LTPP Profile Variability

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

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)

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LIST OF ABBREVIATIONS

AC	Asphalt concrete
ANOVA	Analysis of Variance
APC	AC overay of PC
ASTM	American Society for Testing and Materials
BWP	Both wheelpaths
CN	Construction number
COV	Coefficient of Variation
DMI	Distance Measuring Instrument
FHWA	Federal Highway Administration
GPS	General Pavement Studies
IMS	Information Management System
IRI	International Roughness Index
LTPP	Long Term Pavement Performance
LWP	Left wheelpath
MS	Microsoft
ODBC	Open Database Connectivity
PC	Portland (Cement) Concrete
QC	Quality Control
RCO	Regional Coordination Office
RCOC	Regional Coordination Office Contractor
RMSVA	Root Mean Square Vertical Acceleration
RWP	Right wheelpath
SD	Standard Deviation
SHRP	Strategic Highway Research Program
SPS	Special Pavement Studies

CHAPTER 1. INTRODUCTION

The Long Term Pavement Performance (LTPP) program has been collecting profile and International Roughness Index (IRI) information from more than 2,062 test sections since 1989 using K.J. Law 690DNC optical sensor Profilometers. Analysis of the IRI data has been limited, but with the increasing distribution of the LTPP DataPave software, this data is seeing increasing use. In an effort to confirm the quality of LTPP IRI data in the Information Management System (IMS) database and to document its variability, LTPP initiated an analysis of IRI variability in September 1997. This report documents the results of that study.

Before the data could be analyzed, the quality of the data needed to be confirmed, the single-visit and multiple-visit IRI variability needed to be evaluated, and recommendations and confidence limits needed to be developed for quality control of profile data collection. Although it was initially conceived as a small part of the analysis, the verification and upgrade of data quality became the largest effort in this analysis. During visual review, equipment- and processing-related problems were noted in 14.6 percent of the IMS profiles. Repair and upgrade of 4.5 percent of the IMS data were completed. About 4 percent of the profile runs were noted as irreparable and were deleted from the database, and nearly 2,800 runs (5.9 percent of the database) were considered questionable and are awaiting review and reprocessing or deletion by Regional Coordination Office Contractors (RCOC's).

Single-visit (run-to-run) variability among the five repeated profile runs at 152.4-m test sections has been analyzed using confirmed and upgraded IRI values (nearly 90 percent of the values in the database). This analysis included transforming the data to remove the effect of IRI level on variability. Several conclusions were drawn based on the study of the effects of pavement type, testing time, season, region, equipment type, profile initiation method, and surface roughness. Confidence limits for the expected variability between repeated runs are proposed as a result of this analysis.

Multiple-visit (visit-to-visit) variability between data collected on different dates was also studied, resulting in conclusions regarding the effect of daily and seasonal changes on IRI variability. The presence of inflection points in IRI trends was reviewed. Computed confidence intervals for the expected yearly change in IRI resulting from equipment, seasonal, wheelpath, and other random variation were also developed.

Included in this report is a summary of the data quality review findings and upgrade procedures. Analyses of the run-to-run and visit-to-visit variability are then discussed, followed by a review of other analysis activities. Confidence limits are then provided, along with recommendations for use of the results.

CHAPTER 2. DATA QUALITY REVIEW

Profile data quality in the IMS database was initially reviewed using IRI variability and slope values. This review indicated that focusing on outlier IRI values was insufficient to identify all profile quality problems. As a result, profile plotting software—originally developed for review of a small portion of select questionable profiles—was used to plot and visually review the more than 47,000 profile runs in the IMS database.

The initial statistical review of the IRI data in the IMS database indicated that the run-to-run variability in the left and right wheelpath IRI values was small. Some of these profile sets with large run-to-run variability exhibited equipment or operator problems; many others did not. In a review of the visit-to-visit IRI slopes for a given section, nearly 22 percent of the unrehabilitated test sections exhibited slopes of less than zero for the linear trend of the average IRI. This trend indicates that the pavements are becoming smoother with age (which is illogical), that there is a problem with the profile data, or possibly that unreported maintenance is occurring.

To more easily study the reasons for these trends, the Profile Viewer software was developed for reviewing and overlaying plots of measured LTPP pavement profiles. This software, described further in Appendix C, allows the operator to select and plot individual left or right wheelpath runs from single or multiple site visits. IRI values are displayed for each run, and comments from original data collection are also displayed for review.

Initially, the Profile Viewer software was intended only for review of the outlier section profiles identified in the IRI variability evaluation. However, after viewing profiles for 77 sections in 5 States and finding problems in 52 sections, it was determined that outlier searches of IRI statistics did not identify all of the data collection problems revealed in the profile review. Based on this information, the necessity of plotting and viewing all profile data was evident.

A 2.4-Gb file containing all IMS profile data was downloaded on October 7, 1997, and was split into Microsoft (MS) Access database files for review. Initially, 9,190 General Pavement Studies (GPS) profile plots were printed and visually reviewed. Then, 11,650 Special Pavement Studies (SPS) profile plots were printed. Individual color profiles for the left and right wheelpaths of all five runs from each section were visually reviewed for consistency and for the presence of equipment- or operator-related problems. In addition, color-overlaid profiles of the left and right wheelpaths for the first run from each section visit were reviewed to confirm the testing location and other discrepancies. This provided the first comprehensive review of the repeatability of the profiles in the IMS database.

Overall, the LTPP profile database appeared to have good integrity, with profiles and IRI values that reflect excellent equipment and good collection/processing methods. Many of the runs completed at one site on the same day overlay each other exceptionally well, giving the appearance of a single profile line. IRI values exhibit a steady increase in roughness between consecutive visits for many test sections. However, during the profile review, several types of questionable profile characteristics also became evident, including the following:

- Unnoted equipment-related saturation spikes.
- Partial and complete lost lock.

- Incorrect start location.
- Wrong (unknown) test location.
- Miscalibrated Distance Measuring Instrument (DMI).

Descriptions and illustrations of these questionable characteristics are provided in Appendix A. Many of these characteristics were described by RCOC profiler operators and data reviewers in the comments listed in the IMS MON_PROFILE_MASTER table, but others do not appear to have been noted during field data collection or final evaluation.

Saturation Spikes

Saturation spikes occur as an excess of light is returned to the Profilometer optical sensors, generally as reflections from the transverse pavement stripes used to mark the beginning and end of each test section. This typically results in profiles that increase in amplitude from 5 to 75 mm or more at the location of the spike. Such spikes can be flagged using the LTPP ProQual software so that they are not included in the IRI calculations. However, the spikes in the older version (ProQual 1.4) were still included in computation of the other smoothness indices.

All saturation spikes were identified and recorded in the visual review. These included both those originally edited by RCOC engineers and those identified under the current review. The presence of edited spikes was determined from an August 1998 download from the IMS database. Saturation spikes unnoted during the original review accounted for 4.9, 6.6, 1.6, and 1.6 percent (average 3.8 percent) of the site visit data in the North Atlantic, North Central, Southern, and Western Region profiles, respectively. Saturation spikes in section visit profiles were 1.8 to 11.5 times (averaging 5.2 times) more common in the left sensor than in the right for all regions.

Lost Lock

Lost lock occurs when insufficient light is returning to the optical sensors. As a result, the profile contains only information provided by the accelerometers. The resulting profile is typically very smooth for compete lost lock and choppy when lost lock is intermittent.

Significant lost lock was noted in profiles from about 3.9 percent of site visits. Rapidly intermittent lost lock accounts for about 51 percent of the noted lost lock, and occasionally intermittent or full lost lock makes up the rest. It is possible that the regular short wavelength chatter noted as rapidly intermittent lost lock could, in some cases, be the result of a loose mirror in the optical receiver or other system noise.

Regional Profilometers varied in the sensor that exhibits the most lost lock. The North Atlantic, North Central, and Western Region Profilometers were 1.2 to 2.9 times more likely to exhibit lost lock characteristics on the right sensor, while the Southern Region Profilometer had 5.3 times more lost lock on the left sensor. Lost lock characteristics were most prominent in the North Atlantic Region's Profilometer, with 8.2 percent of its profile runs indicating significant lost lock.

There appears to have been a shift in the North Atlantic Profilometer from primarily producing lost lock in the left sensor to doing so in the right sensor around September 1994. Prior to that date, lost lock was identified in the left sensor 5.7 times more than in the right sensor. Subsequent to that date, right sensor lost lock was 8.3 times more common. This shift was noted by the RCOC, and attempts to identify and remedy the problem were taken with only limited success.

Incorrect Start Location

Occasionally, the profiles for individual runs or for a single date do not begin at the same location as the remaining test dates. This has been noted as a "shifted profile start."

Profile runs where the start location was incorrect but the spatial relation to the true start location is known are identified in the shifted start categories listed in table 3 and in Appendix G. Shifted starts, or profile runs shifted more than 5 m, are most common in the North Central (4.9 percent) and Western (7.2 percent) Regions. The estimated range of shifted profile distances in the Western Region is 5 to 53 m, with an average distance of 11 m. Western Region GPS section profile shifts averaged 33 m, and SPS sections with shifts averaged 35 m. The average GPS and SPS profile shifts for the North Central Region, where present, are 21 and 441 m, respectively. Shifted profiles for the remaining regions are evident in less than 1.2 percent of section visit profile runs.

Wrong Test Location

Several profiles in the IMS database for a single date or for consecutive dates do not match those of previous dates for the same test section. It is evident that they were collected in an unknown location different from the true section location, and they are categorized as such.

Profiles identified as being in the wrong location are different from those identified as having a shifted start location because the offset from the true section location is unknown. If the reviewers had exact knowledge of a shift in profile location, the runs were identified as being in the shifted start category. The majority of these "wrong location" runs occurred in the North Central Region, accounting for 1.2 percent of the IMS database.

Miscalibrated DMI

A miscalibrated DMI affects profiles by including too little or too much profile data in a section profile. Occasions where the DMI appears to be miscalibrated more than 1.5 m in 152.4 m have been noted.

Miscalibration of the DMI was only found to be a significant problem in the North Central Region's profiles, with 3.1 percent of the profile runs being off by 6 to 8 m. All of these runs were completed in May 1990, April 1995, or June 1995. This indicated that an equipment problem was experienced, the calibration period was too infrequent, or the calibration test section was inadequate at those times.

Out of Study

Correspondence with RCOC personnel regarding unaccounted-for changes in section profiles between visits has identified several profiles in the IMS database that were collected after the section was declared "out of study." This is possible because test section removal from the LTPP study may occur several years after section rehabilitation, after additional profile collection and database entry have been completed.

Summary tables listing the noted characteristics related to equipment or operator problems are shown in Appendixes E through L of this report. Tables 1, 2, and 3 list the number of LTPP test section profile runs exhibiting each of these critical problems.

Table 1. Reparable profile runs in the LTPP database

Region	Total runs	RCOC noted spikes	Additional spikes	Total reparable
North Atlantic	10,011	96	486	582
North Central	14,604	185	970	1,155
Southern	10,693	0	171	171
Western	11,766	22	183	205
Total	47,074	303	1,810	2,113

Table 2. Irreparable profile runs in the LTPP database.

Region	Total runs	Lost lock	Out of study	Total irreparable
North Atlantic	10,011	821	100	921
North Central	14,604	382	70	452
Southern	10,693	542	10	552
Western	11,766	83	30	113
Total	47,074	1,828	210	2,038

Table 3. Pending profile runs in the LTPP database.

Region	Total runs	Shifted start (>10 m)	Shifted start (5-10 m)	Miscalib-rated DMI	Wrong location	Total pending
North Atlantic	10,011	105	13	0	48	166
North Central	14,604	534	188	455	366	1,543
Southern	10,693	36	7	0	9	52
Western	11,766	287	558	0	156	1,001
Total	47,074	962	766	455	579	2,762

Other Sources of Data Variability

Typically, for a single date, the five profiles from a wheelpath overlaid well for all regions. Poor profile repeatability was noted in about 10 and 30 percent of the GPS and SPS section visit profiles, respectively. It was defined as a difference in elevation for repeated runs of more than 3 mm over at least 30 percent of the test section length. Differences in the location of the measured wheelpath and equipment limitations can contribute to this vertical variability. Overall, it was identified in about 22 percent of the IMS section visit profiles. However, the variability seems to have had very little effect on IRI values and was not included in the profile problems slated for repair or deletion.

A significant amount of the noted vertical profile variations occurred in profiles collected using the new T-6600 Profilometer. Visual review of profiles collected using the 690DNC and the T-6600 indicate that good profile repeatability is more commonly obtained using the old 690DNC system.

Although not a profile problem, unreported rehabilitation noted in the review was confirmed with RCOC's in an effort to update IMS construction information. Only 115 profile runs (0.2 percent) were identified as being on a rehabilitated pavement for which the IMS construction number had not been incremented.

Summary

In summary, about 14.6 percent of the IMS profile run data exhibit equipment- or operator-related problems. Many of these profiles could be adequately repaired and replaced. The status of others is pending, requiring additional review of the available profile archives. About 4.3 percent of the IMS profile runs exhibit irreparable effects of equipment or operator problems, most notably lost lock. Table 4 categorizes these profile problems.

Table 4. Status of runs with equipment/operator problems.

Region	All problems, %	Repairable, %	Irreparable, %	Pending, %
North Atlantic	16.6	5.8	9.2	1.7
North Central	21.4	7.9	3.1	10.6
Southern	7.2	1.6	5.2	0.5
Western	11.1	1.7	1.0	8.5
All regions	14.6	4.5	4.3	5.9

Many of these questionable data were not easily identified using the quality control software and methods available at the time of collection. There was no ability to overlay profiles from a single date, nor was there an option to overlay profiles from different visit dates. Without these options, regional engineers had a limited ability to identify lost lock, spikes, early starts, and different profiles. As a result, this review is, in essence, a supplemental quality review rather than a judgment of regional data collection operations.

