patching of the instrumentation hole and conduit trench. NCE staff completed all the SMP equipment installation. The site was inspected by Marco Fellin and Michael Esposito on March 2, 1995. Distress survey and FWD testing of the section was also carried out on this date.

SMP Equipment Installed

Type and quantity of instruments installed at the section are listed in table 3. These included instrumentation to measure air and subsurface temperature, subsurface moisture content, rainfall, ground water table depth, and an equipment cabinet to house the cable ends and the CR10 datalogger. The rain gauge and the air temperature probe were mounted on a 51mm diameter steel pole near the equipment cabinet. The resistivity probe for frost depth was not installed as the section was in the "No Freeze" region.

Table 3. Equipment installed.

Equipment	Quantity	Serial No.
Instrument Hole		
MRC Thermistor Probe	1	04D#2
TDR Sensors	10	04D01-04D10
Equipment Cabinet		
Campbell Scientific CR 10 Datalogger	1	16529
Battery Pack	1	None
Weather Station		
TE 525 Tipping Bucket Rain Gauge	1	12041-693
Air Temperature Probe	1	None
Radiation Shield	1	None
Observation Well/Bench Mark	1	None

Pre Installation Equipment Check and Calibration

Prior to installation, all equipment used in the installation were checked for functionality, accuracy, and calibrated whenever necessary. The air temperature probe, thermistor probe and the rain gauge were connected to the CR10 datalogger to verify that they were functioning properly. The rain gauge was calibrated by recording the number of tips to drain out 473ml of water from the container in at least 45 minutes. For the first trial, it took 53 minutes and 95 tips to drain 473ml of water. The two screws at the bottom of the rain gauge were adjusted by one half turn (each turn causes a 2-3% increase in tips), this resulted in increased number of tips to 100 ± 3 which is within the recommended limits. The air temperature probe and the thermistor probe were checked for proper functioning by placing them in an ice bath and in direct sunlight and comparing the measured temperatures. The results indicated that both were functioning properly. The spacing of thermistor sensors within the clear plastic tube were measured and recorded. Descriptions of MRC thermistor probe and sensor spacing are presented in table 4. The CR10 datalogger and battery unit was also checked. They were found to be in working order.

Calibration of TDR probes was completed by performing two measurements in air, one with the prongs shortened at the beginning of the sensor and the other not shortened. An additional measurement was made with the TDR sensor submerged in water. The TDR measured dielectric constants were within the specified limits, and the sensors produced the expected traces and were functioning properly. Individual TDR probe traces obtained during calibration are presented in figures B1 through B10 in appendix B. Serial numbers of equipment to be installed were noted, with the exception of radiation shield and air temperature sensor. The bench mark did not have a serial number and the battery pack serial number was not recorded because the batteries get frequently changed.

Instrument Installation

Analysis of pre-installation FWD data indicated uniformity of the section at both ends. The equipment installation followed the schedule given below;

0730	:	Depart from Phoenix.
0800	:	Arrive at site, start unpacking equipment in preparation for installation.
0815	:	Traffic control in place, instrumentation hole and piezometer located and marked, FWD testing of instrumentation hole.
0815-0845	:	Drill piezometer, saw cutting of thermistor unit 1 slot, conduit trench and instrument hole.
0845- 0930	:	Installation of piezometer, drill weather station pole hole, place pole and concrete the base.
0930-1000	:	Install equipment cabinet.
1000-1030	:	Excavation of instrumentation cable trench
1030-1200	:	Layout the cables, run the cables through the conduit, drill instrument hole.

Table 4. Description of MRC thermistor probe and sensor spacing.

Unit No.	Channel No.	Distance from Top of Unit (m)	Remarks
1	1	0.000	Unit installed in AC layer
	2	0.152	
	3	0.305	
2	4	0.014	Unit installed in base & subgrade
	5	0.092	
	6	0.168	
	7	0.243	
	8	0.319	
	9	0.471	
	10	0.624	
	11	0.776	
	12	0.929	
	13	1.080	
	14	1.235	
	15	1.386	
	16	1.537	
	17	1.691	
	18	1.841	

1200-1500	:	Installation of thermistor unit #2, TDR probes, collection of moisture samples from each TDR location, proctor test, testing of each TDR probe, etc .
1515-1545	:	Installation of thermistor probe unit #1, into the groove previously cut in the pavement, check all equipment for proper functioning.
1545-1630	:	Patch and repair instrumentation hole and conduit trench, seal all saw cuts with silicone sealant.
1630-1730	:	Clean up site, pack all equipment, place instrument cabinet cover and lock.
1730-1745	:	Depart from site.

Pavement and subsurface instrumentation was installed at the leave end of the section at a distance of 155.84m (station 5+11'2") from the section beginning, in a 0.30m diameter hole bored using a 252mm diameter flight auger after sawing out a 0.5m square block from the surface PCC layer. The pavement temperature sensors (thermistors, unit #1) were installed in the JPCC layer as per LTPP guidelines. TDR moisture probes and subsurface temperature sensors (thermistors, unit #2) were installed in the base course and subgrade layers. The instrumentation hole was 2.17m deep. Figure C1 in appendix C presents the site layout and site location. The TDR probes were placed in an offset fan pattern such that the lead wires were on the side closest to the pavement edge. All the TDR probes were placed with an "S" shaped stress relief loop in their cables. Each TDR probe was connected to the 1502B cable tester while the soil around it was being compacted. Manual traces were generated to ensure that none of the TDR sensors were damaged during backfilling and compaction of the instrumentation hole. TDR traces monitored during installation are presented in figures C2 and C3 in appendix C. TDR and thermistor probe lead wires were bundled and pulled through a 51mm diameter flexible electrical conduit buried in a 76mm wide trench leading to the equipment cabinet. The equipment cabinet was located 9.60m away, to the right of lane edge on almost level ground. Extension cables were used for all the sensors placed in the pavement. The installed depths of the TDR sensors are presented in table 5. All instruments at this site were installed in adherence to FHWA LTPP SMP Guidelines, April 1994.

Moisture samples were collected at each TDR probe location. A representative Proctor sample was taken at a depth of 1.52m from pavement surface. TDR traces obtained during installation were later used to determine in-situ moisture content at each TDR probe depth. From the individual trace, apparent probe length was determined and used in the moisture determination equations provided in the FHWA LTPP SMP Guidelines, April 1994.

A comparison of moisture contents determined from TDR traces obtained during installation with field measured moisture contents are presented in table 6.

Table 5. Installed depths of TDR sensors.

TDR Sensor No.	Depth from Pavement Surface (m)	Layer
04D01	0.345	Base
04D02	0.499	Subgrade
04D03	0.650	
04D04	0.803	
04D05	0.956	
04D06	1.108	
04D07	1.261	
04D08	1.415	
04D09	1.715	
04D10	2.120	

Table 6. Measured moisture contents during installation.

Sensor No.	Sensor Depth (m)	Layer	Moisture Content (% by wt)	
			Field Measured[1]	TDR Installation[2]
04D01	0.345	Base	7.9	2.5
04D02	0.499	Subgrade	6.6	7.8
04D03	0.650		8.8	7.8
04D04	0.803		12.0	12.0
04D05	0.956		12.3	10.3
04D06	1.108		9.7	7.8
04D07	1.261		10.6	7.1
04D08	1.415		12.2	7.1
04D09	1.715		10.1	5.0
04D10	2.120		9.6	7.1

[1]Moisture contents determined in field from the material sampled at each TDR probe depth.

[2]The moisture contents were determined from TDR traces obtained during TDR probe installation. From the individual trace, apparent length was determined and used in the moisture determination equations given in FHWA LTPP SMP Guidelines, April 1994.

It is seen from the above data, field measured moisture contents varied significantly from the moisture contents determined from the TDR traces obtained during installation. Variability observed in moisture contents at some sensor depths can be attributed to the field conditions, soil type and limitations of the moisture determination method used.

Thermistor unit #2 was installed in the unbound base and subgrade layers as per the SMP instrument installation guidelines. Table 7 presents the installed locations of thermistor sensors with reference to the pavement surface.

Table 7. Installed locations of MRC thermistor sensors.

Unit No.	Channel No.	Depth from Pavement Surface (m)	Remarks
1	1	0.013	AC
	2	0.125	
	3	0.238	
2	4	0.334	Base
	5	0.412	
	6	0.488	Subgrade
	7	0.563	
	8	0.639	
	9	0.791	
	10	0.944	
	11	1.096	
	12	1.249	
	13	1.400	
	14	1.555	
	15	1.706	
	16	1.857	
	17	1.011	
	18	2.161	

A 152mm diameter flight auger was used to bore the observation piezometer/benchmark at the edge of the pavement shoulder at a distance of 121.95m (section station 4+00), and 5.2m to the right of lane edge. Upon completion of instrumentation installation, all wiring connections to the equipment cabinet were checked carefully for continuity and proper contacts. The "ONSITE" computer program was downloaded to the CR10 datalogger located in the

equipment cabinet. The datalogger was left "ON" overnight to collect data so that the results could be evaluated the next day. A set of steel snap rings was placed on either side of the transverse joints to monitor joint displacement in accordance with LTPP guidelines the next morning.

Site Repair

The instrumentation hole and the conduit trench were patched by ADOT personnel with ready-mix concrete. Care was exercised to prevent damage to all of the equipment installed or the wires leading to the equipment cabinet. Subsequent tests confirmed that all the installed equipment was functioning properly. The repair patch placed on the instrument hole did not perform well, the patch was repaired and replaced with asphalt concrete during the monitoring period.

INITIAL DATA COLLECTION

The second day (August 25, 1995) was spent checking the functionality of installed equipment. This included collection of initial data, elevation surveys of the section, examination of the overnight data collected by the onsite datalogger and TDR data collection using the mobile data acquisition system. Air temperature, rainfall, pavement and subsurface temperature data monitored and stored by the onsite datalogger were examined. The equipment and datalogger were functioning correctly. The battery voltage was checked and found acceptable.

TDR data was not collected using the mobile data acquisition system. The mobile data acquisition box was damaged by rainwater during the seasonal instrumentation installation at site 041024. The decision to continue with installation was made after carefully considering the additional expense, inconvenience, and scheduling problems for the various personnel involved in the installation effort. However, mobile data collected during the subsequent data collection visits clearly indicated proper functioning of the TDR sensors.

Post installation FWD testing of the section was completed as per the guidelines. One set of elevation measurements was collected following the LTPP guidelines. The elevation of the observation well top was assumed as 1.0 meter. The elevation survey results are presented in table D2 in appendix D.

SUMMARY

This report describes the SMP equipment installation activities on section 040215 located in the State of Arizona. The section is located on the eastbound outside lane of Interstate Route 10 near the City of Phoenix. The beginning of the section is at milepost 105.95, 2.5 miles east of 339th Avenue. This is a SPS-2 section in the "Dry, No Freeze" climatic zone in SMP cell #17.

The site was inspected on March 2, 1995. A planning meeting with ADOT representatives was held in Phoenix on July 21, 1995 to discuss SMP equipment installation and work responsibilities. Successful installation of SMP equipment and initial data collection were carried out on August 24 and 25, 1995, respectively, in accordance with the LTPP SMP guidelines. Equipment to measure and record the following data was installed at site:

- Ambient temperature and daily rainfall
- Pavement surface and subsurface depth-temperature profile
- Subsurface depth-moisture profile
- Ground water measurements
- Pavement joint opening measurements

A resistivity probe was not installed at this site as the site is in a "Dry, No Freeze" zone. The equipment installation hole is located at the leave end of the section at a distance of 155.84m from the section beginning. The equipment cabinet is located 9.6m to the right of the lane edge on almost level ground. Post installation checks indicated proper functioning of all installed equipment. Post installation FWD testing was performed.

TDR data was not collected using the mobile data acquisition system, however, manual data was collected. The mobile data acquisition box was damaged by rainwater during the seasonal instrumentation installation at site 041024. The decision to continue with installation was made after carefully considering the additional expense, inconvenience, and scheduling problems for the various personnel involved in the installation effort. However, mobile data collected during the subsequent data collection visits clearly indicated proper functioning of the TDR sensors. Unfortunately, no pictures of the installation were taken because of camera malfunction. Other than this, there were no exceptions or special conditions at this site.