CHAPTER 3. PROFILE DATA QUALITY UPGRADE

To repair, replace, or delete the identified problem profile runs, the Action Plan summarized in Appendix B was developed. This plan defines criteria for acceptance and rejection of profile data. It also details the steps necessary for addressing profiles that fall within the repairable, irreparable, and pending categories. Table 5 provides an overview of the quality upgrade process and criteria. The methods used and the status of this upgrade are described in this chapter.

Table 5. Categorization of profile problem runs.

Profile problem	Repairable	Irreparable	Pending
Saturation spikes	All runs		
Lost lock		All runs	
Shifted profile (>10 m)	Replacement data available	Replacement data unavailable	Replacement unknown
Shifted profile (5-10 m)	All runs		
Miscalibrated DMI (>10 m)		All runs	
Miscalibrated DMI (5-10 m)	All runs		
Wrong location	Replacement data available	Replacement data unavailable	Replacement unknown
Unnoted rehabilitation	All runs		

Repairable Profiles

Profiles that contain saturation spikes can be repaired using the ProQual Version 2.08a software used in current LTPP profile data processing. This software allows the user to eliminate the saturation spikes from the profiles during computation of smoothness indices. As a result, computed IRI values from these reprocessed profiles can be very accurate, since only one or two data points are eliminated from the profile.

Profiles that do not begin at the correct location can also be reprocessed, using the ProQual software, when replacement data are available. Initially, all profile runs shifted more than 10 m were deleted from the IMS and reloaded if reprocessed profiles collected in the correct location were available. If profiles shifted 5 to 10 m had no available replacement data, or if the DMI was miscalibrated 5 to 10 m, the IMS profile data were extracted, comments were added, the Regional Coordination Office (RCO) quality code was reduced to 2, and the IMS profile data were reloaded.

Profiles collected at an unknown, wrong location were repaired if correct replacement data were available. For this evaluation, all such profile runs will be deleted from the analysis data set.

Unreported rehabilitation is not related to problems with the profile collection operations. However, since its identification was facilitated by the visual review of profiles, it is reported in this evaluation. Repair of this problem requires that the RCO obtain the necessary information

and forms from a State or Province to incorporate the maintenance/rehabilitation informationinto the IMS database.

All profiles listed in Appendix E containing saturation spikes have been extracted from the IMS database and reprocessed without the spikes. The Profile Extractor software, described in Appendix D, was used to extract profile data and convert them to a form that can be used by the ProQual Version 2.08a software. Replacement IMS upload files, archive files, and appropriate paper files have been compiled for distribution to the RCOC's for IMS upload.

Lists of shifted profile sections, those with miscalibrated DMI values, and profiles collected in an unknown location were submitted to the Federal Highway Administration (FHWA) on February 27, 1999, for distribution to RCOC's. RCOC's were asked to replace all saturation spike profile data and, if possible, to review and replace all shifted or unknown location profiles. The RCOC's have replaced profile data for many of the shifted profiles. Profiles with miscalibrated DMI values for the North Central Region have been extracted and appropriate comments added.

Irreparable Profiles

Because of the loss or distortion of profile data input that accompanies lost lock, most such profiles are irreparable. It is possible that profiles that include rapidly intermittent lost lock could be filtered to remove those data with only a small effect on IRI. However, such efforts are not tested or have not proven to be reliable. The option of reducing the quality rating of profiles exhibiting lost lock was considered and dismissed, and in the interest of preserving database integrity, all profiles exhibiting lost lock effects have been deleted from the IMS database.

Profiles that were collected in the wrong location and profiles shifted more than 10 m, for which accurate replacement data are unavailable, are also considered irreparable. Currently, only a few such data sets have been identified, and they have been deleted from the IMS database.

Irreparable profiles in the IMS database and regional databases were deleted in stages. Initially, all profile runs exhibiting lost lock and runs that were collected in the wrong location with no available replacement data were deleted. Lists of confirmed irreparable profile runs were distributed to RCOC's in early March 1999 for deletion from the Regional Information Management System (RIMS) database. As RCOC's identified additional profile runs for which replacement data were unavailable, these were also deleted.

Pending Profiles

Although shifted profiles and profiles tested in the wrong location have been identified under this research, RCOC's were required to search their archive files to determine if accurate data were available to replace these runs. For many GPS and all SPS sections, profiles for an entire test site (which includes several test sections) were collected. In addition to the test section profiles, regional archives contain profile data collected between test sections. This sometimes contained replacement profile information for the true test site location that could be resectioned and reprocessed to replace shifted profile data with profiles from the correct location.

All profiles shifted more than 10 m were deleted from the IMS. If replacement data were prepared by the RCOC's for shifted profiles, they were reloaded into the IMS as they became available. Runs with profiles shifted between 5 and 10 m, where replacement data were unavailable, were extracted from the IMS, a comment was added, and the RCO quality code was reduced to 2. Again, lists of pending profile runs were sent to the RCOC's for review, and response and replacement were completed by September 1999.

Effect of Profile Data Upgrade

Currently, the data upgrade has consisted of reprocessing and reloading to the IMS database of 2,128 runs containing equipment-related spikes and deletion of 1,110 runs with lost lock, tested in the wrong location, or shifted more than 10 m. The effect of this upgrade on data quality can be quantified by comparing the data variability and the data trends before and after the upgrade.

IRI Variability

LTPP profiles are typically collected in at least five consecutive runs. The Profilometers measure surface elevations and compute IRI for the left wheelpath (LWP) and right wheelpath (RWP). An IRI for both wheelpaths (BWP) is computed as the average of the two wheelpaths. BWP IRI standard deviations of the five runs in the IMS database following the upgrade decreased 7.6 percent overall. It was assumed that reduced variability resulted from elimination of the large IRI variations associated with saturation spikes and lost lock. The coefficient of variation (COV), or percentage ratio of standard deviation to mean, also improved. A COV of 2 percent is generally considered representative of good repeatable data. The number of sections with COV values greater than 2 percent decreased by 2.8 percent with a corresponding increase in sections with COV values less than 2 percent. Figure 1 shows this effect for each wheelpath.

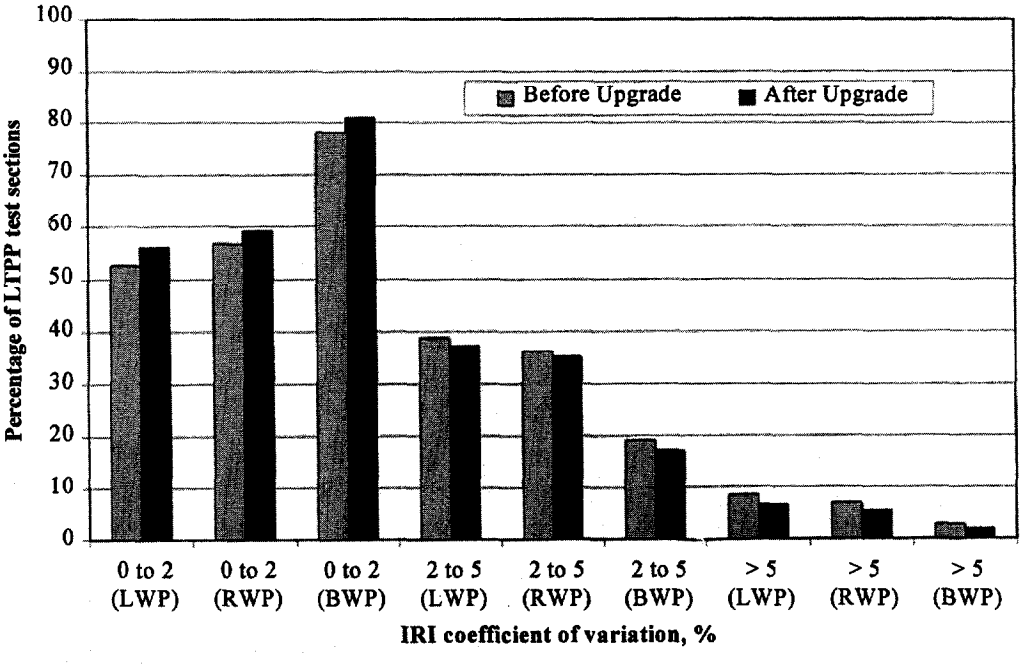


Figure 1. Effect of upgrade on IRI variability.

IRI Slope

The slope over time of the mean IRI for each wheelpath of unrehabilitated sections was also used to identify questionable IRI values and to quantify the effect of the data upgrade. The IRI slope is defined as the rate of change in average IRI across all visits. A steadily increasing rate is expected as pavement deterioration progresses. Seasonal, daily, and other testing variability can result in this rate, or change in IRI over time, being zero or less than zero. Testing in the wrong location, saturation spikes, lost lock, unreported rehabilitation, and shifted starts can also significantly change the slope, making analysis of the performance trends difficult. Prior to the data upgrade, 21.7 percent of the unrehabilitated sections having two or more visits exhibited average IRI slopes of less than zero. Following the upgrade, the improvement resulting from the data upgrade is evident, as only 15.8 percent of the sections have average IRI slopes of less than zero (see figure 2). Summaries of IRI data slopes for each region are provided in table 6. The North Atlantic Region exhibited the greatest percentage of sections with slopes of less than zero, and the Western Region has the least.

Table 6. Effect of upgrade on average IRI slope values.

Region	Percentage of sections with an IRI slope < 0	
	Before upgrade	After upgrade
North Atlantic	25.1	16.7
North Central	21.1	15.6
Southern	23.1	15.2
Western	18.5	15.9

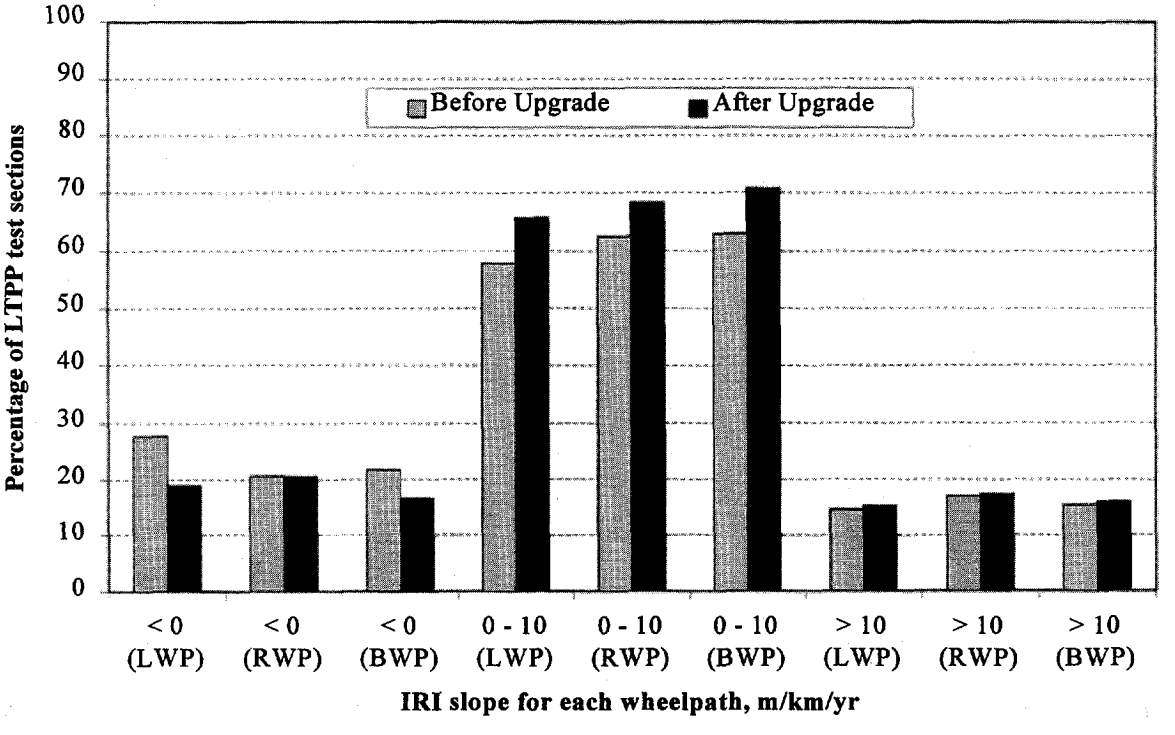


Figure 2. Effect of upgrade on IRI slopes.

CHAPTER 4. RUN-TO-RUN VARIABILITY

One main objective of this study is to identify confidence limits for IRI variability between repeated runs using Profilometer data from the LTPP database. To develop these limits, the variability of the IRI data in the database was defined. In addition, the effects of pavement type, equipment, pavement roughness, and other variables were studied. Using this variability information, effective IRI confidence limits were developed.

IRI variability was determined in three steps. First, outliers were identified using run-to-run IRI comparisons, visit-to-visit IRI trends, and visual review of profile data. If the causes of these outliers were anything other than pavement variability, they were removed from the data set. Next, using the upgraded IRI data, the run-to-run variability was identified using statistical analysis methods, data processing analysis, and field testing. Finally, confidence limits for expected variation in future profile data collection were developed. Each of these steps is described in this chapter, along with a summary of general statistics.