Appendix A

Test Section Background Information

Appendix A includes the following supporting information.

Figure A1. Site location map.
Figure A2. Normalized deflection profile from FWDCheck.
Figure A3. Corrected normalized deflection profile from FWDCheck.
Figure A4. Elastic modulus of subgrade from FWDCheck.
Figure A5. Composite modulus at station 5+00 from FWDCheck.
Figure A6. Equivalent structural number from FWDCheck.
Figure A7. Sampling log of section during construction.
Figure A8. Boring log of instrument hole.

Figure A1. Site location map.

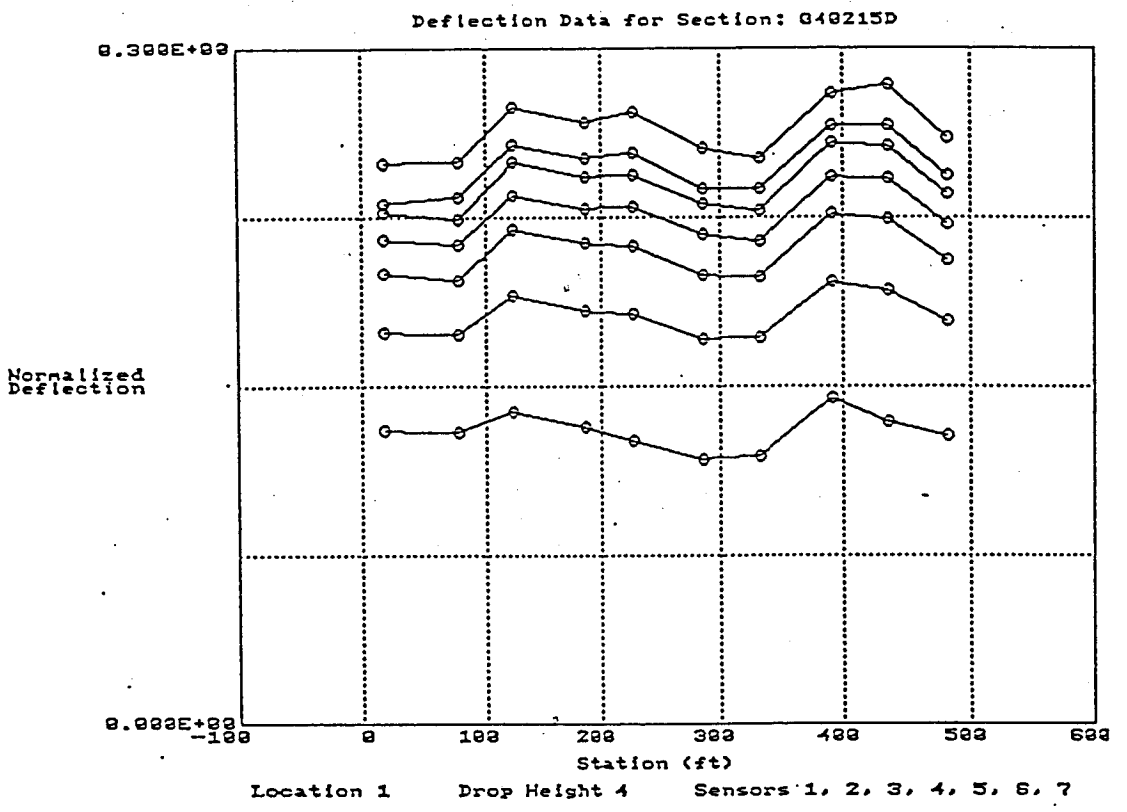


Figure A2. Corrected normalized deflection profile from FWDCheck.

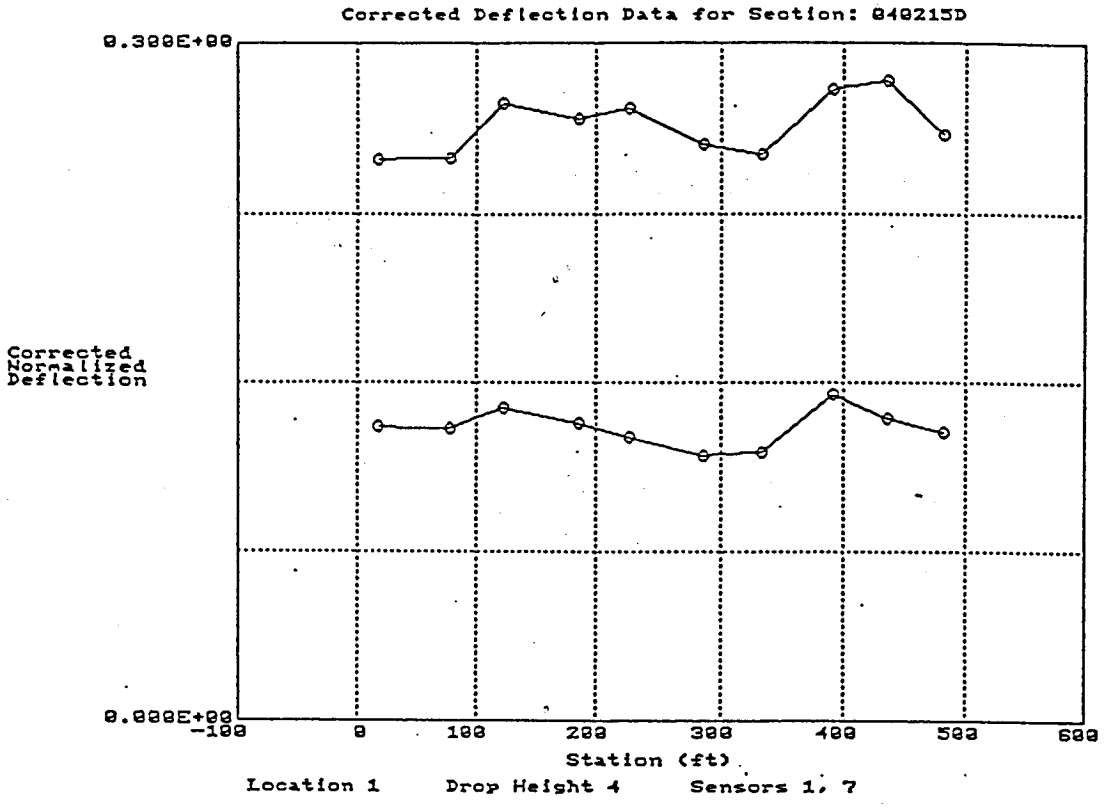


Figure A3. Corrected normalized deflection profile from FWDCheck.

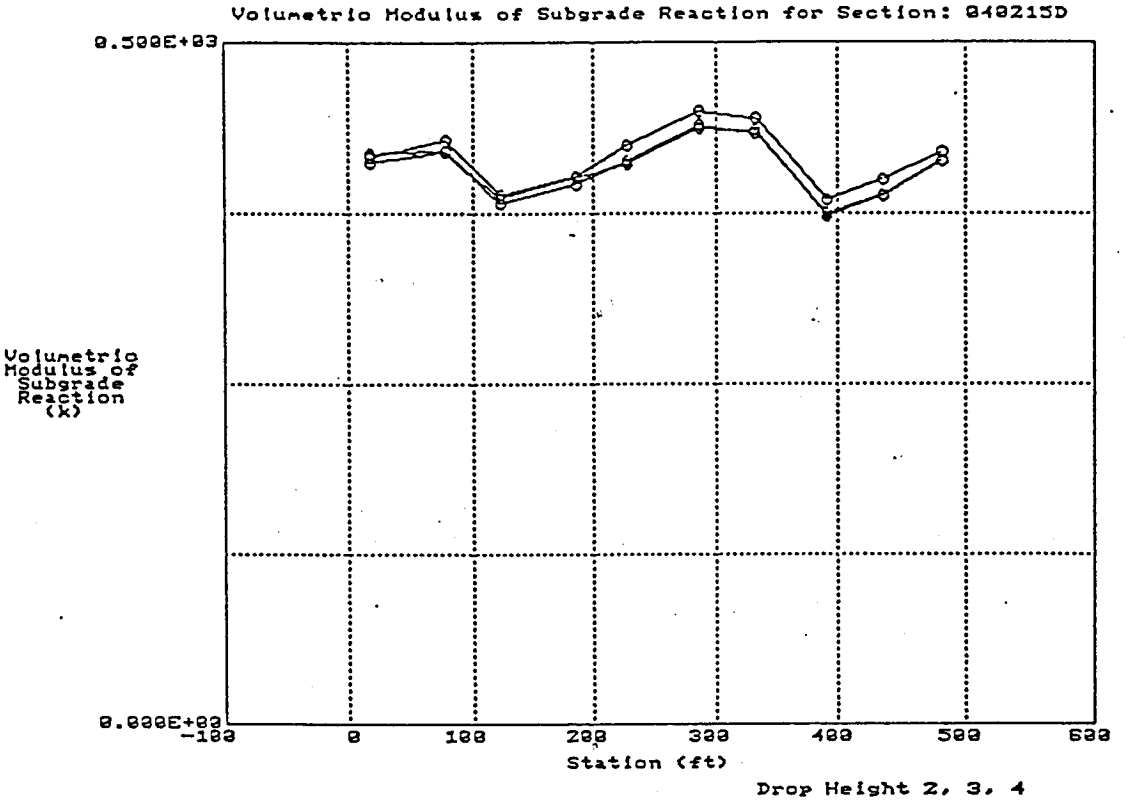


Figure A4. Elastic modulus of subgrade from FWDCheck.

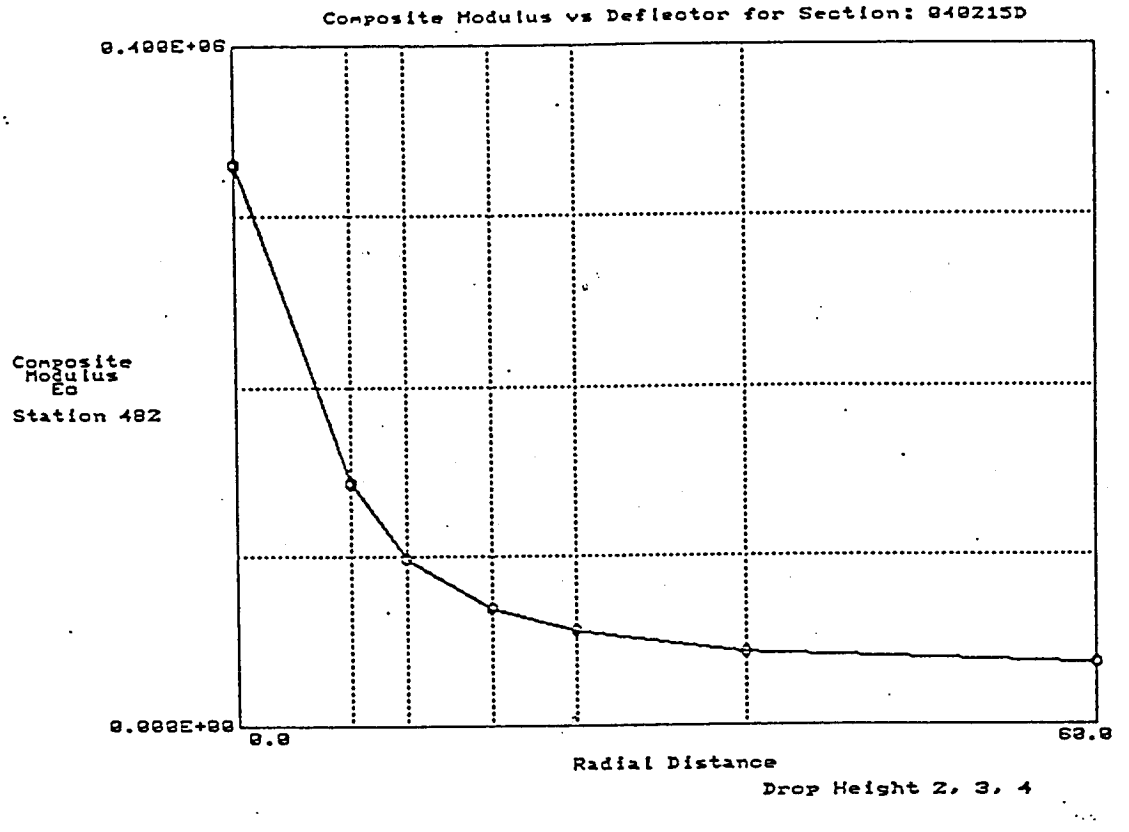


Figure A5. Composite modulus at station 5+00 from FWDCheck.