General Statistical Summary

The general statistical results of the variability analysis provide valuable information. COV values from visits with two or more runs in the updated data set for COV ranged from 0.0 to 32.3 percent, with mean left, right, and average IRI COV's of 2.3, 2.2, and 1.5 percent, respectively — indicative of generally good repeatable measurements. Figure 3 indicates the distribution of COV's for each wheelpath. Because the IRI from both wheelpaths is the average of the left and right wheelpath IRI's, variability is much less for the "both wheelpaths" values.

Shown in figure 4 are cumulative summaries of these COV values. About 60 percent of the left and right wheelpath IRI COV's are less than 2 percent, and more than 80 percent of the COV's for the IRI average of the two wheelpaths are less than the 2 percent currently recommended as a quality check in LTPP Directive P-6. Both wheelpath IRI COV values fall below 3.5 percent in 95 percent of the database. At least 95 percent of the left wheelpath IRI COV values are less than 5.5 percent, and about 95 percent of the right wheelpath IRI COV values are less than 5.2 percent. Figure 4 shows slightly more variation in the IRI values from the right wheelpath. This may merely illustrate the tendency of roadways to deteriorate more rapidly near the outside shoulders.

Some regional differences in run-to-run, single-visit IRI variability in terms of COV can be seen in figure 5. The North Atlantic, North Central, and Southern Region IRI data exhibit very similar ranges of COV values, with more than 80 percent of average IRI COV values being less than 2 percent. However, additional variability in the Western Region has kept the percentage of BWP IRI COV values that are less than 2 percent to only 66 percent of the data. This has resulted in more section visit data exhibiting COV values greater than 2 percent.

Visual review of the majority of the run-to-run profiles from the Western Region indicated more vertical variation, or differences in profile traces of consecutive runs. As a result, the profile runs from a single date do not typically overlay each other as well as in other regions, with a

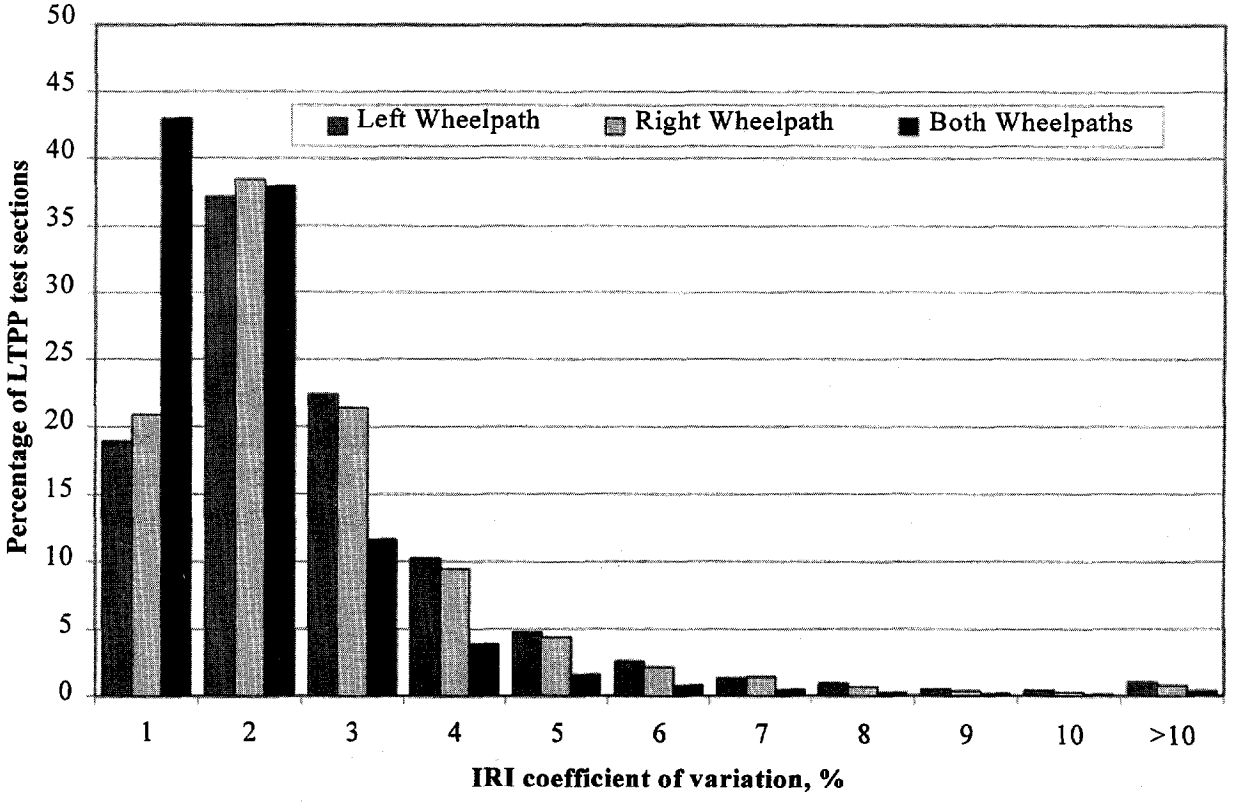


Figure 3. Histogram of IRI coefficients of variation.

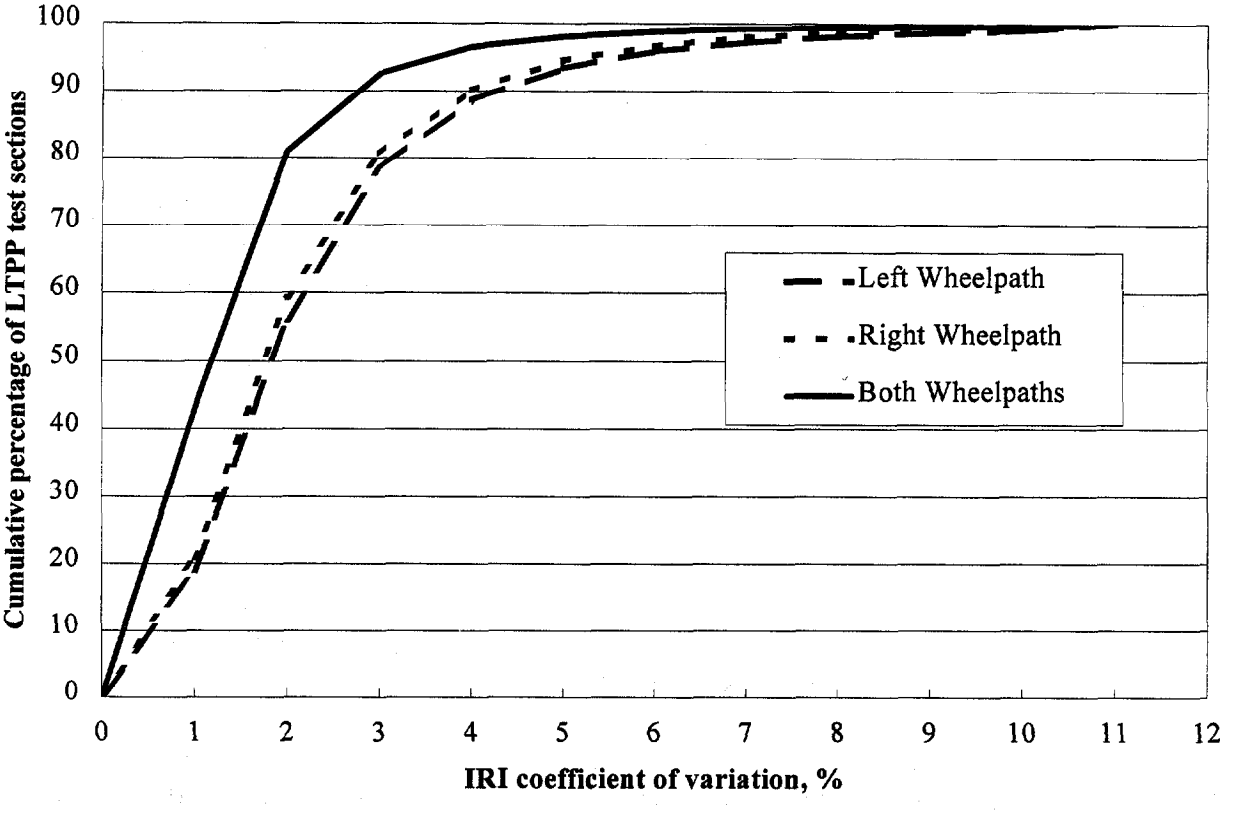


Figure 4. Cumulative IRI COVs for LTPP database.

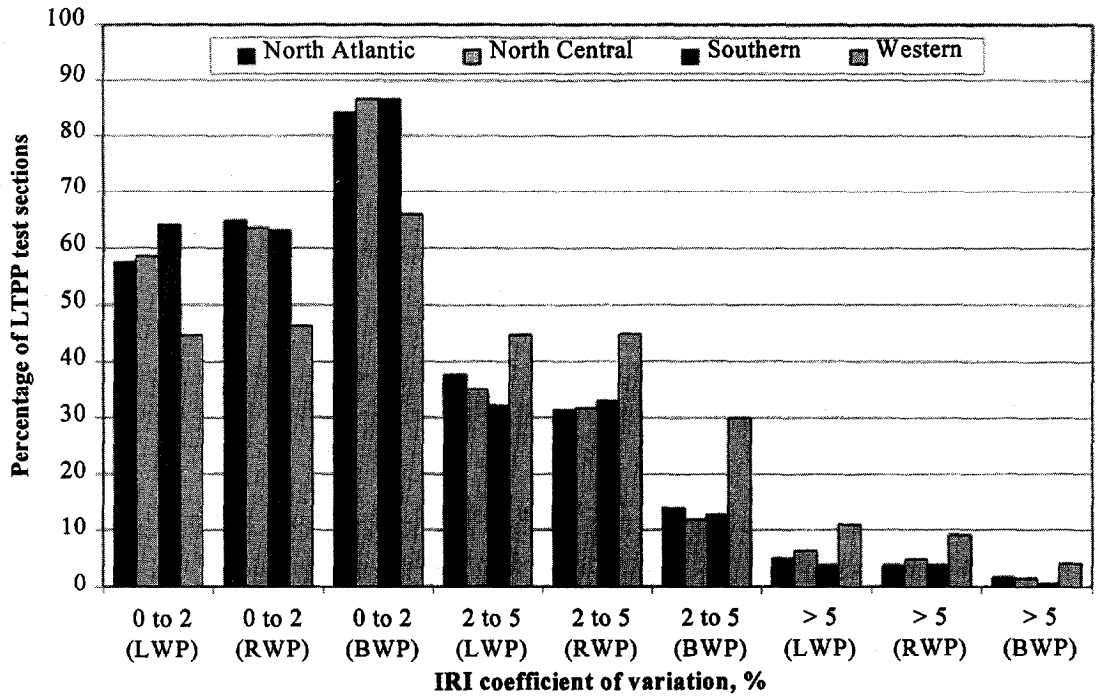


Figure 5. Regional run-to-run variability.

subsequent increase in run-to-run IRI variability. This vertical variability is sometimes attributed to a large amount of transverse pavement profile variability, variations in the collection wheelpaths, or profile collection equipment problems. Because the variability appears to be unrelated to the operator, and since the average roughness of the Western Region pavement sections is not different from other regions, it is possible that slight Profilometer equipment problems led to the additional run-to-run variability.

Also, profile runs for the SPS sections in the Western Region are shifted longitudinally from each other much more frequently than profiles from other regions. This shifting is reportedly attributable to problems with the Profilometer DMI that the Western Region Contractor worked at repairing throughout much of the data collection period.

Design of Analysis

To identify confidence limits for the collection of LTPP IRI data, a clean data set was prepared. The upgraded IRI database used in this analysis was modified from the original 1997 IMS database by deleting all runs exhibiting saturation spikes and replacing them with reprocessed data files. Also, all runs affected by lost lock, tested in the wrong location, or shifted more than 10 m from the true start location were excluded. No replacement data were available at the time of analysis for shifted runs that had been reprocessed in the correct location.

Observed interactions between roughness level and IRI standard deviation were then eliminated through data transformation, and the data were converted to a normal form. Analysis of variance

was conducted using 10 fixed variables and 3 random effects. Several significant effects of these variables were observed and quantified using these models.

Data Transformation

Plots generated for the mean IRI versus the run-to-run standard deviation indicate that, as mean IRI increased, the standard deviation increased. This trend is shown in figure 6 for the GPS data. An average increase in standard deviation of 0.008 m/km for each 1 m/km change in IRI was noted for the GPS data, and an average increase of 0.013 m/km was observed for the SPS data. The increased variation at SPS sites is probably due to the difficulty encountered in maintaining the correct wheelpath on rougher sections over the longer distances required for SPS data collection.

Profilometer operators have reported this trend and its effect on quality control operations for many years. The past and current *LTPP Manual for Profile Measurements*[1-3] require Profilometer operators to more closely check profiles when the COV is greater than 2 percent. As a result of this trend, the COV was used instead of standard deviation (SD) for quality control (QC) for run-to-run IRI data. COV values exceed the 2 percent QC limit more frequently for smooth pavements than for rougher pavements. This can result in excessive review of smooth pavement profiles and possible insufficient review of rough pavement profiles.

To provide Profilometer operators with a QC statistic that is not affected by pavement roughness level, transform equations were developed. The IRI data were transformed using Box-Cox transformations with different powers for left, right, and average wheelpath data on GPS and SPS sections.

Iterative analysis was used to determine the powers λ_a, λ_l, and λ_r such that the slope of the regression of the mean and SD of the transformed variables was as close to zero as possible. Variables used in the analysis were the transformed average wheelpath IRI (tr_IRI_a), the transformed left wheelpath IRI (tr_IRI_l), and the transformed right wheelpath IRI (tr_IRI_r). Powers computed for the transformations are:

GPS: $\lambda_a = 0.38075$; $\lambda_l = 0.24665$; $\lambda_r = 0.2998$

SPS: $\lambda_a = 0.11535$; $\lambda_l = 0.08975$; $\lambda_r = 0.08715$

Each of the variables was transformed according to the following equations:

$$tr\_IRI\_a = \frac{IRI^{\lambda_a - 1}}{\lambda_a (geoIRI)^{\lambda_a - 1}} \quad (1)$$

$$tr\_IRI\_l = \frac{IRI^{\lambda_l - 1}}{\lambda_l (geoIRI)^{\lambda_l - 1}} \quad (2)$$

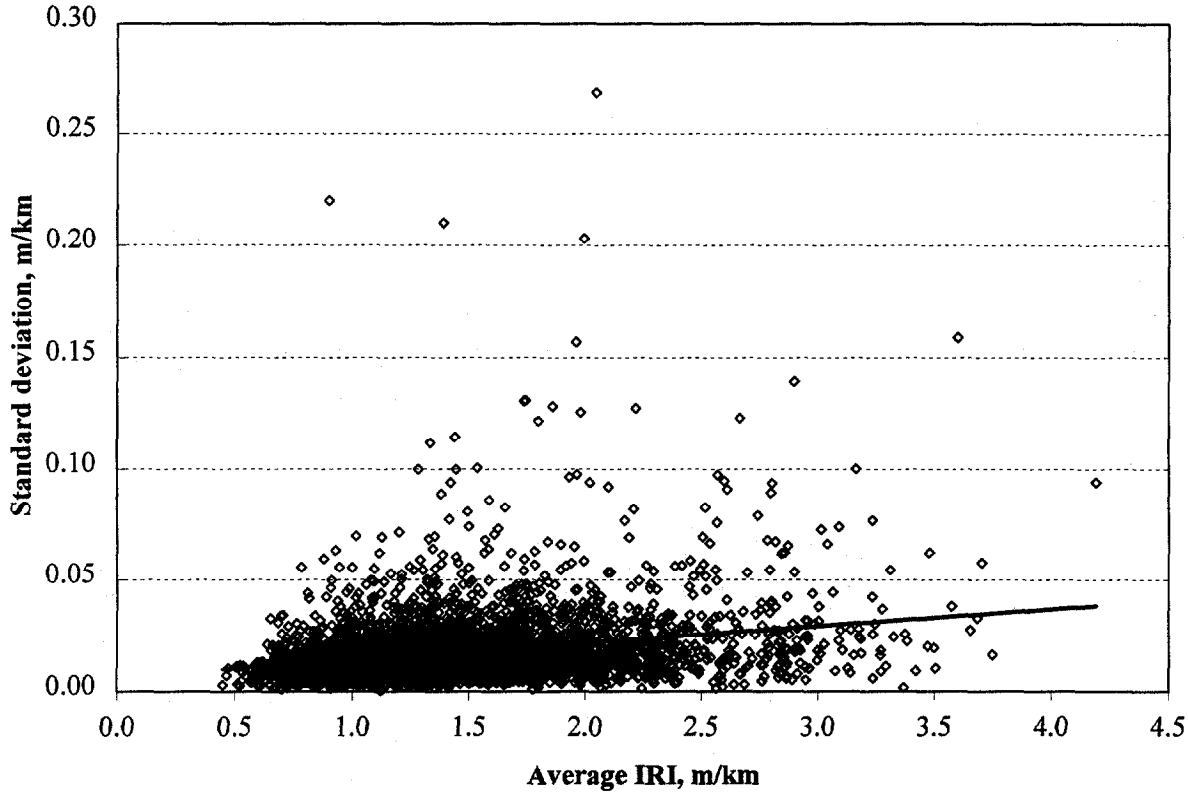


Figure 6. Relationship of IRI with standard deviation of IRI.

$$tr\_IRI\_r = \frac{IRI^{\lambda_r - 1}}{\lambda_r (geoIRI)^{\lambda_r - 1}} \tag{3}$$

Where geoIRI is the geometric mean of the IRIs and N is the number of observations:

$$geoIRI = e^{\frac{\sum \log IRI}{N}} \tag{4}$$

Even though the section type and wheelpath standard deviations are calculated from different Box-Cox transformations, these are designed to keep the resulting variables comparable. The results are typified by the relationship for average IRI of GPS sections shown in figure 7. The slope of the linear relationship for these data is 0.00005, showing no effect on standard deviation from the roughness level.

Although these transformed data can be used for quality control, histograms of the standard deviations of the transformed IRI values indicated a significant skew in the data. To allow for proper analysis of variance, the transformed IRI standard deviation data were modified with a natural log (*ln*) function to achieve a normal relationship between frequency and *ln* of the

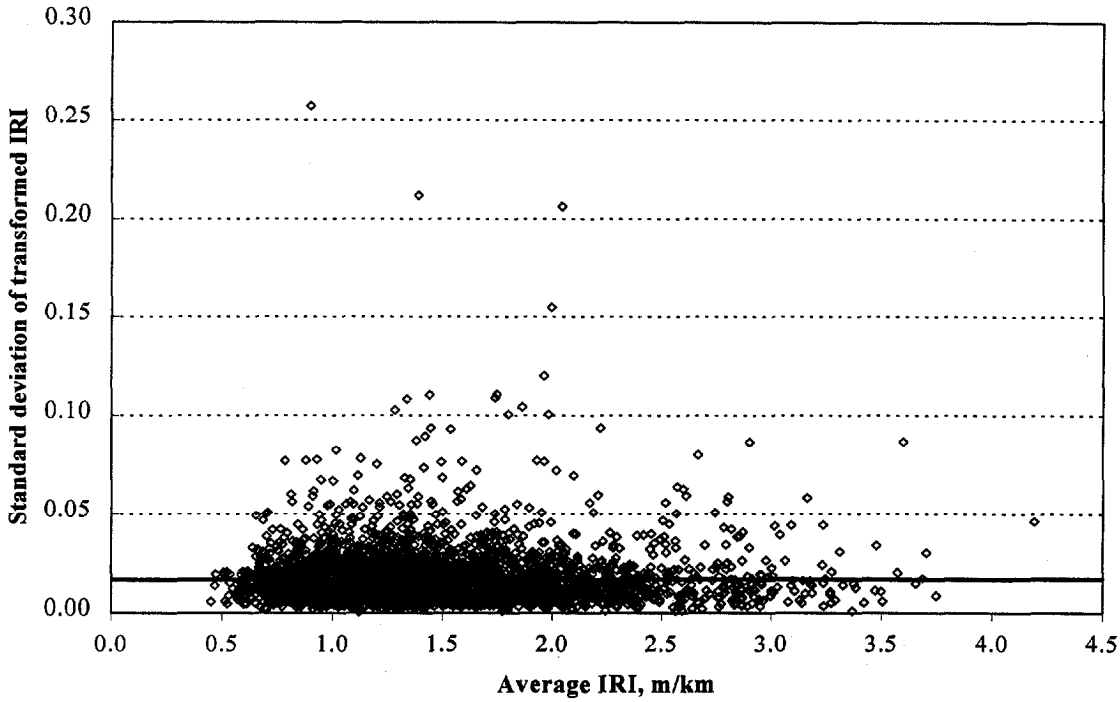


Figure 7. Transformed GPS IRI versus standard deviation.

transformed IRI standard deviation. A progression of histograms for the original, transformed, and normalized standard deviation data is shown in figures 8, 9, and 10, respectively. These normalized standard deviation data were used in the analysis of the run-to-run and visit-to-visit IRI data for this variability review.

Run-to-Run Analysis Models

The analysis of the normalized transformed IRI standard deviation data from the upgraded data set was conducted using the SAS PROC mixed utility. Random variables used in the analysis included the State, Strategic Highway Research Program (SHRP) ID, and profiler driver. Fixed variables initially included in the analysis are:

- Pavement type (AC [asphalt concrete], PC [portland cement concrete], APC [AC overlay of PC]).
- Pavement structure (AC, AC/AC, AC/PC, PC, PC/PC).
- Testing time (3 a.m. to 8 a.m., 8 a.m. to 6 p.m., and 6 p.m. to 3 a.m.).
- Season (winter, spring, summer, fall).
- Region (North Atlantic, North Central, Southern, Western).
- Equipment type (690DNC, T-6600).
- Start method (photocell, manual pendant).
- Roughness level, m/km (low [0 to 1.11], medium [1.11 to 1.56], high [>1.56]).

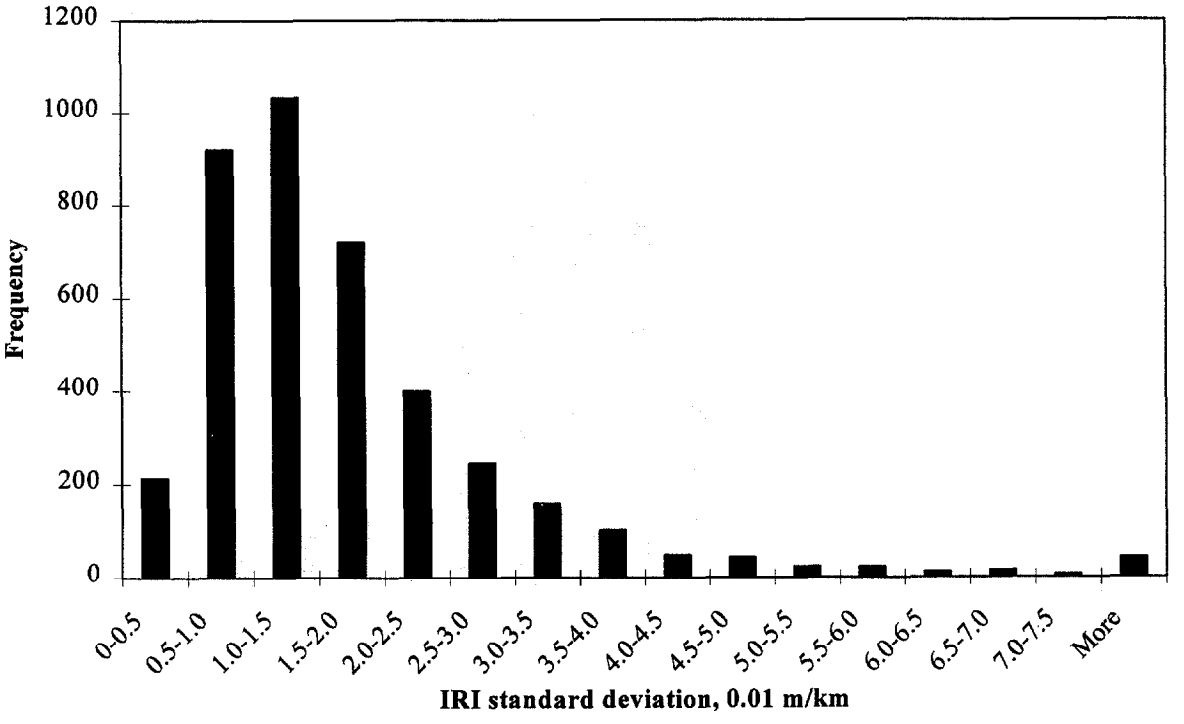


Figure 8. Histogram of GPS IRI standard deviations.

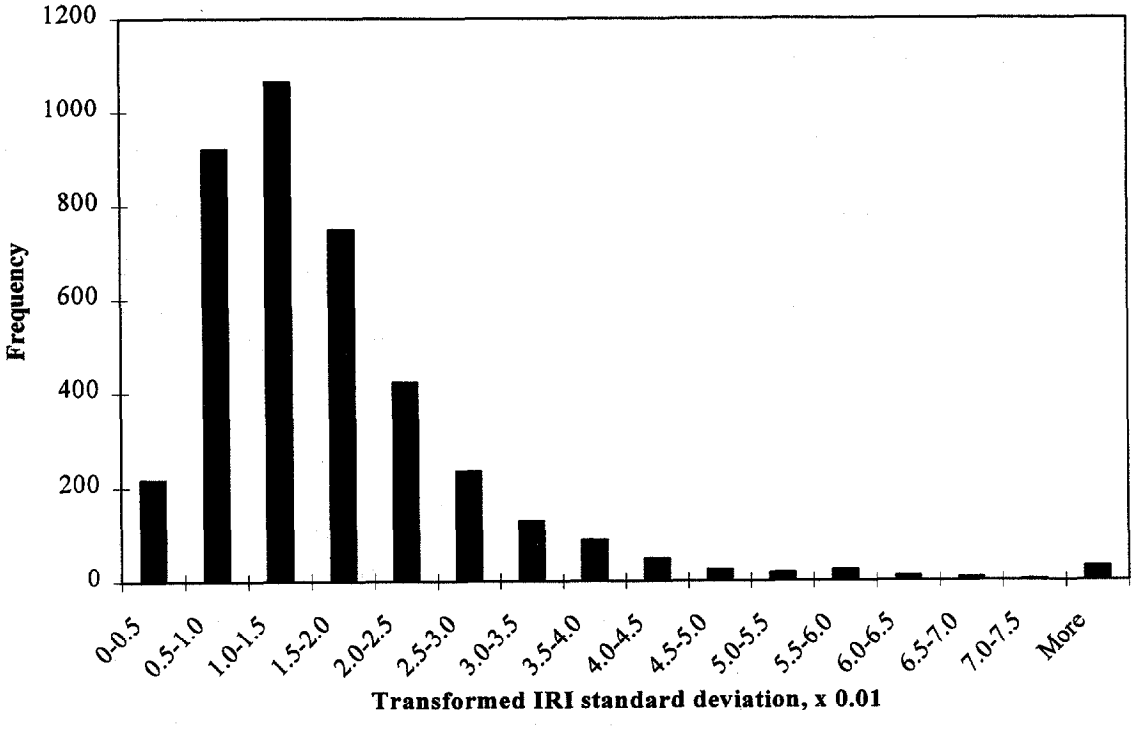


Figure 9. Histogram of GPS transformed IRI standard deviation.