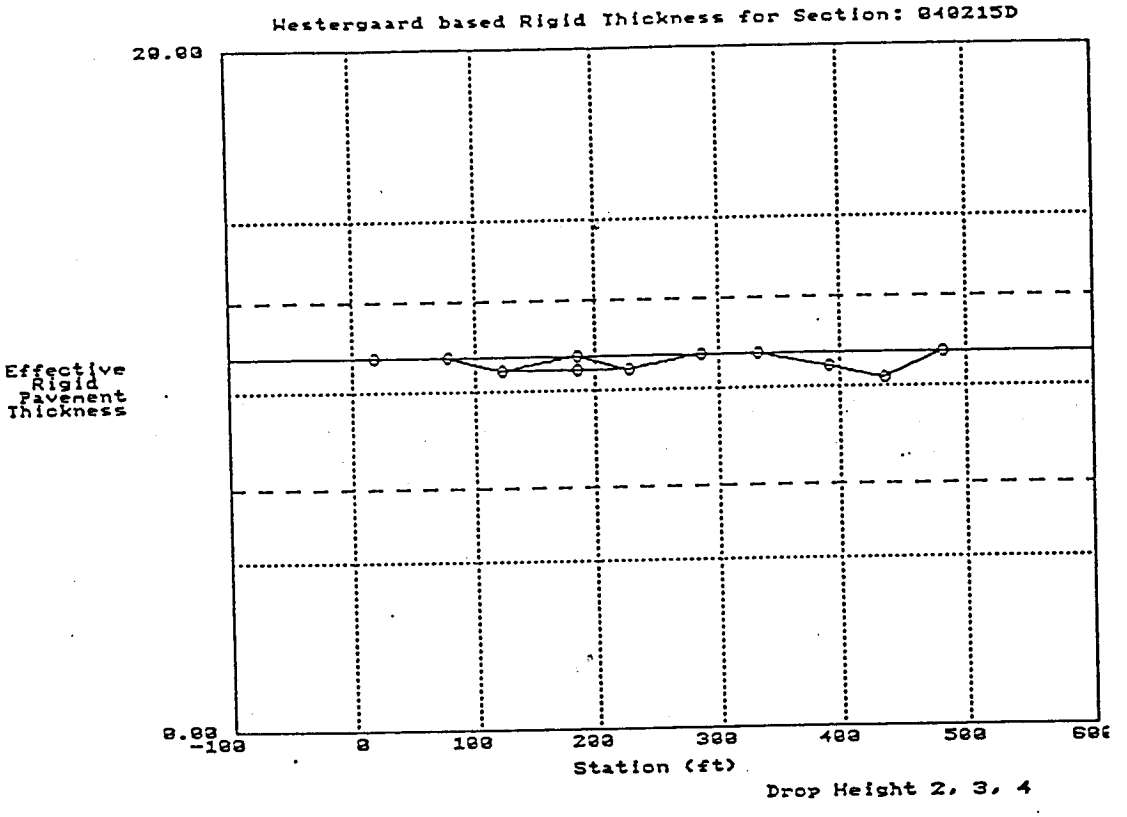


Figure A6. Equivalent structural number from FWDCheck.

DRILLING & SAMPLING LOG

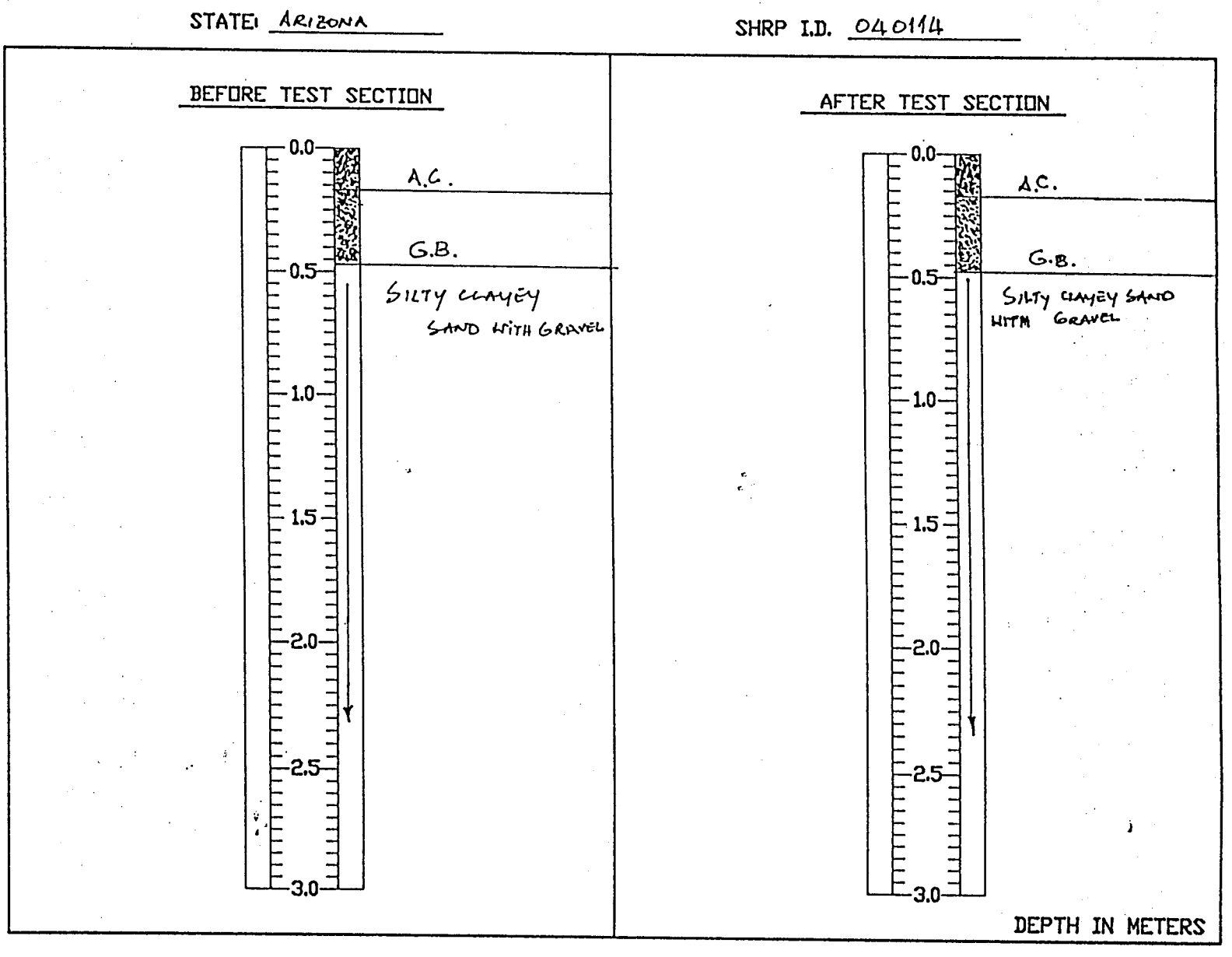
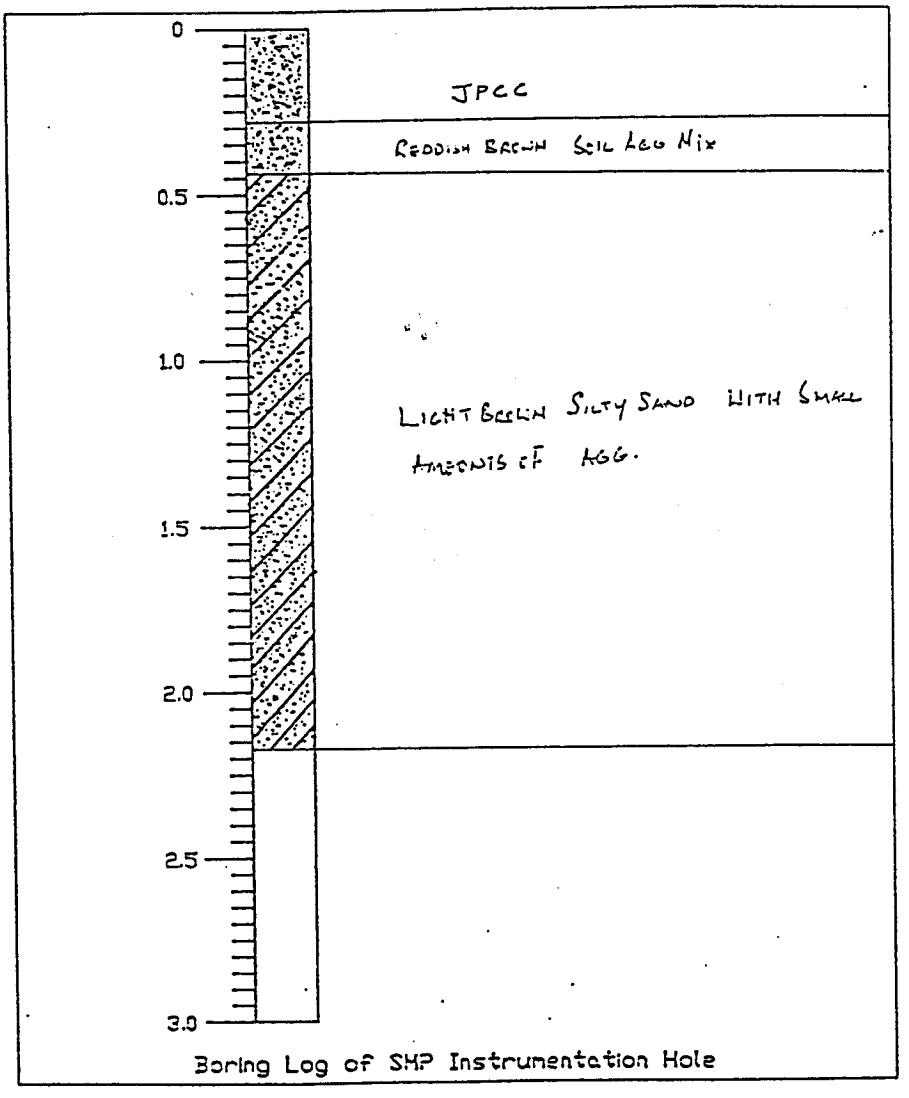


Figure A7. Sampling log of section during construction.

State ID. 04 SHRP ID. 0215

Station 155.44m (510+11'2") Date(dd/mm/yy) 24/06/96



Start Time _____ End Time _____

Prepared By [illegible] A. POTTER Employed By NCE

Figure A8. Boring log of instrument hole.

Revised May 29, 1992

SHEET 4

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID ____

STATE CODE 04

SHRP SECTION ID 0215

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 08/25/95

SURVEYORS: mc ____, ____, ____
PAVEMENT SURFACE TEMP - BEFORE ____ 30 °C; AFTER ____ °C
PHOTOS, VIDEO, OR BOTH WITH SURVEY (P, V, B) ____

DISTRESS TYPE	SEVERITY LEVEL LOW	MODERATE	HIGH
CRACKING			
1. CORNER BREAKS (Number)	0	0	0
2. DURABILITY "D" CRACKING (Number of Affected Slabs)	0	0	0
AREA AFFECTED (Square Meters)	0.0	0.0	0.0
3. LONGITUDINAL CRACKING (Meters)	0.0	0.0	0.0
Length Sealed (Meters)	0.0	0.0	0.0
4. TRANSVERSE CRACKING (Number of Cracks)	0	0	0
(Meters)	0.0	0.0	0.0
Length Sealed (Meters)	0.0	0.0	0.0
JOINT DEFICIENCIES			
5a. TRANSVERSE JOINT SEAL DAMAGE Sealed? (Y, N)			0
If "Y" Number of Joints	0	0	0
5b. LONGITUDINAL JOINT SEAL DAMAGE Number of Longitudinal Joints that have been sealed (0, 1, or 2)			0
Length of Damaged Sealant (Meters)			0.0
6. SPALLING OF LONGITUDINAL JOINTS (Meters)	0.0	0.0	0.0
7. SPALLING OF TRANSVERSE JOINTS Number of Affected Joints	0	0	0
Length Spalled (Meters)	0.0	0.0	0.0

ENTERED
JAN 08 1996
By RS

Revised May 29, 1992

STATE ASSIGNED ID _ _ _ _

SHEET 5

STATE CODE 0 4

DISTRESS SURVEY

SHRP SECTION ID 0 2 1 5

LTPP PROGRAM

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 0 4/2 6/9 5

SURVEYORS: ME _, _ _ _

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES (CONTINUED)

DISTRESS TYPE	SEVERITY LEVEL LOW	MODERATE	HIGH
SURFACE DEFORMATION			
8a. MAP CRACKING (Number)			0
(Square Meters)			0.0
8b. SCALING (Number)			0
(Square Meters)			0.0
9. POLISHED AGGREGATE (Square Meters)			0.0
10. POPOUTS (Number)			0.
MISCELLANEOUS DISTRESSES			
11. BLOWUPS (Number)			0
12. FAULTING OF TRANSVERSE JOINTS AND CRACKS - REFER TO SHEET 6			
13. LANE-TO-SHOULDER DROPOFF - REFER TO SHEET 7			
14. LANE-TO-SHOULDER SEPARATION - REFER TO SHEET 7			
15. PATCH/PATCH DETERIORATION			
Flexible (Number)	0	0	0
(Square Meters)	0.0	0.0	0.0
Rigid (Number)	0	0	0
(Square Meters)	0.0	0.0	0.0
16. WATER BLEEDING AND PUMPING (Number of Occurrences)			0
Length Affected (Meters)			0.0
17. OTHER (Describe) _____			

ENTERED JAN 08 1996 RS

Revised April 23, 199

SHEET 6

STATE ASSIGNED ID _ _ _ _

DISTRESS SURVEY

STATE CODE 0 4

LTPP PROGRAM

SHRP SECTION ID 0 2 1 5

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 0 6 / 2 5 / 9 5

SURVEYORS: M E _, _ _ _

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES (CONTINUED)

12. FAULTING OF TRANSVERSE JOINTS AND CRACKS

Point[1] Distance (Meters)	Joint or Crack (J/C)	Crack Length (Meters)	Well Sealed (Y/N)	Length of Joint Spalling, m L	M	H	Faulting[2], mm 0.3m	0.75m
2.8	J			0	0	0	1.0	0
7.4							0.2	0.2
11.0							0.1	0.1
16.5							-0.3	0.3
21.1							-0.2	0.2
25.7							0.4	0.4
30.3							0.4	0.4
34.9							-0.3	-0.1
39.5							0	-0.2
44.0							-0.4	-0.4
48.6							-0.8	-0.8
53.2							0.2	0.2
57.8							-0.4	-0.8
62.4							-0.6	-0.5
67.0							-0.4	-0.3
71.5							-0.1	0.2
76.1							0.1	0.0
80.7							-0.4	0
85.2							0.3	-0.1
89.8							-0.7	-0.4
94.4							1.3	0.7
99.0							-0.8	-0.8
103.6							0.3	0.3
108.2							-0.9	-1.0
112.8							-1.5	-0.8
117.4							-0.1	0.4
121.9	L			0	0	0	-0.5	-0.3

Note 1. Point Distance is from the start of the test section to the measurement location.

Note 2. If the "approach" slab is higher than the "departure" slab, faulting is recorded as positive (+ or 0); if the "approach" slab is lower record faulting as negative (-) and the minus sign must be used.

SHEET 6

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID _ _ _ _

STATE CODE 0 5

SHRP SECTION ID 0 2 1 5

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 0 8/2 5/9 5

SURVEYORS: M E _, _ _ _

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES (CONTINUED)

12. FAULTING OF TRANSVERSE JOINTS AND CRACKS

Point[1] Distance (Meters)	Joint or Crack (J/C)	Crack Length (Meters)	Well Sealed (Y/N)	Length of Joint Spalling, m L	M	H	Faulting[2], mm 0.3m	0.75m
126.5	J	_._	_	_.0	_.0	_.0	-0.3	0.2
131.1	J	_._	_	_.0	_.0	_.0	0.1	0.3
135.7	J	_._	_	_.0	_.0	_.0	0.2	0.5
140.4	J	_._	_	_.0	_.0	_.0	0.2	0.3
145.1	J	_._	_	_.0	_.0	_.0	-0.7	0.1
149.7	J	_._	_	_.0	_.0	_.0	-0.8	-0.8
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _
_ _ _._	_	_._	_	_._	_._	_._	_ _ _	_ _ _

Note 1. Point Distance is from the start of the test section to the measurement location.

Note 2. If the "approach" slab is higher than the "departure" slab, faulting is recorded as positive (+ or 0); if the "approach" slab is lower, record faulting as negative (-) and the minus sign must be used.

STATE ASSIGNED ID _ _ _ _

SHEET 7

DISTRESS SURVEY

STATE CODE 0 7

LTPP PROGRAM

SHRP SECTION ID 0 2 1 5

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 0 9/2 5/9 5

SURVEYORS: ML _, _ _ _

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES (CONTINUED)

13. LANE-TO-SHOULDER DROPOFF

14. LANE-TO-SHOULDER SEPARATION

Point No.	Point[1] Distance (meters)	Lane-to-shoulder[2] Dropoff (mm)	Lane-to-shoulder Separation (mm)	Well Sealed (Y/N)
1.	0.	2.0.	___.42	Y
2.	15.25	_1.9.	___.41	Y
3.	30.5	=0_.5	___.48	Y
4.	45.75	0.3.	___.44	Y
5.	61.	_1.6.	___.44	Y
6.	76.25	_1.3.	___.44	Y
7.	91.5	__0.2	___.44	Y
8.	106.75	__0.8	___.47	Y
9.	122.	__1.1	___.35	Y
10.	137.25	_0.2	___.37	Y
11.	152.5	=0_.3	___.4	Y

Note 1. Point Distance is from the start of the test section to the measurement location. The values shown are SI equivalents of the 50 feet spacing used in previous surveys.

Note 2. If heave of the shoulder occurs (upward movement), record as a negative (-) value. Do not record (+) signs, positive values are assumed.

Appendix B

Installed Instrument Information

Appendix B includes the following supporting information.

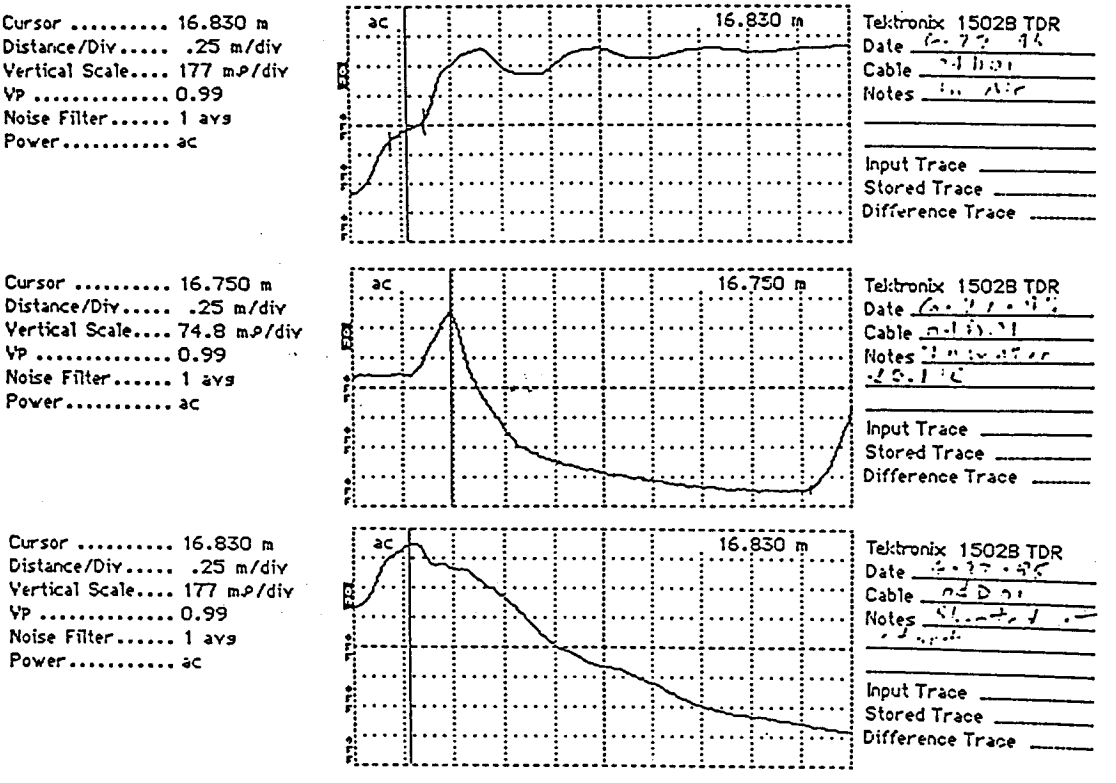


Figure B1. TDR traces obtained during calibration for sensor 04D01.

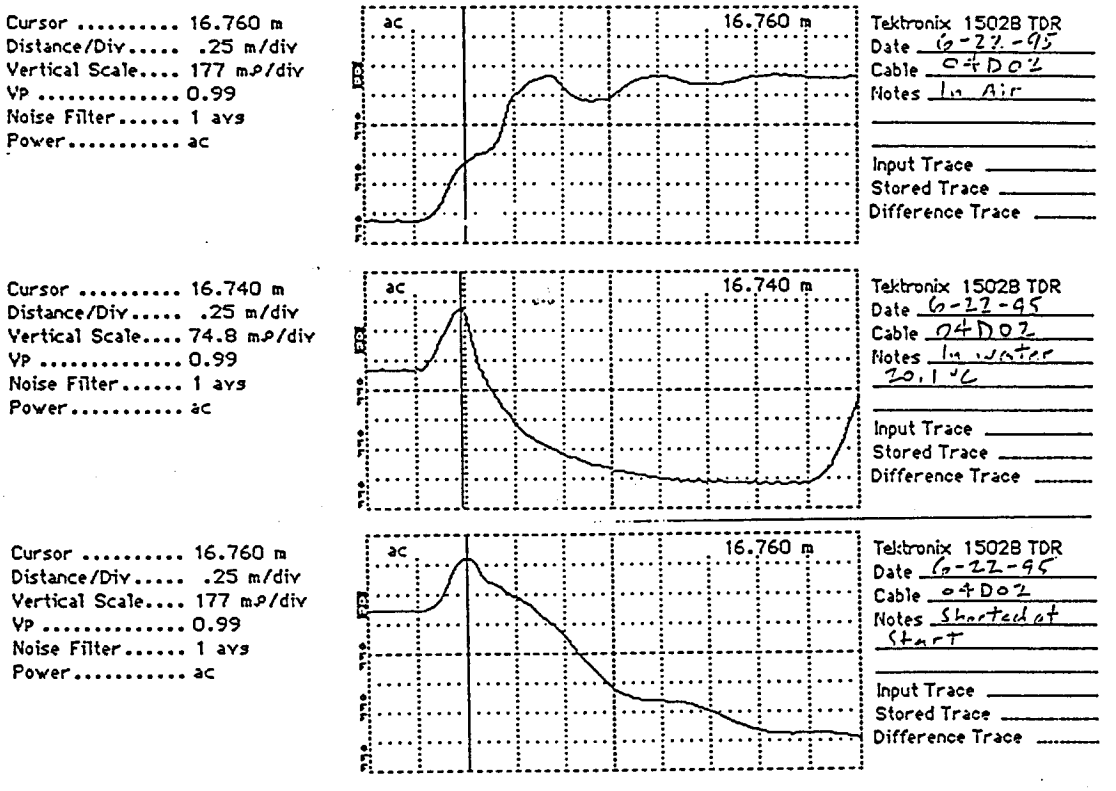


Figure B2. TDR traces obtained during calibration for sensor 04D02.