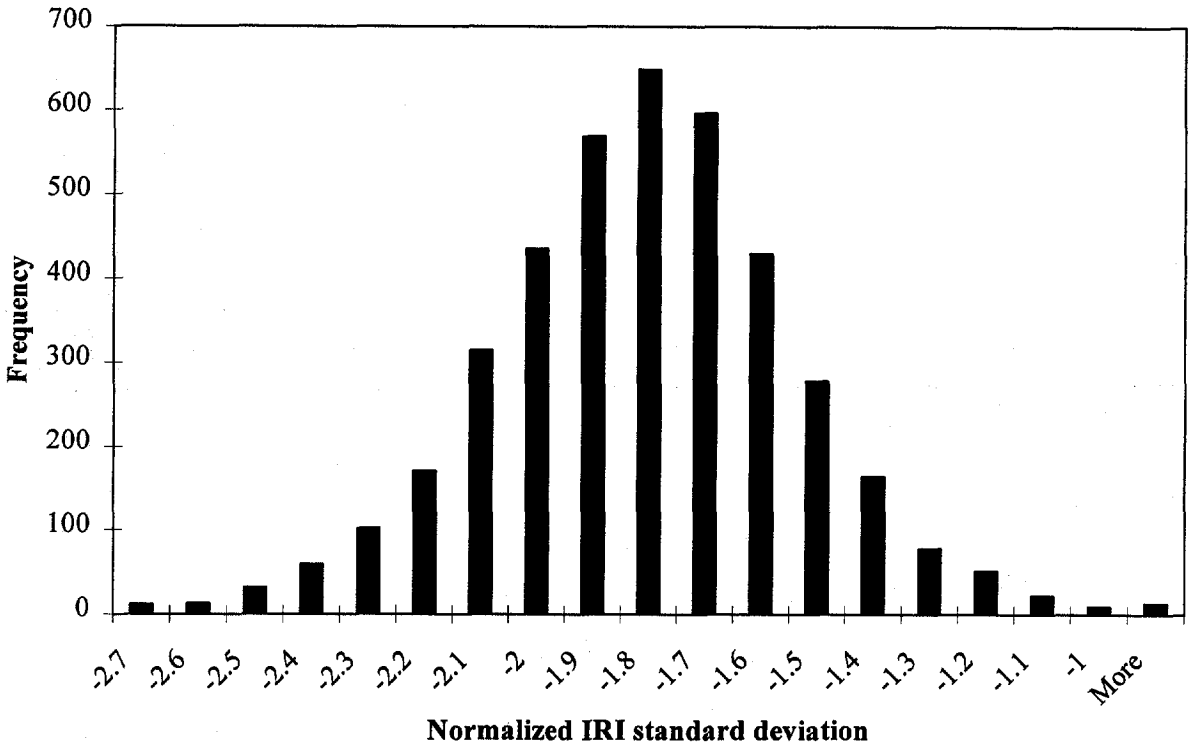


Figure 10. GPS histogram of normalized IRI standard deviation.

- Visit number (1 through 21).
- Construction number (1 through 3).

The statistical models were run initially using main effects and two- and three-factor interactions. The models were then simplified in stages, where appropriate. The resulting final models differed for GPS and SPS road segments. Results of the statistical analysis of GPS and SPS fixed effects are shown in tables 7 and 8, along with the degrees of freedom (DF) and the probability that the hypothesis of equality is true (Pr > F). The Pr > F values indicate, with 95-percent confidence, that there are significant differences in the first four GPS variables and the first eight SPS variables.

Run-to-Run Variability Results

The SPS and GPS model results indicate that differences in standard deviation for several independent variables are significant. In addition, interactions between many of these variables are significant. These independent variables include the pavement type and equipment types in GPS sections and the region, pavement structure, start method, and season for SPS sections. Significant interactions are evident between region and start method, pavement type and roughness level, region and pavement type, and season and roughness level. (All significance statements in this report, unless otherwise noted, were developed using the normalized standard deviation of the IRI for the average of the left and right wheelpaths at a 95-percent confidence level.)

Table 7. GPS statistical model results.

Main variable	Interaction with	DF	Pr > F
Pavement type		2812	0.0001
Pavement type	Roughness level	2812	0.0072
Region	Start method	2812	0.0123
Equipment type in each region		2812	0.0340
Region	Roughness level	2812	0.1641
Region		57	0.1877
Testing time		2812	0.1899
Construction number		2812	0.3169
Season		2812	0.5047
Roughness level		2812	0.6475
Region	Construction number (CN)	2812	0.8189
Start method		2812	0.8557

Table 8. SPS statistical model results.

Main effect	Interaction with	DF	Pr > F
Pavement structure	Pavement type * CN	3026	0.0001
Season		3026	0.0003
Region	Start method	3026	0.0024
Pavement type	Roughness level	3026	0.0061
Region		40	0.0144
Start method		3026	0.0222
Region	Pavement type	3026	0.0226
Pavement structure	Region * Pavement type	3026	0.0373
Season	Roughness level	3026	0.0470
Region	Season	3026	0.0496
Region	Roughness level	3026	0.0511
Pavement type	Season	3026	0.1318
Pavement type		3026	0.1498
Roughness level		3026	0.2750
Equipment type in each region		3026	0.2781
Testing time		3026	0.6428

Effect of Region

For SPS sections, there is a significant difference between regional standard deviations; however, no significant regional difference was found for GPS sections in the overall model. Summaries of the GPS and SPS transformed and normalized standard deviations for each region are shown in figure 11. According to a one-way analysis of variance (ANOVA) with least-squares means,

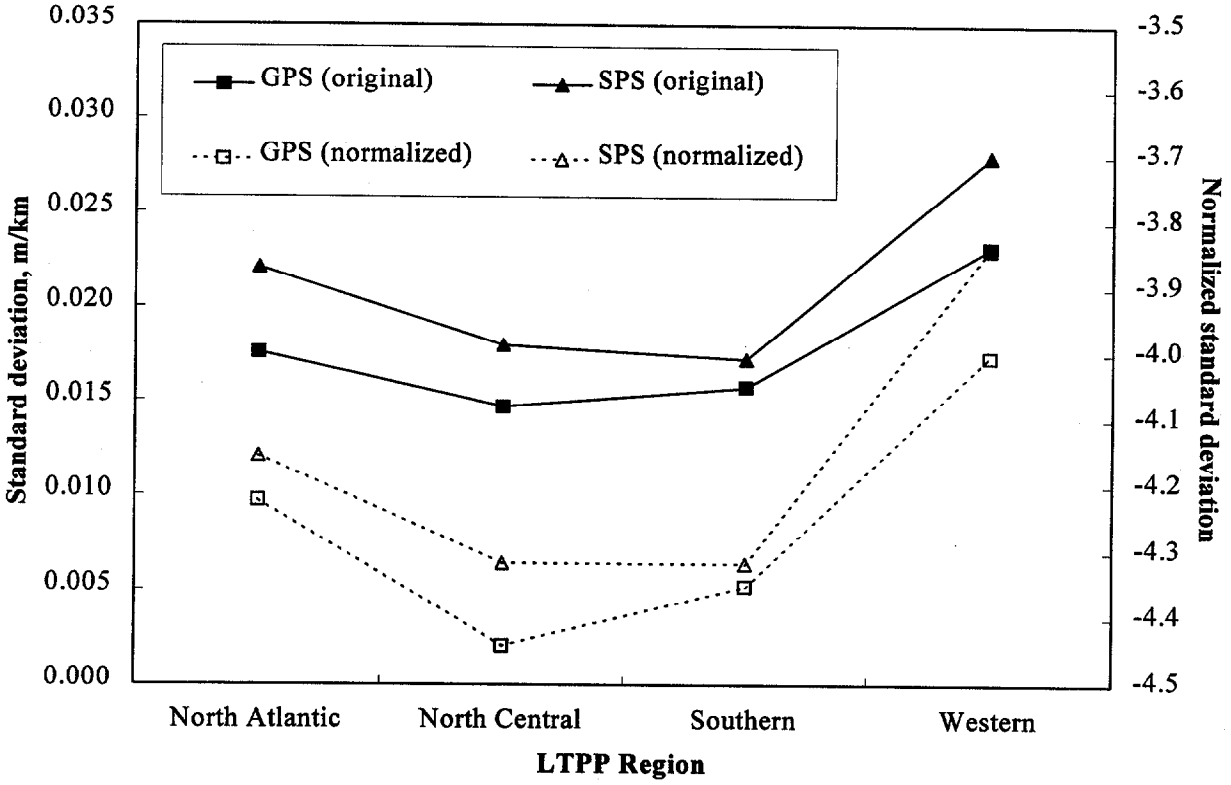


Figure 11. Regional variability for GPS and SPS sections.

the variance of Western Region SPS average IRI values is statistically greater than that of the other regions. The ANOVA is a procedure for using the variation of the components of a set of data to judge whether differences in the sample means are statistically significant. This increase in Western Region IRI values is probably the result of the problems experienced with the DMI on the Western Region's original profiler. Statistically, the least variability was found in the North Central and Southern Regions. Other effects and interactions explain the insignificance of similar trends in the GPS sections.

Effect of Pavement Surface Type

For this analysis, the LTPP pavement sections were divided by surface type into three categories—AC, APC, and PC. Figure 12 shows the variability associated with these surface types in each LTPP region. In GPS sections, the variability associated with AC and APC surfaces is statistically greater than that associated with PC surfaces. Variability for SPS sections is numerically, but not statistically, greater for the AC sections than for the PC sections.

The GPS and SPS interactions between pavement type and roughness level are indicative of the lowest variability in each roughness group occurring in AC pavements. Variances were similar for APC and PC in the low ($0 < IRI < 1.11$) and moderate ($1.11 < IRI \leq 1.56$) roughness groups, but were different for the high ($IRI > 1.56$) roughness group.

Effect of Pavement Material Structure

Information in the IMS database allows each pavement section to also be grouped by pavement material structure into five categories—AC, AC/AC, AC/PC, PC, and PC/PC. In both GPS and SPS sections, no statistical differences in variability were noted for pavement sections in these categories. The reason is illustrated in figures 13 and 14, which show no clear relationship between pavement structure and variability. Across regions for both GPS and SPS sections, the PC structures generally have the lowest IRI variability. Unrehabilitated AC sections have the greatest run-to-run variability in SPS sections, and AC overlays of PC pavements show the most GPS variability.

The SPS interactions noted between pavement material structure and the interaction of region and pavement type are caused by the close relationship between the pavement surface material and pavement material structure variables. Its significance, as well as that of pavement material structure with the interaction of pavement type and construction number, is anticipated, but is not useful for the analysis.

Effect of Equipment Differences

Each RCOC collected profiles from June 1988 to October 1996 using K.J. Law 690DNC optical-sensor Profilometers. In the fall of 1996, these profilers were replaced by K.J. Law T-6600 Profilometers with infrared sensors. The number of GPS and SPS section visits

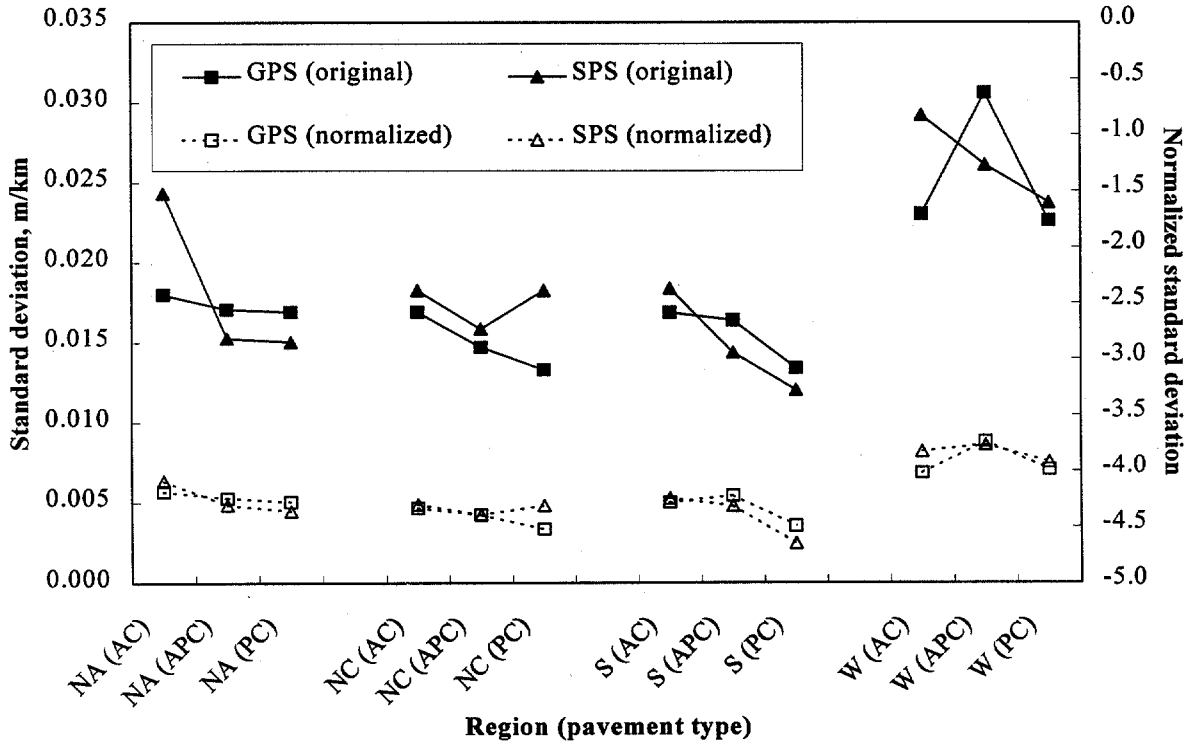


Figure 12. Variation among regional surface types.