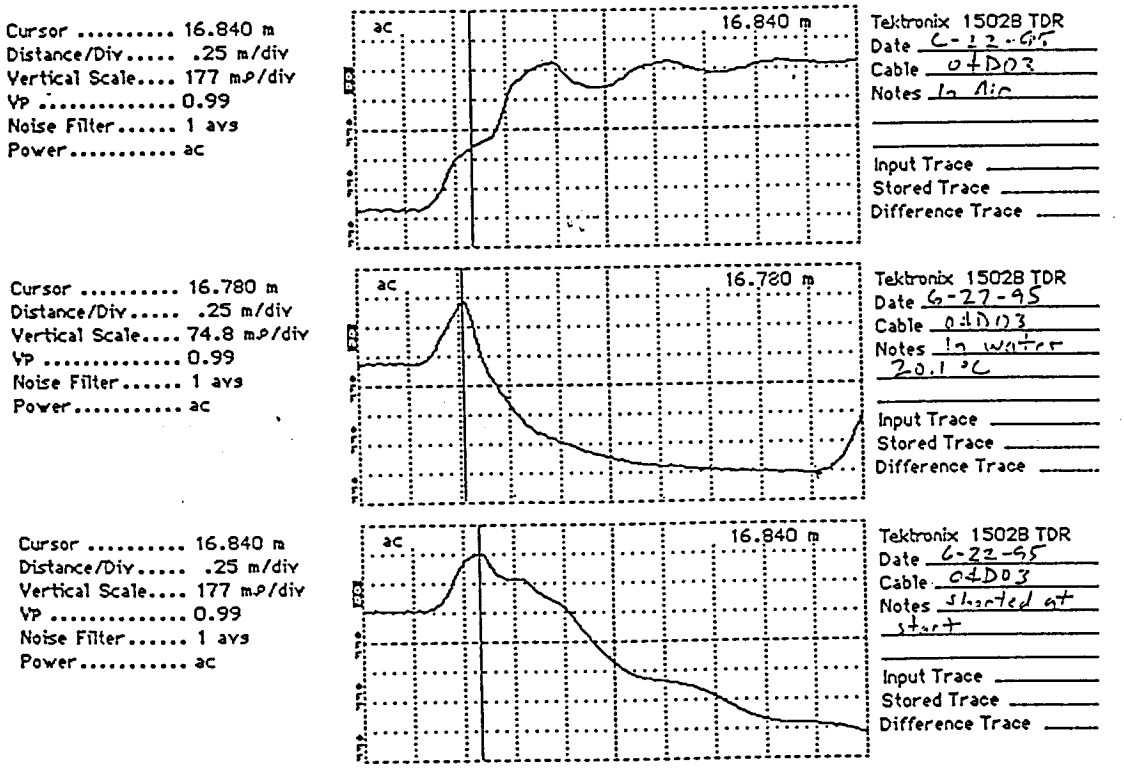


Figure B3. TDR traces obtained during calibration for sensor 04D03.

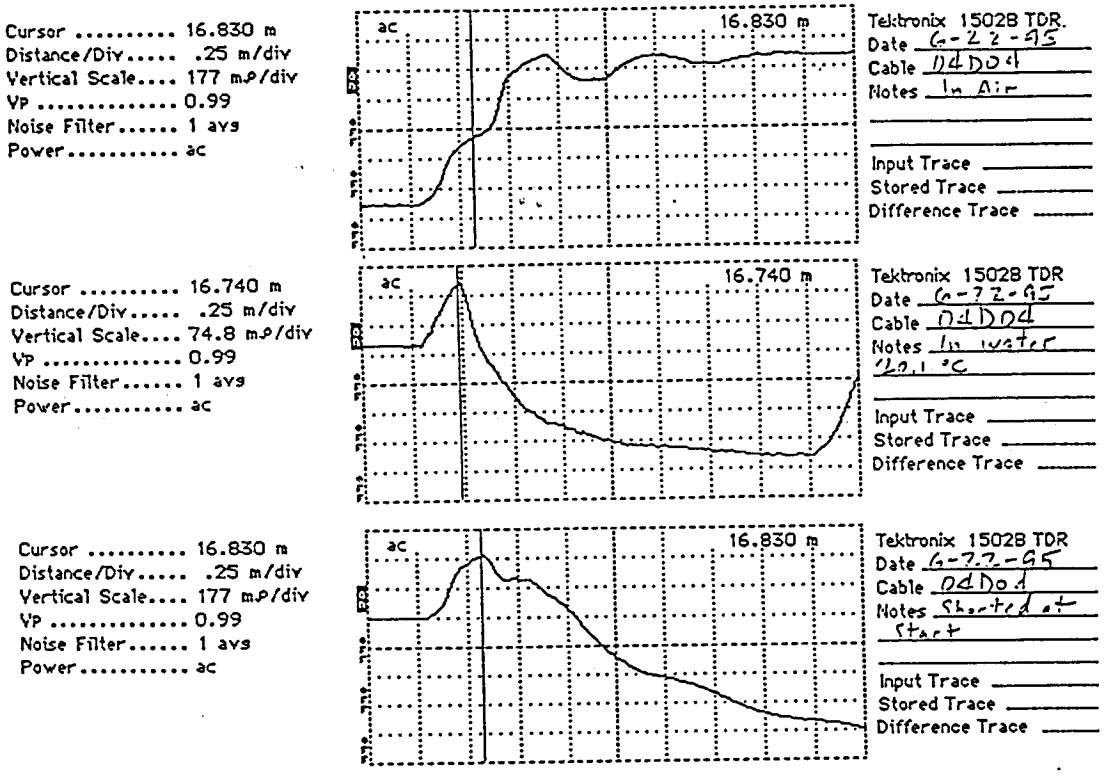


Figure B4. TDR traces obtained during calibration for sensor 04D04.

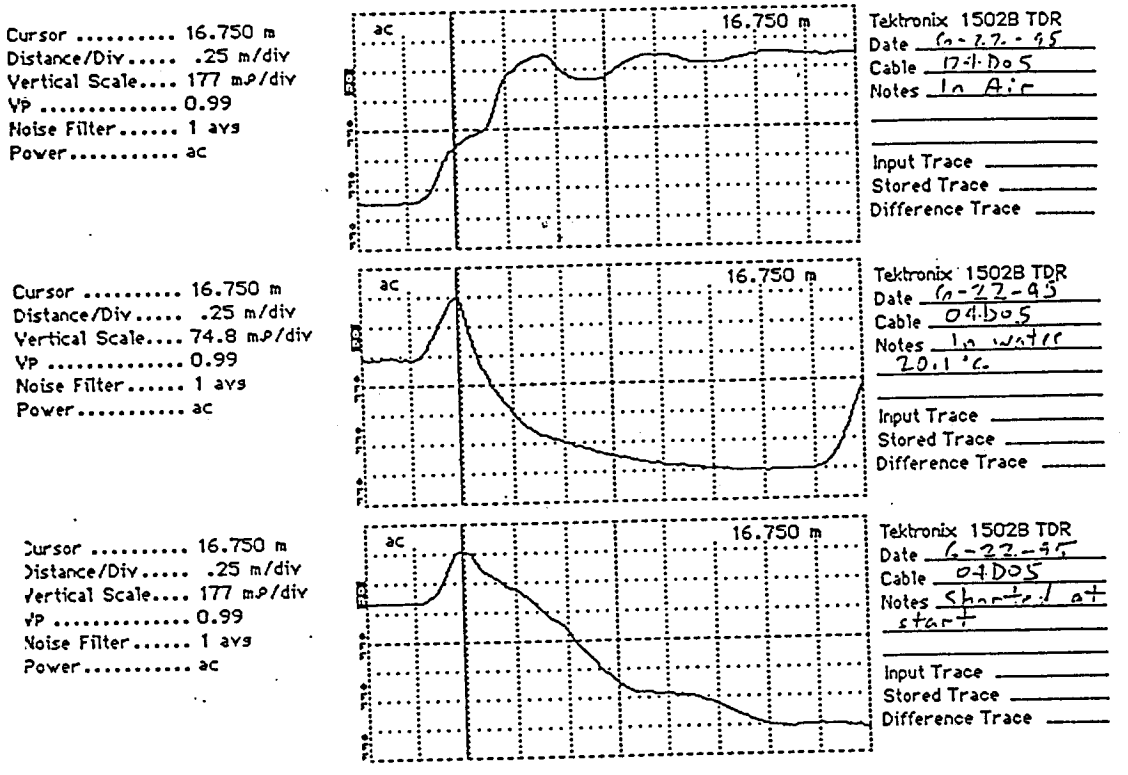


Figure B5. TDR traces obtained during calibration for sensor 04D05.

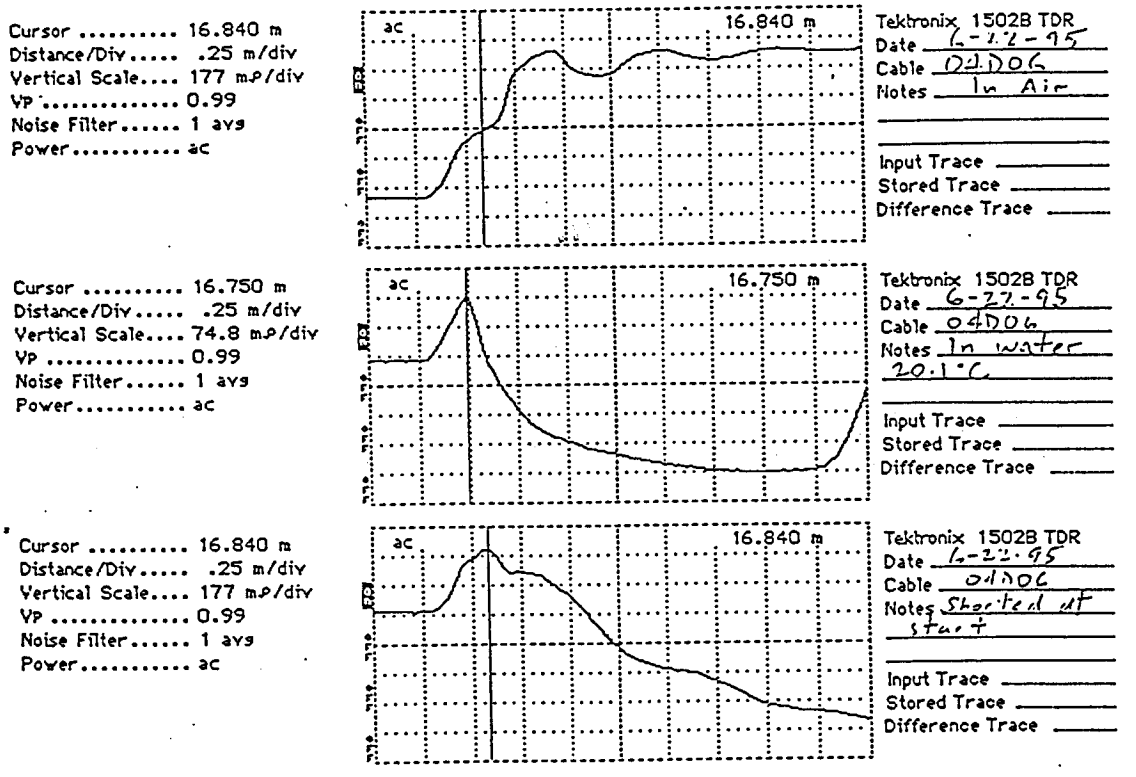


Figure B6. TDR traces obtained during calibration for sensor 04D06.

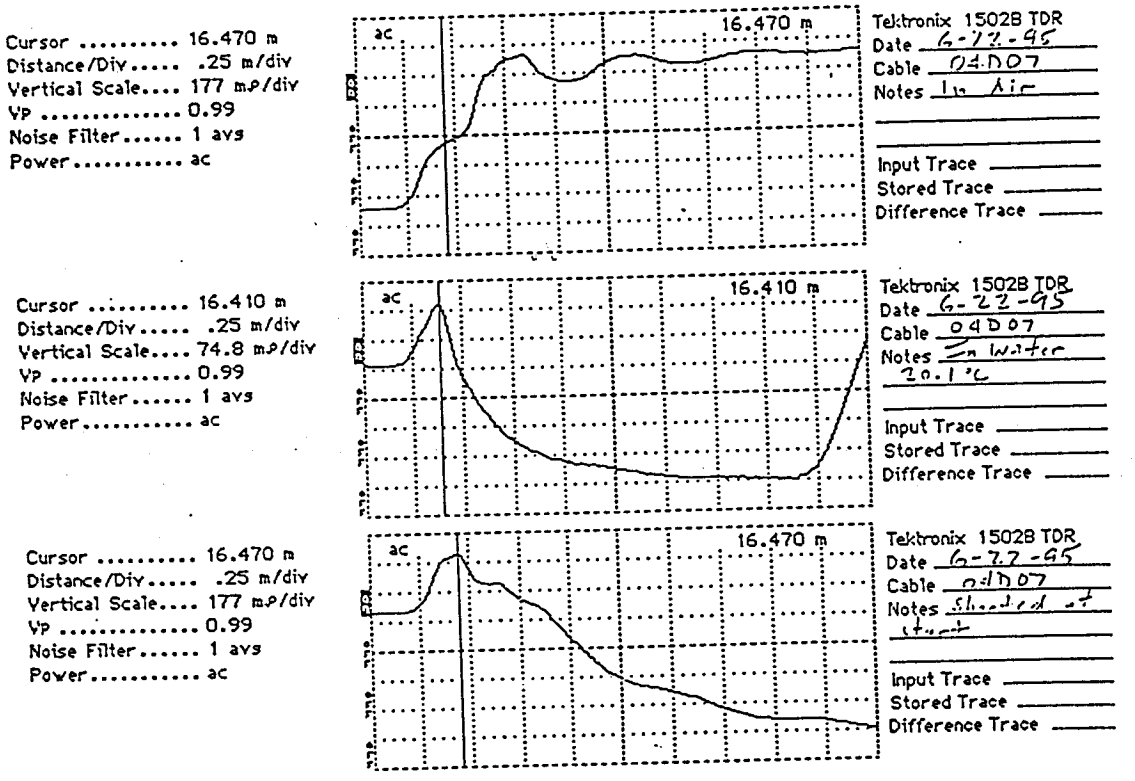


Figure B7. TDR traces obtained during calibration for sensor 04D07.

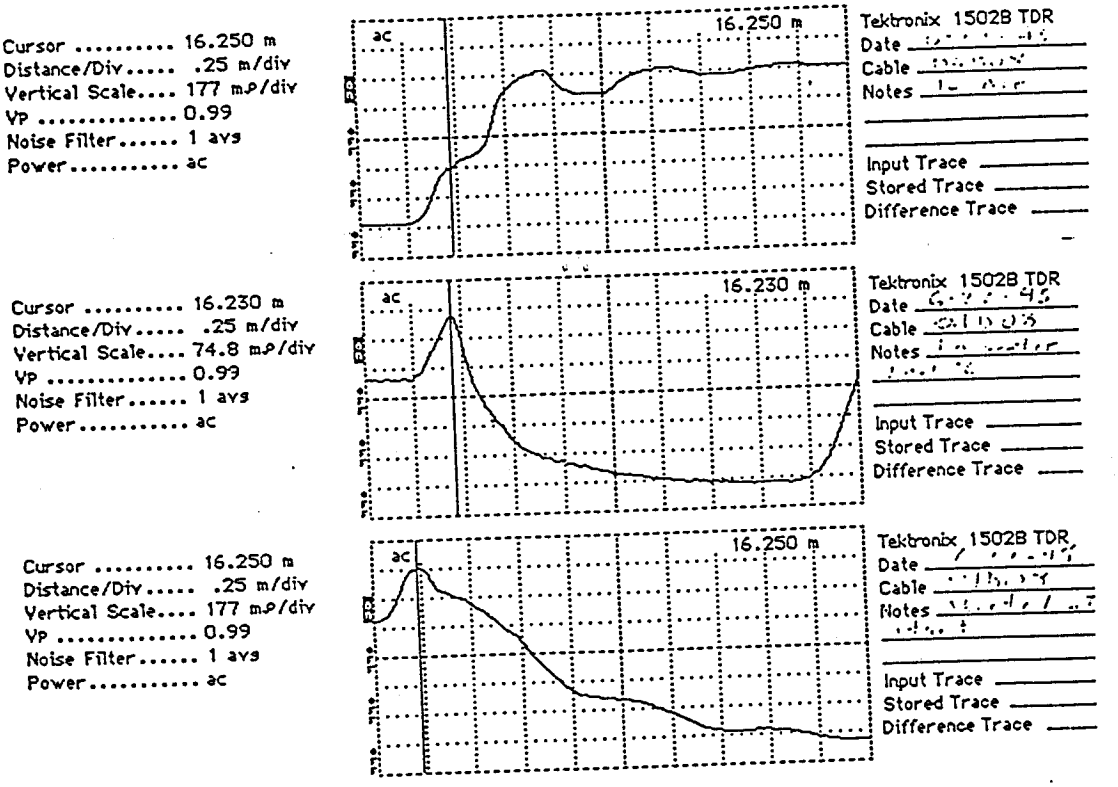


Figure B8. TDR traces obtained during calibration for sensor 04D08.

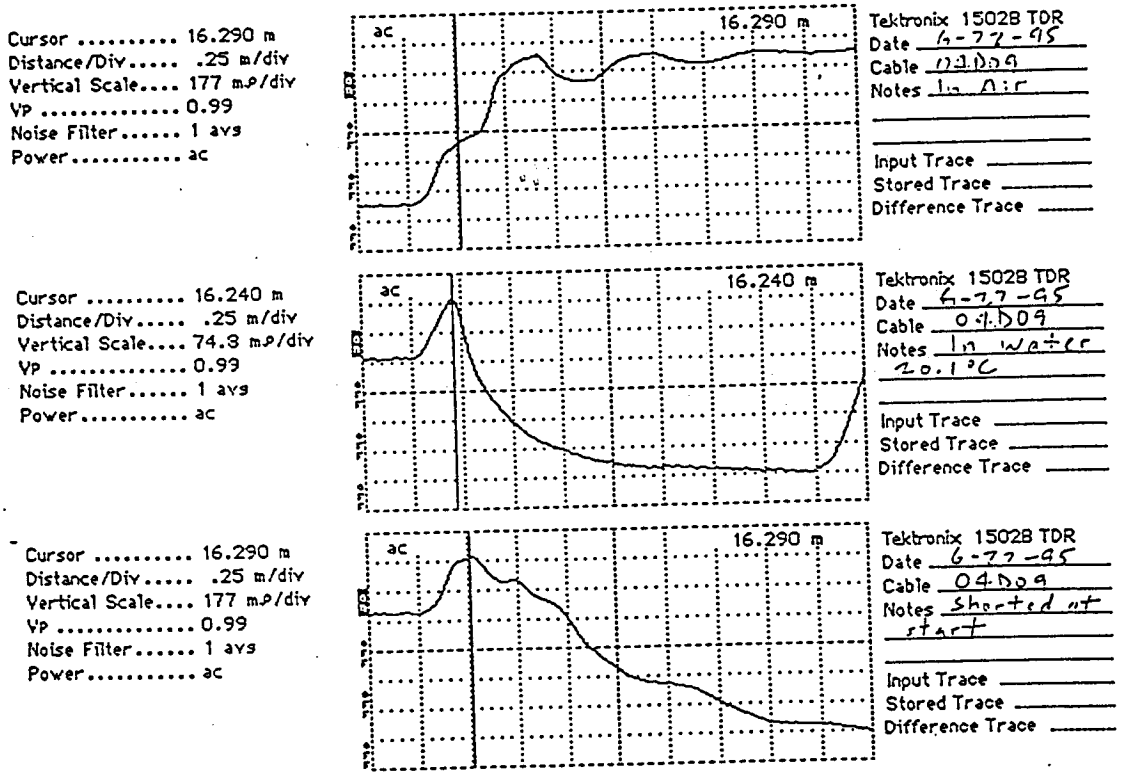


Figure B9. TDR traces obtained during calibration for sensor 04D09.

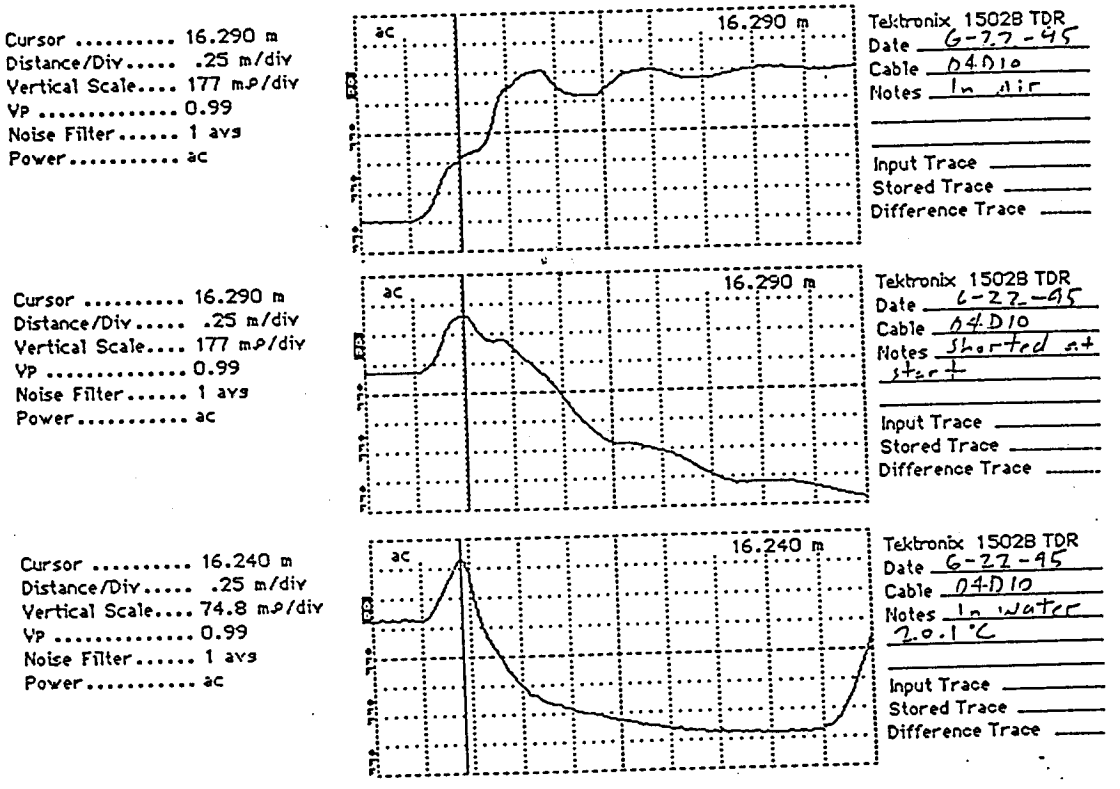


Figure B10.TDR traces obtained during calibration for sensor 04D10.

Appendix C

Installation Information

Appendix C has the following supporting information.