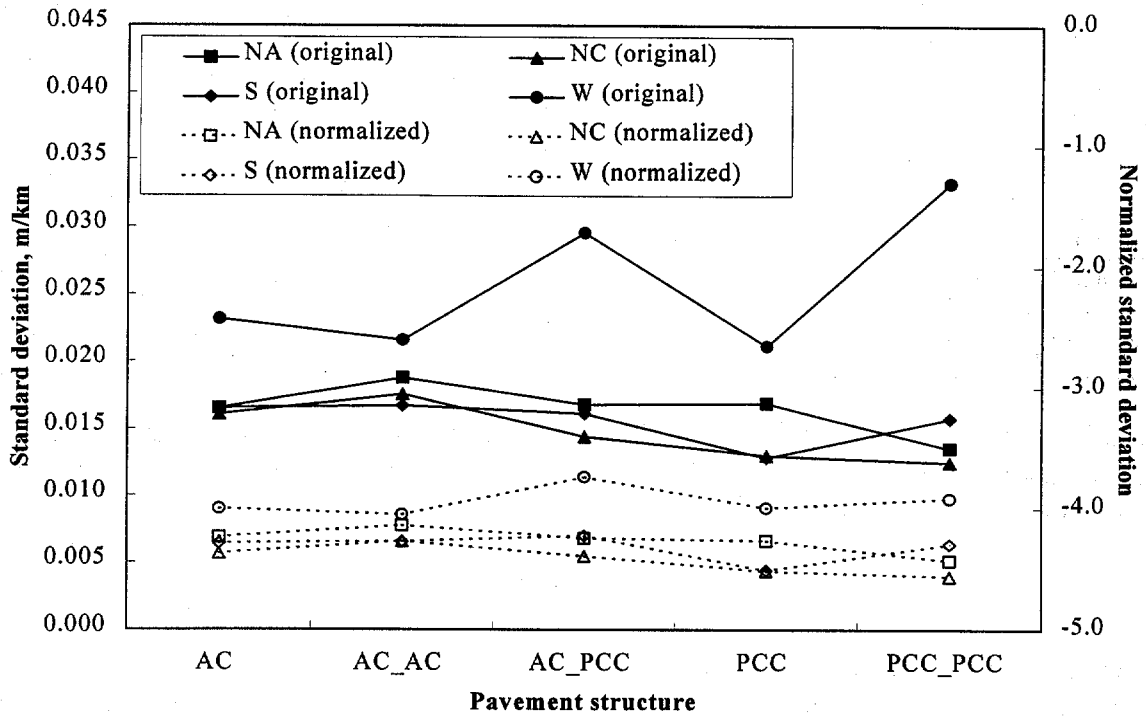


Figure 13. GPS regional IRI variability for pavement material structures.

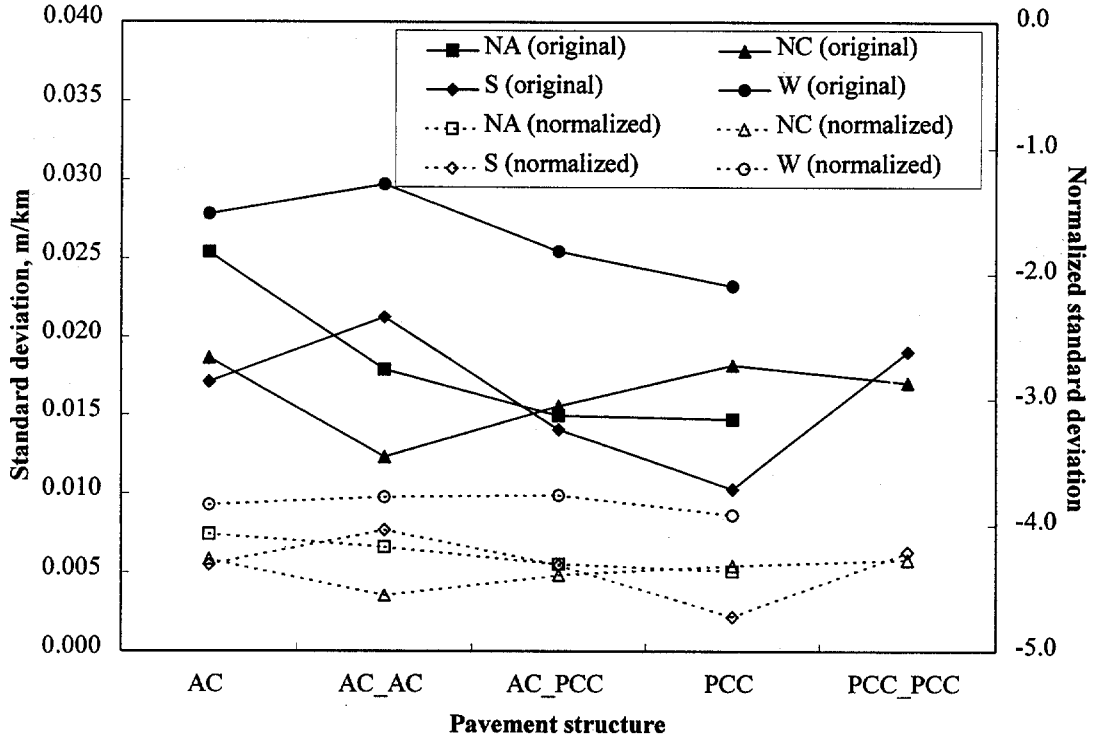


Figure 14. SPS regional IRI variability for pavement material structures.

conducted by each region is shown in table 9. Insufficient data had been collected using the T-6600 profilers in the North Central and Southern Regions to allow for statistical comparison.

Table 9. Section visits using old and new Profilometers.

Region	690DNC visits	T-6600 visits
North Atlantic	1,640	110
North Central	2,673	2
Southern	1,948	8
Western	2,022	121

Figure 15 shows the IRI variability of each piece of equipment from the four regions. The Western Region variability associated with the 78 T-6600 visits at SPS sections was significantly less than that of the 690DNC. This reduction can be related to the improved DMI repeatability in the new profiler. No difference was noted in the North Atlantic Region between equipment types based on 36 T-6600 GPS visits and 74 T-6600 SPS visits.

This equipment comparison was not conducted on results from the tests made using each type of equipment on the same site at the same time. Typically, 1 to 8 years had passed between testing with the 690DNC and the T-6600. Over this time, transverse pavement variability can change at a section, disrupting the direct comparison of variability between equipment type. Acceptance testing of the new T-6600 Profilometers has confirmed the insignificance of the difference in

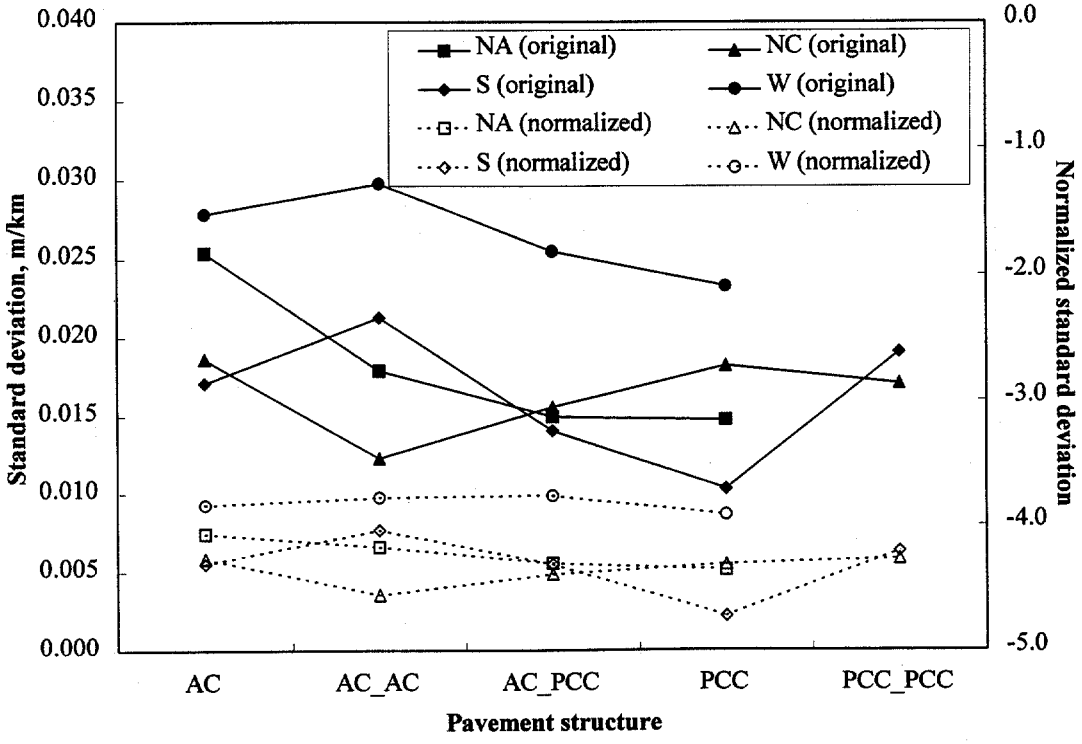


Figure 15. Variability of regional profilers.

IRI output from the two profilers on the same day at the same site. However, additional study of this comparison can be made in future analyses using the additional data collected by the T-6600 to further study similarities or differences in IRI variability.

Effect of Photocell Initiation Method

Both the 690DNC and the T-6600 were fitted with photocells for electronic initiation of data collection, and manual initiation of data collection is not currently allowed. However, between 1989 and 1991, operators collected 41 GPS and 19 SPS data sets in the North Atlantic (0 GPS, 1 SPS), North Central (29 GPS, 3 SPS), and Western (12 GPS, 15 SPS) Regions while the photocells were inoperative. Operators manually triggered the start of data collection for those sections, sometimes resulting in start location differences of more than 6 m between runs. The effect on IRI variability was significant for both GPS and SPS sections for the Western Region and for the GPS sections in the North Central Region.

Figure 16 illustrates these trends. However, because so many more visits were performed using the photocell, these data sets are quite unbalanced and not appropriate for analysis. Western Region SPS sections show the greatest increase in variability related to manual initiation, and GPS sections in the Western Region show the next greatest increase. North Central Region GPS sections show the only other significant variability increase resulting from manual profile initiation. Trends for SPS sections in the North Atlantic and North Central Regions are invalid because only one visit was collected manually in the North Atlantic Region and three were collected in the North Central Region.

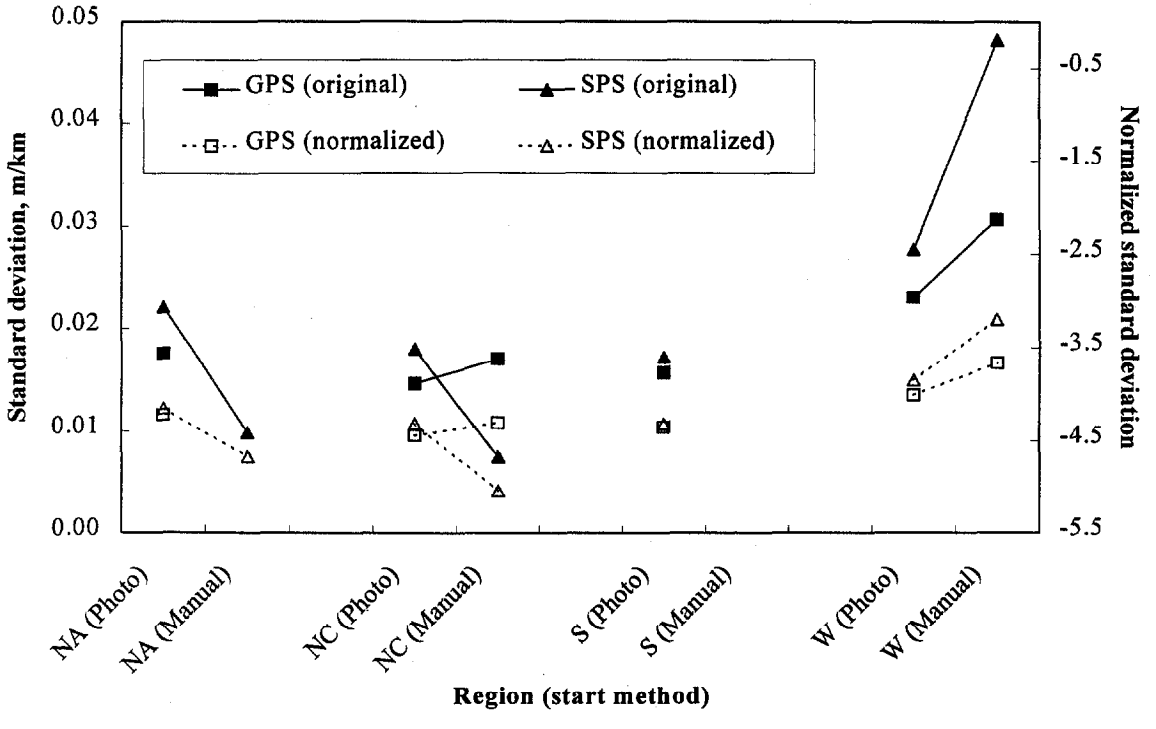


Figure 16. IRI variability from equipment start method.