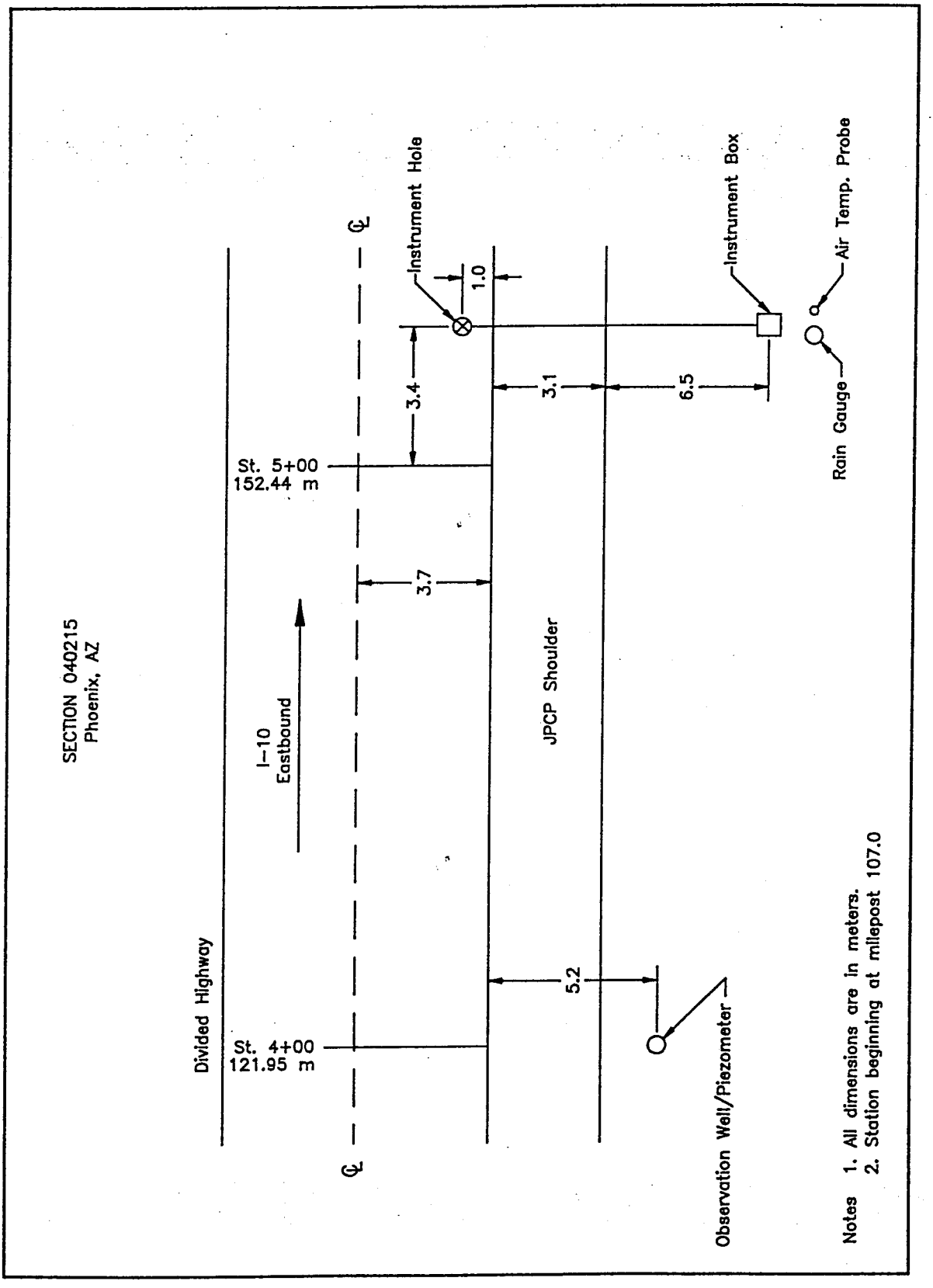


Figure C1. Instrumentation location within the section.

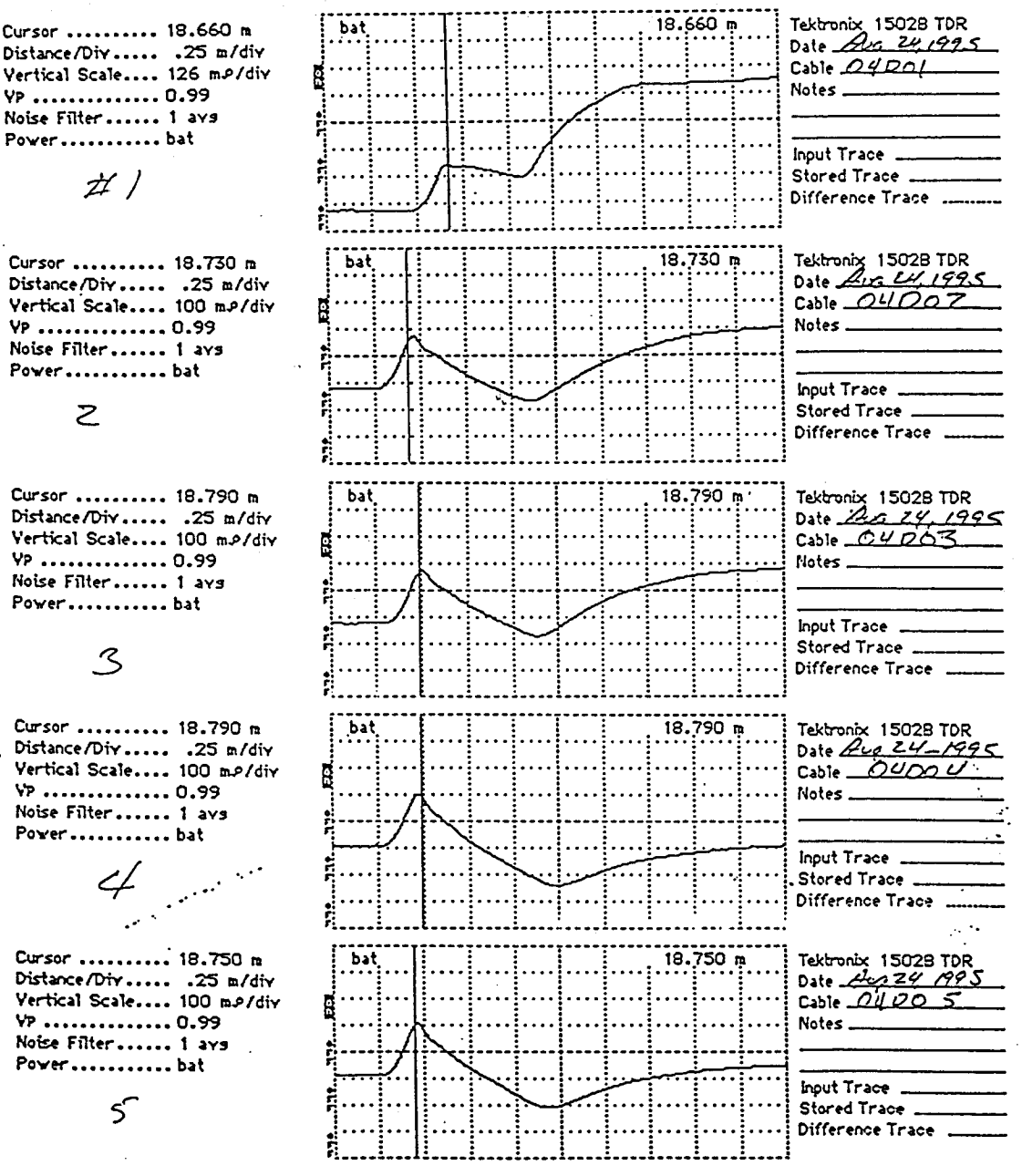


Figure C2. TDR traces obtained during installation for sensors 04D01 thru 04D05.

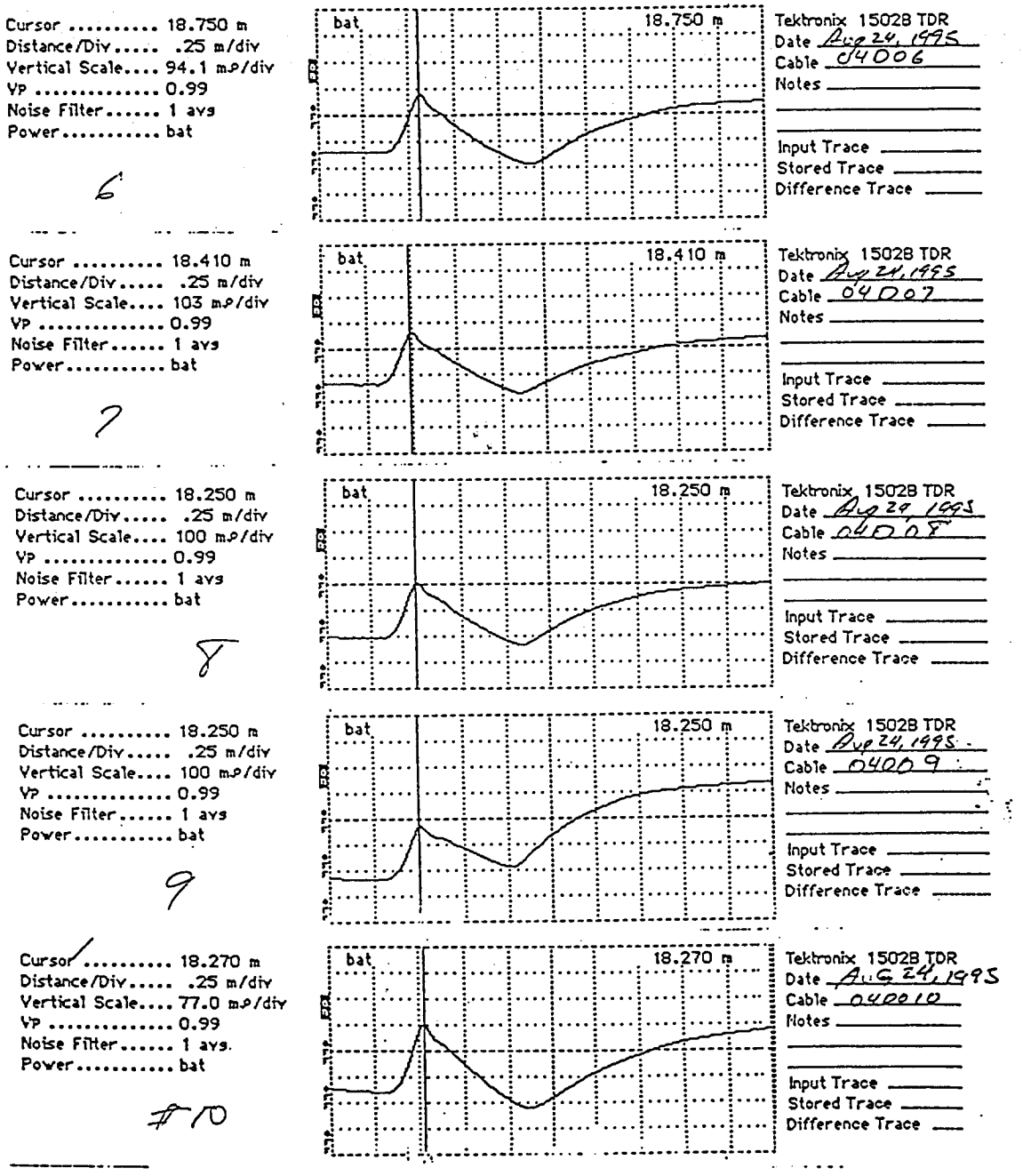


Figure C3. TDR traces obtained during installation for sensors 04D06 thru 04D10.