Effect of Season

Especially in freezing and moist climates, the season of testing could have an important effect on variability because of the effects of pavement swelling and frost heave. Analysis of the seasonal effect was completed by dividing the year into four 3-month seasons. Winter included December, January, and February. Spring included March, April, and May, and so on.

Shown in figure 17 is a summary of the regional variability within each season. Statistically, there is no seasonal difference for GPS and SPS sections in the Southern Region. This is probably the result of not having freezing effects on pavements and base materials. The North Central Region exhibited significant differences between the spring season and the remaining seasons for SPS IRI variability. Spring provided statistically more SPS variability in the North Atlantic Region, and the winter season was more variable than the other seasons for SPS sections in the Western Region.

Overall, the variability was greater in the spring for sections with the highest level of roughness. This trend is possibly the result of a greater effect from frost heave and soil swelling on rougher pavement sections.

Effect of Time of Day

Figures 18 and 19 show the GPS and SPS variability for 10 equal time periods, beginning and ending at midnight. Although there appears to be more variability in the early morning and evening hours, this is the result of having large amounts of data in the mid-day fields and very

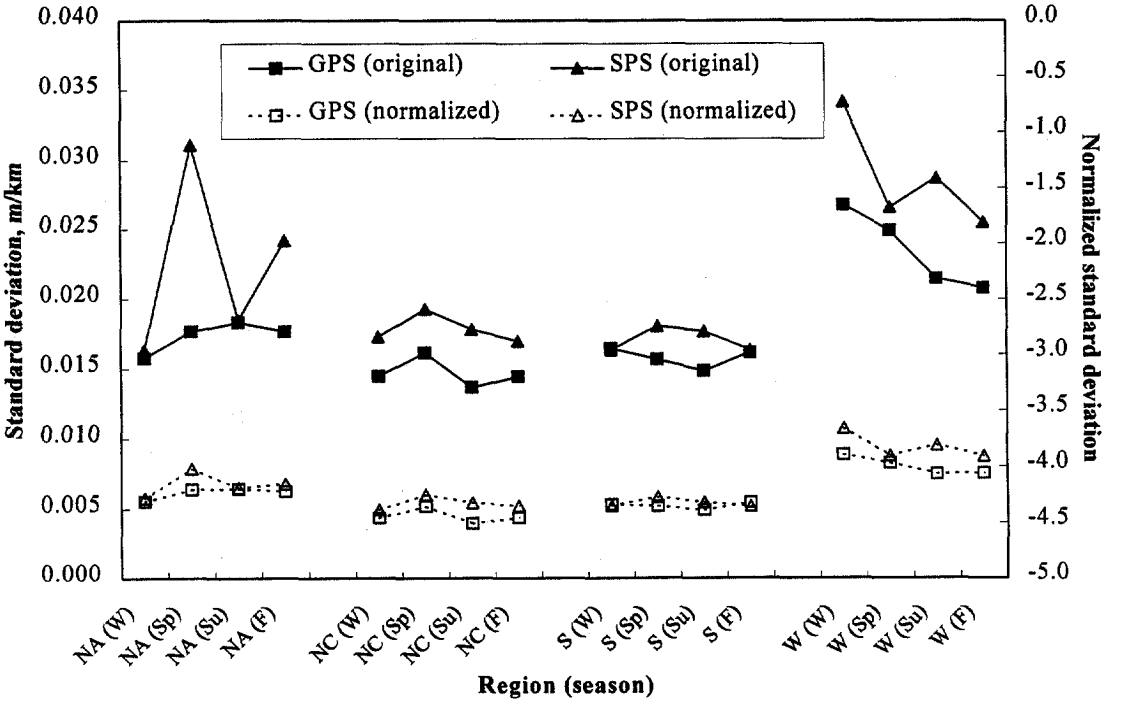


Figure 17. Seasonal effect on regional IRI variability.

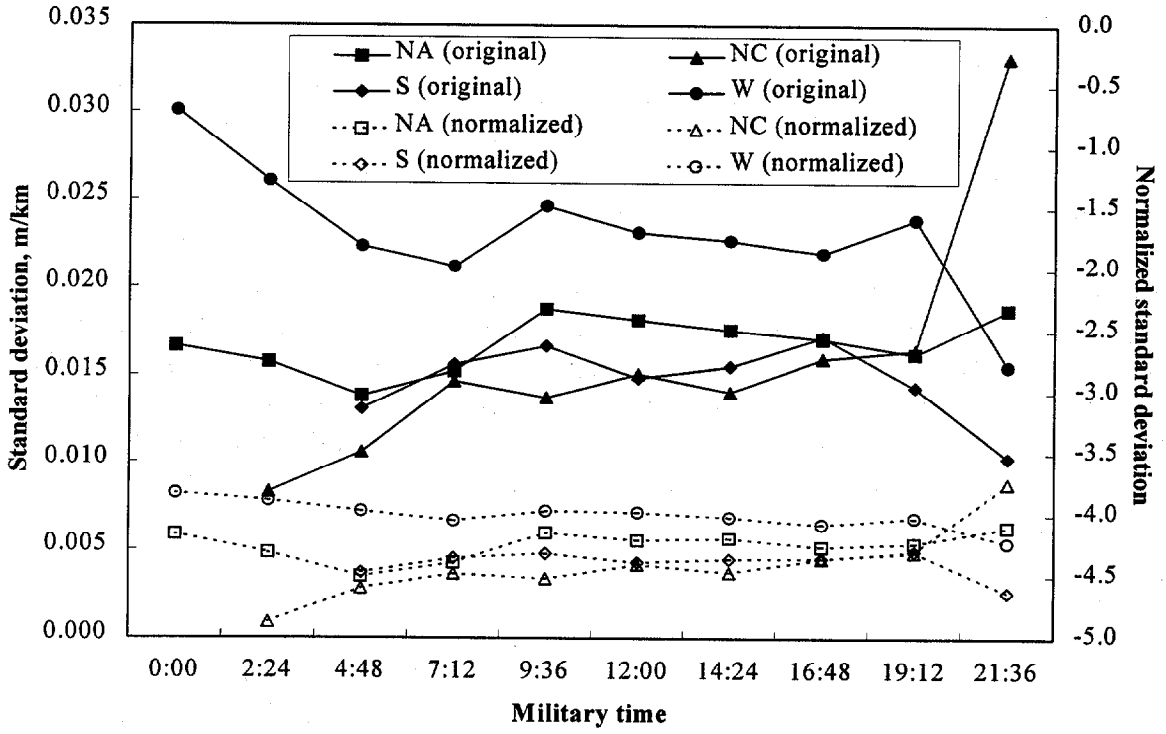


Figure 18. GPS time series IRI variability.

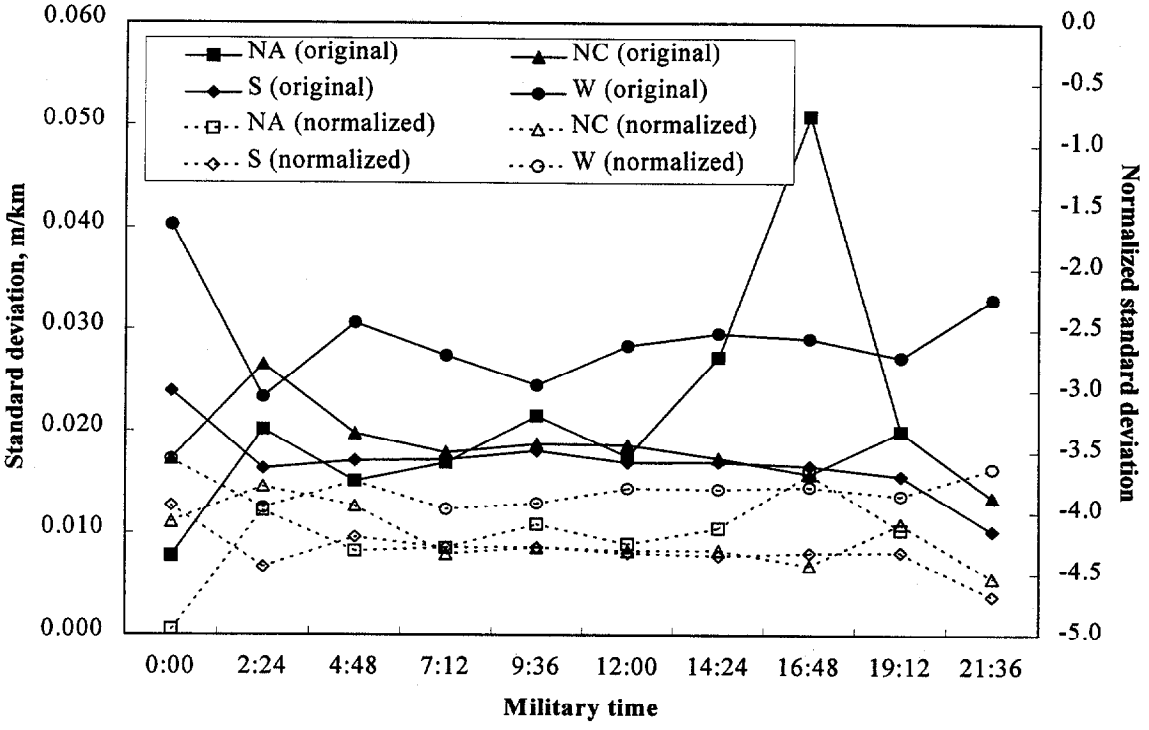


Figure 19. SPS time series IRI variability.

little data in the other fields. Analysis of this data was conducted on data from the three time periods representing different variability — 3:00 a.m. to 8:00 a.m., 8:00 a.m. to 6:00 p.m., 6:00 p.m. to 3:00 a.m. Time of day for testing had no significant effect on the variability associated with IRI data collection.

Effect of Roughness Level

To analyze the effect of pavement roughness level on variability, the GPS and SPS sections were divided into three evenly distributed categories (0 to 1.11, 1.11 to 1.56, and > 1.56 m/km). Since the IRI means for GPS and SPS sections were transformed to ensure that the level of roughness did not affect the standard deviation, no significant effect was noted as a result of roughness level. However, significant interactions were noted with pavement type and season. Also, significant, with 90-percent confidence, was an SPS interaction of roughness level with region. The reason for this last interaction is shown in figure 20. Variability was greatest in the high roughness level for the North Atlantic and Western Regions, but variability was least for the highest roughness level in the Southern Region.

The SPS interaction of roughness level with pavement type is significant in that variability is highest for the AC sections at the highest roughness level. However, at the lowest roughness level, variability is least for the AC sections. Interaction between roughness level and season was noted because the SPS variability was greater in the spring for the highest roughness level, but least in the spring for the lowest roughness level.

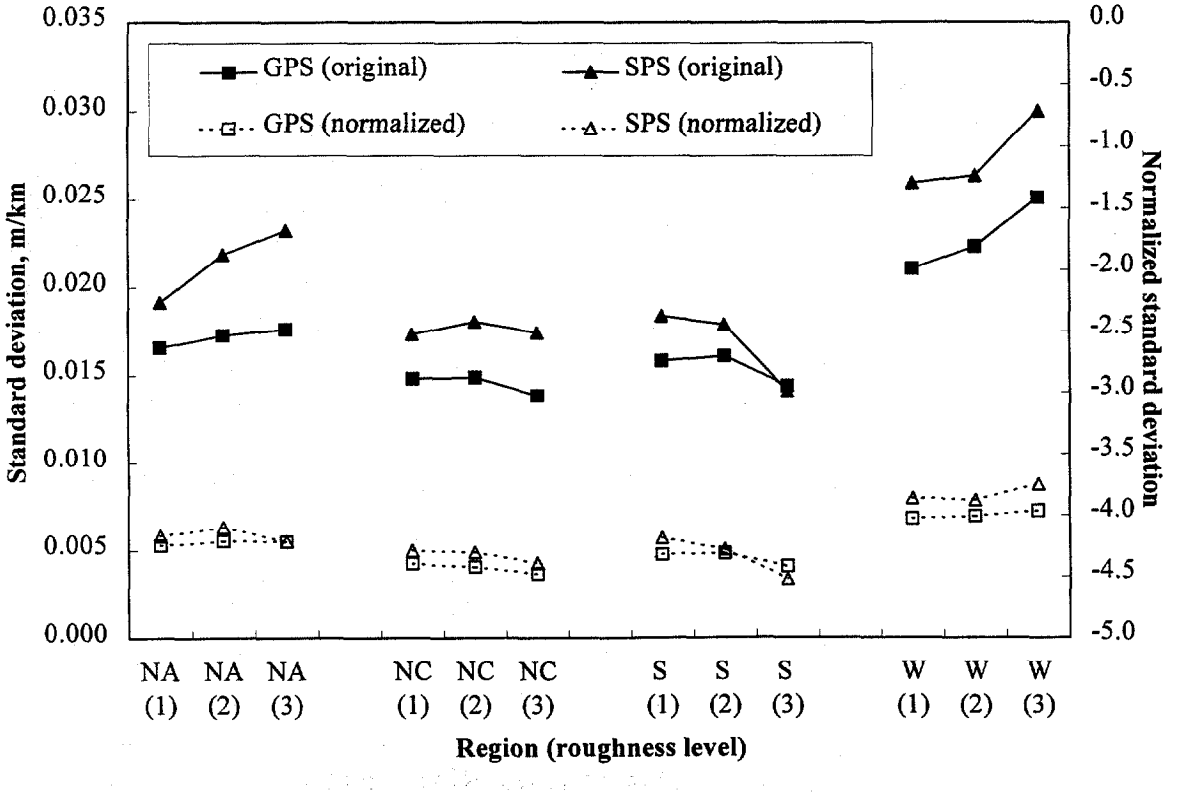


Figure 20. Regional IRI variability across roughness level.