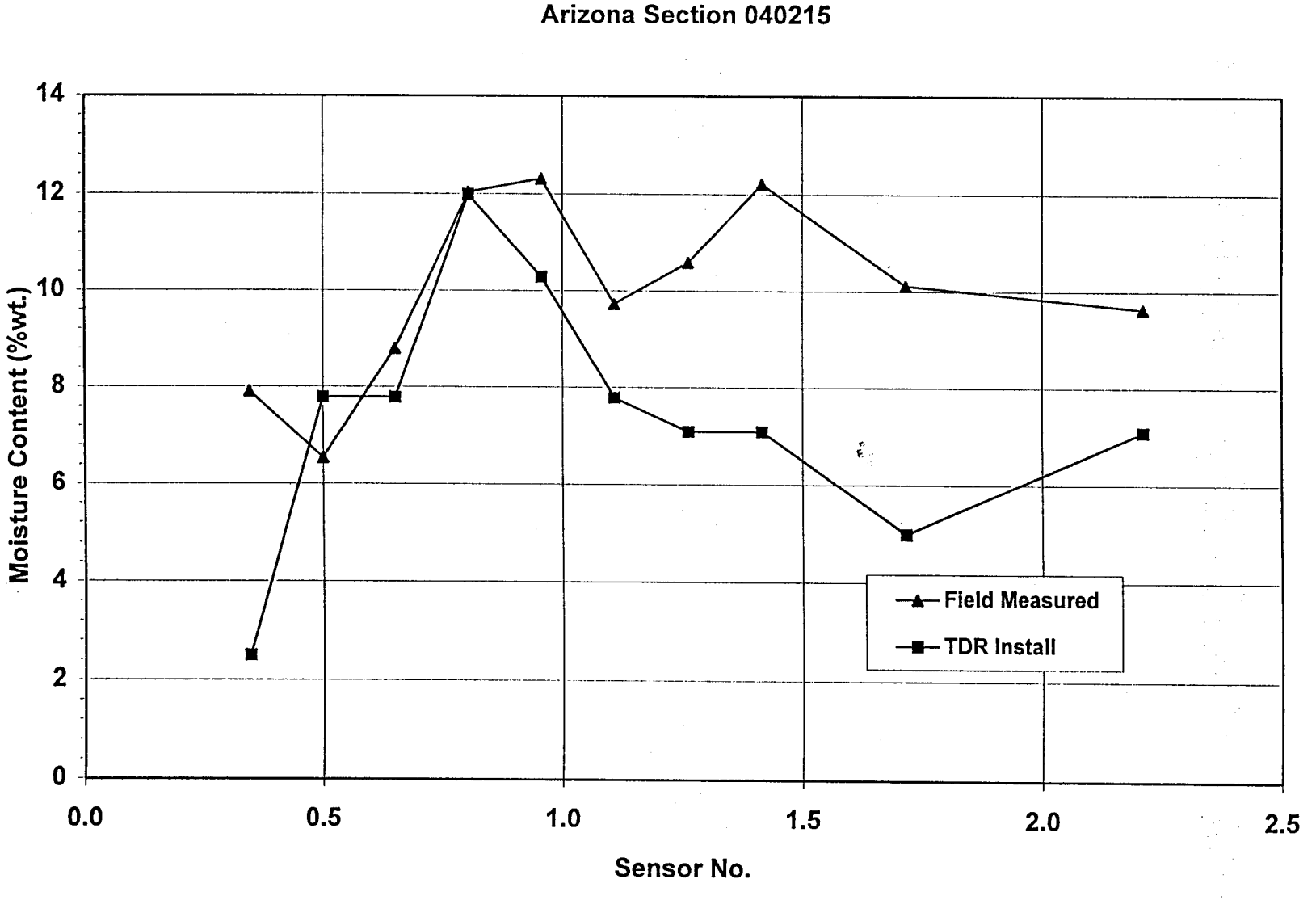


Figure C4. Moisture contents measured during installation.

Table C1. Measured field moisture contents during installation.

LTPP Seasonal Monitoring Study Field Measured Moisture Contents	* State Code [04] * Test Section Number [0215]

Personnel : Phil Friedman
Date : 8/24/95
Start Time : NA
Finish Time : NA
Surface Type : Asphalt Concrete
Weather Conditions : Clear, Sunny
Unusual Conditions : None

TDR Sensor Number	Field Measured Moisture Content %
10	9.6
9	10.1
8	12.2
7	10.6
6	9.7
5	12.3
4	12.0
3	8.8
2	6.6
1	7.9

Appendix D

Initial Data Collection

Appendix D includes the following supporting information.

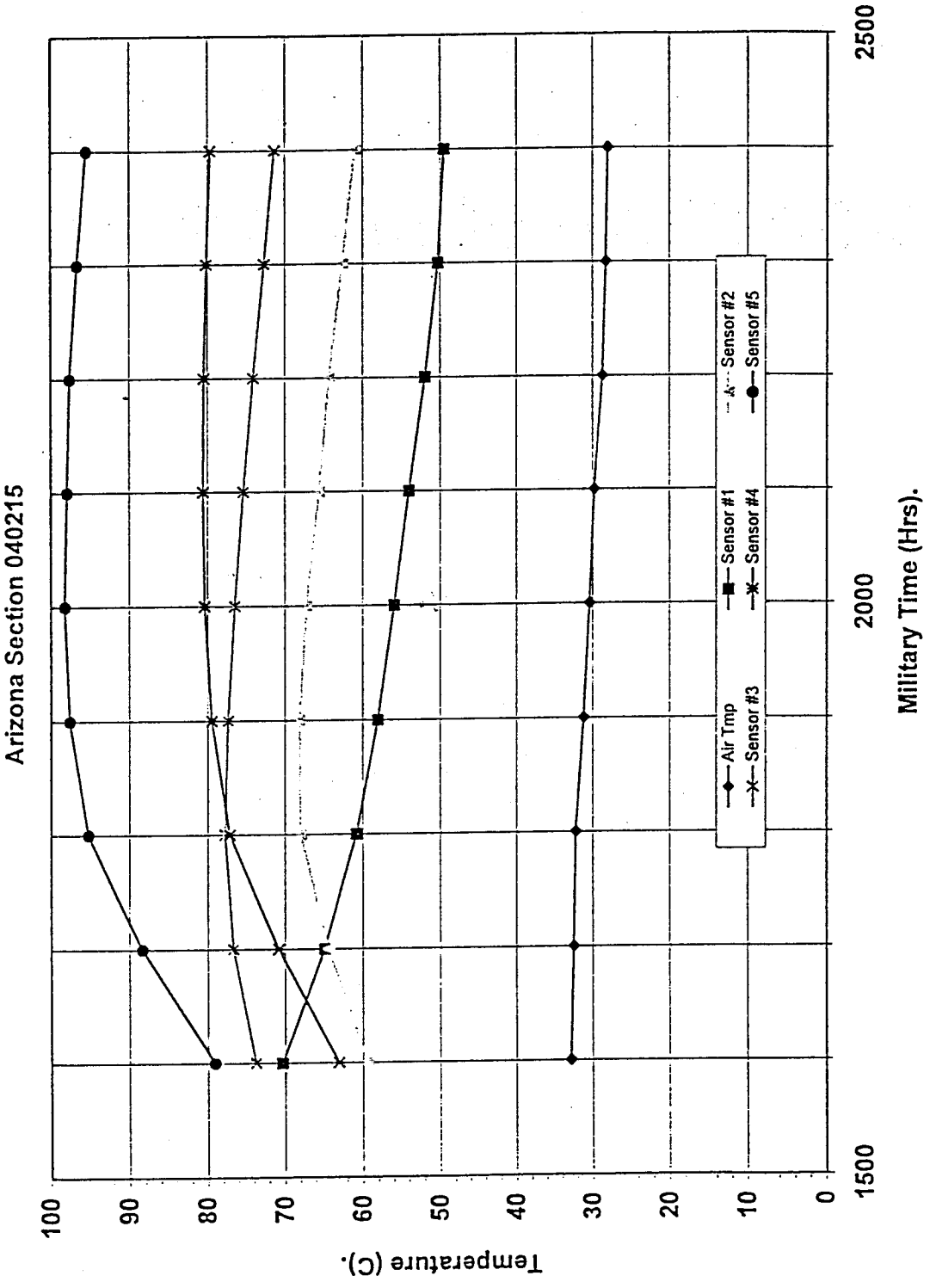


Figure D1. Hourly average air and top five sensor temperatures.

Table D1. Raw data collected by the onsite datalogger.

Arizona Section 040215, Raw onsite data collected during installation.																														
5	1995	236	1600	12.41	32.86	0																								
6	1995	236	1600	70.4	59.45	73.8	63.1	54.42																						
5	1995	236	1700	12.42	32.51	0																								
6	1995	236	1700	64.92	64.39	76.7	70.9	57.52																						
5	1995	236	1800	12.42	32.26	0																								
6	1995	236	1800	60.86	68.02	77.8	77.2	62.04																						
5	1995	236	1900	12.42	31.22	0																								
6	1995	236	1900	58.13	68.18	77.4	79.5	65.3																						
5	1995	236	2000	12.41	30.44	0																								
6	1995	236	2000	55.97	67.25	76.5	80.4	67.28																						
5	1995	236	2100	12.41	29.83	0																								
6	1995	236	2100	54.04	65.61	75.4	80.6	68.5																						
5	1995	236	2200	12.41	28.7	0																								
6	1995	236	2200	51.96	64.31	74.1	80.5	69.37																						
5	1995	236	2300	12.41	28.25	0																								
6	1995	236	2300	50.33	62.59	72.7	80.2	69.8																						
1	1995	236	2400	12.41	12.43	1824	12.4	1548	30.23	33.02	1547	27.12	0	0	4067															
2	1995	236	2400	56.14	65.01	75.2	78.2	65.91	60.4	58.74	58.29	58.27	57.73	57.22	56.8	56.18	55.33	54.51	53.65	53.06	52.6									
3	1995	236	2400	72.2	1547	68.69	1804	77.9	1747	80.8	2018	70.3	2350	64.33	2358	61.49	2353	60.02	2357	59.06	0	58.56								
4	1995	236	2400	49.28	0	58.32	1547	70.7	2359	61.18	1547	54	1547	54.71	1556	55.56	1556	56.24	1557	56.97	1559	56.75								
5	1995	236	2400	12.41	27.98	0																								
6	1995	236	2400	49.54	61.02	71.4	79.7	70.1																						
5	1995	237	100	12.41	27.58	0																								
6	1995	237	100	48.97	59.88	70.3	79.1	70.2																						
5	1995	237	200	12.41	26.97	0																								
6	1995	237	200	48.31	58.92	69.27	78.5	70.2																						
5	1995	237	300	12.4	26.81	0																								
6	1995	237	300	47.18	57.93	68.18	77.9	70.1																						
5	1995	237	400	12.4	26.98	0																								
6	1995	237	400	46.55	56.91	67.14	77.2	69.89																						
5	1995	237	500	12.4	26.32	0																								
6	1995	237	500	46.44	56.08	66.19	76.3	69.59																						

Table D2. Pavement elevations at the time of installation.

Station*	Offsets in m.			Comments
	PE[1]	ML[3]	IWP[4]	
4+29	1.354	1.379	1.412	Observation Well/Piezometer top assumed as 1.0 meter
4+36	1.361	1.387	1.416	
4+42	1.373	1.396	1.428	
4+43	1.372	1.395	1.427	
4+52	1.382	1.405	1.434	
4+58	1.386	1.415	1.445	
4+59	1.387	1.412	1.445	
4+67	1.394	1.419	1.449	
4+73	1.400	1.427	1.461	
4+74	1.400	1.428	1.459	
4+81	1.406	1.434	1.462	
4+89	1.414	1.442	1.471	
4+90	1.413	1.440	1.470	
4+97	1.422	1.446	1.476	
5+03	1.428	1.455	1.484	
5+04	1.427	1.453	1.483	
5+11	1.434	1.460	1.492	
5+18	1.436	1.465	1.496	

*. Customary units.
1. Outer Wheel Path
2. Middle of Lane
3. Inner Wheel Path

Table D3. Joint opening measurements during installation.

LTPP Seasonal Monitoring Program Data Sheet SMP-D06 Joint Opening Measurements	Agency Code [04] LTPP Section ID [0215]

Station (ft.)	Time (Military)	Joint Opening (mm)			Joint Width (mm)
		Offset (PE)[1] 0.3m	Offset (ML)[2] 1.80m	Offset (ILE)[3] 3.40m	
4+28	0952	4.58	4.64	4.61	----
4+42	1009	4.67	4.79	4.33	----
4+58	1010	4.89	4.66	4.51	----
4+74	1015	4.41	4.54	4.77	----
4+89	0951	4.39	4.37	4.80	----
5+03	0949	4.93	4.51	4.47	----

PE : Pavement Edge (Outer Lane Edge)
ML : Middle of Lane
ILE : Inner Edge of Lane

Prepared By: Michael Esposito Employer: NCE

Date (dd/mm/yy): 25/08/95

Data Sheet SMP-D06: Joint Opening Measurements

Table D4. Joint faulting measurements during installation.

LTPP Seasonal Monitoring Program Data Sheet SMP-D07 Joint Faulting Measurements	Agency Code [04] LTPP Section ID [0215]

Station (ft.)	Time (Military)	Joint Faulting (mm)		
		Offset (OWP)[1] 0.30m	Offset (ML)[2] 1.80m	Offset (IWP)[3] 2.40m
4+28	1217	0.3	-3.0	0.2
4+42		0.5	0.0	0.4
4+58		0.5	0.3	0.4
4+74		2.0	0.2	2.0
4+89		0.2	-0.2	-0.3
5+03		1.5	-0.1	-0.1

OWP : Outer Wheel Path
ML : Middle of Lane
IWP : Inner Wheel Path

Prepared By: Michael Esposito Employer: NCE

Date (dd/mm/yy): 25/08/95

Data Sheet SMP-D07: Joint Faulting Measurements.