Quality Control Implications

Currently, Profilometer operators are using a COV of 2.0 percent or greater from run-to-run as a flag for possible data problems. Operators are asked to review any profile data more closely if the limit is exceeded. This analysis has defined the run-to-run variability for SPS and GPS sections in the IMS database. An application of that information is in defining levels of variability that are within a normal limit.

Since the standard deviation of IRI data is affected by the mean IRI level, the required current practice of using a COV tends to flag very smooth pavements too frequently, and it is less stringent on rougher pavements. This analysis used a Box-Cox transform to eliminate the effect of the IRI level on standard deviation. Thus, it is possible to define a standard deviation limit that is normal across all roughness levels within the program.

Box-Cox IRI transforms can be approximated for GPS sections using the equations ($r^2 = 0.999$):

Left or Right Wheelpaths: $IRI_T = 0.0463\ IRI^3 - 0.4472\ IRI^2 + 1.9819\ IRI - 1.5899$ (5)

Average Wheelpath: $IRI_T = 0.0463\ IRI^3 - 0.4220\ IRI^2 + 1.8972\ IRI - 1.5272$ (6)

For SPS sections, the transformed IRI values can be estimated using the equations ($r^2 = 0.999$):

Left or Right Wheelpaths: $IRI_T = 0.0559\ IRI^3 - 0.5515\ IRI^2 + 2.2047\ IRI - 1.7238$ (7)

Average Wheelpath: $IRI_T = 0.0570\ IRI^3 - 0.5488\ IRI^2 + 2.2011\ IRI - 1.7209$ (8)

For each of these wheelpaths and section types, the 75-, 90-, 95-, and 99-percent confidence limits on transformed IRI standard deviations are shown in table 10. Estimated untransformed standard deviations are also shown in table 10; however, the linear relationship used in this estimate has an r^2 of 0.898. To simplify the quality checks, operators can be instructed to check all data more closely if the standard deviation of the transformed IRI data exceeds the recommended confidence limits. Figures 21 and 22 show the standard deviation of transformed GPS and SPS IRI data and several typical confidence limits. A confidence limit of 90 percent is recommended. This limit corresponds to an estimated untransformed COV for GPS sections of 2.2 percent and for SPS sections of 3.0 percent. These limits are based on the actual variability within the LTPP profile database, and they are not affected by the level of section roughness.

Table 10. Confidence limits for transformed average IRI standard deviations.

	GPS confidence limits		SPS confidence limits	
	Transformed SD	Estimated SD	Transformed SD	Estimated SD
Mean	0.017	0.018	0.021	0.022
75% level	0.022	0.022	0.026	0.027
90% level	0.032	0.033	0.040	0.042
95% level	0.040	0.042	0.053	0.058
99% level	0.061	0.068	0.087	0.101

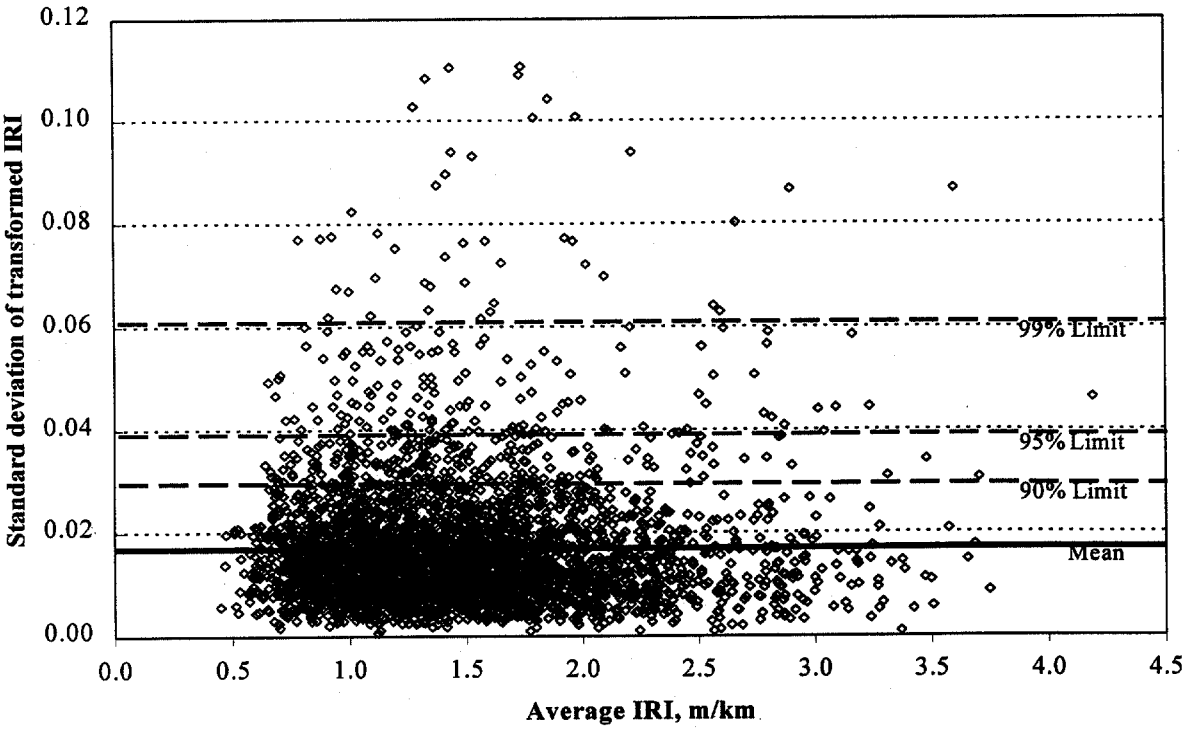


Figure 21. Confidence limits for GPS transformed IRI standard deviation.

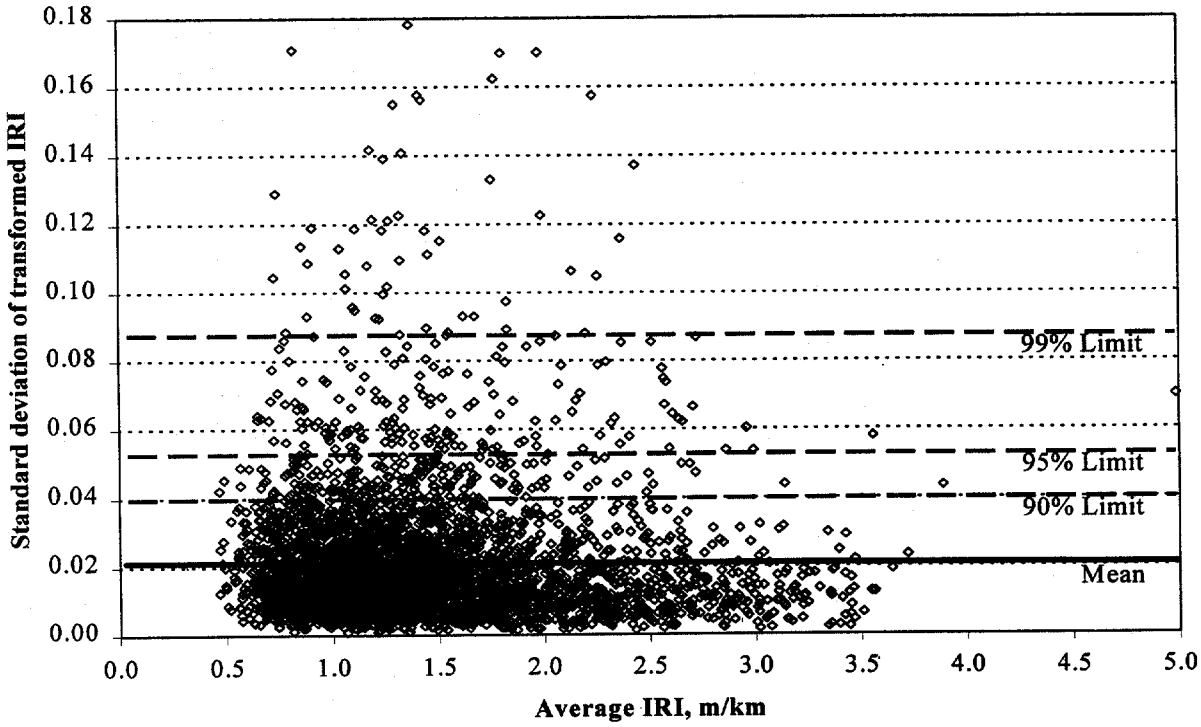


Figure 22. Confidence limits for SPS transformed IRI standard deviation.

Summary of Run-to-Run Analysis

Analysis of run-to-run variability was completed on IRI data collected between 1989 and 1997. IRI values were recomputed for runs that contained equipment-related spikes. Also, profiles that exhibited lost lock or that were shifted more than 10 m were excluded from the data set. The revised data set was transformed to eliminate the interaction between standard deviation and IRI level. In addition, the transformed IRI data were normalized using a natural log function to improve analysis accuracy.

Using main effects and two- and three-factor interactions with ANOVA analysis of the average IRI values, several key findings were identified:

- The average wheelpath run-to-run IRI variances for SPS data collected in the Western Region are significantly greater than in the other regions. This is probably related to the DMI problems reported by that region.
- Variances for the IRI of the GPS sections are not significantly different between regions. SPS data collected in the Southern and North Central Regions have the least variability. The variability associated with GPS AC and APC sections is significantly greater than that of PC sections. This may be because rutting in the wheelpaths of AC and APC sections causes differences in longitudinal profiles measured a few centimeters apart.
- SPS sections exhibit no significant variability difference between AC, APC, and PC sections, although more variability is found in the AC sections than in the PC sections.
- SPS and GPS variability of the 690DNC and the T-6600 Profilometers in the North Atlantic Region is not significantly different. The T-6600 variability in the Western Region is significantly less than that of the 690DNC. However, less than 6 percent of the data from that region was collected using the T-6600. Insufficient data are available to compare the variability in the North Central and Southern Regions' Profilometers.
- Manual triggering of data collection significantly increases the run-to-run IRI variability in all regions where a sufficient amount of data is available for analysis.
- Overall run-to-run variability is greatest in the spring for SPS sections in the North Central and North Atlantic Regions. This is possibly a result of the effect of additional moisture or thawing. Variability for SPS sections in the Western Region is statistically greatest in the winter.
- The time of day had no effect on variability for GPS or SPS sections.
- Run-to-run variation in IRI for a typical section is less than 2 percent COV. This represents very good test repeatability.
- A 90-percent confidence limit on the transformed IRI standard deviation is recommended for field quality control on the IRI average of both wheelpaths. For GPS sections, this corresponds to a transformed standard deviation value of 0.32; for SPS sections, the value is 0.40.

CHAPTER 5. VISIT-TO-VISIT VARIABILITY

Visit-to-visit IRI variability is associated with the effects of collecting profiles over time, while run-to-run variability is associated with the five profiles collected during a single site visit. Over time, the effects of daily temperature changes, seasonal changes, pavement deterioration, and other factors add additional variability to the run-to-run variability. One objective of the analysis was to define a time or roughness level inflection point where rapidly increasing pavement deterioration makes it necessary to increase the data collection frequency. The two main objectives of the visit-to-visit variability study were to define the effects of the above-stated factors and to identify confidence limits for expected change in average IRI between profile collection visits.

Inflection Point Analysis

To achieve the first objective, three approaches were taken. First, the rate at which the IRI increases with the time since construction or last rehabilitation was studied for various surface types and regions. In addition, the research team attempted to identify an inflection point in the IRI time history where the rate of yearly change significantly increases. Following on this approach, an inflection point associated with the level of roughness where more rapid IRI increases occurred was also sought. Each of these approaches failed because of the lack of an apparent inflection point or general trend toward more rapid IRI increases at higher roughness levels or pavement ages. This result indicated that, in general, the LTPP IRI data change linearly with time, inhibiting the identification of inflection point trends. However, this linear relationship helped to make it possible to achieve the two main objectives.

Time to Rapid IRI Increase

The objective of the first inflection point approach was to identify a pavement age associated with a rapid increase in the rate of IRI changes. This rate increase is important because it could indicate impending pavement failure and could be used to drive data collection scheduling or repair planning. Initially, visual analysis of the IRI data indicated that only about 99 (5 percent) of the 2,035 sections in the upgraded data set show any specific positive inflection point in the IRI time-history trend. In reality, it is debatable whether several of the sections included in this list show true inflection points. When the times between last construction or rehabilitation and these inflection points were compared, the range in time from initial reconstruction to the inflection points for each pavement type was 7 to 25 years. This is shown in figure 23. The same large range is seen in the regional data of figure 24, where the range in time from construction or last rehabilitation to the estimated inflection points was 12 to 25 years.

Even with this reduced data set, the variability in the time to rapid IRI increases is still extremely large. Thus, it is not possible to determine well-defined guidelines to trigger increasing site visit frequency or pavement maintenance based on time from last construction or rehabilitation.

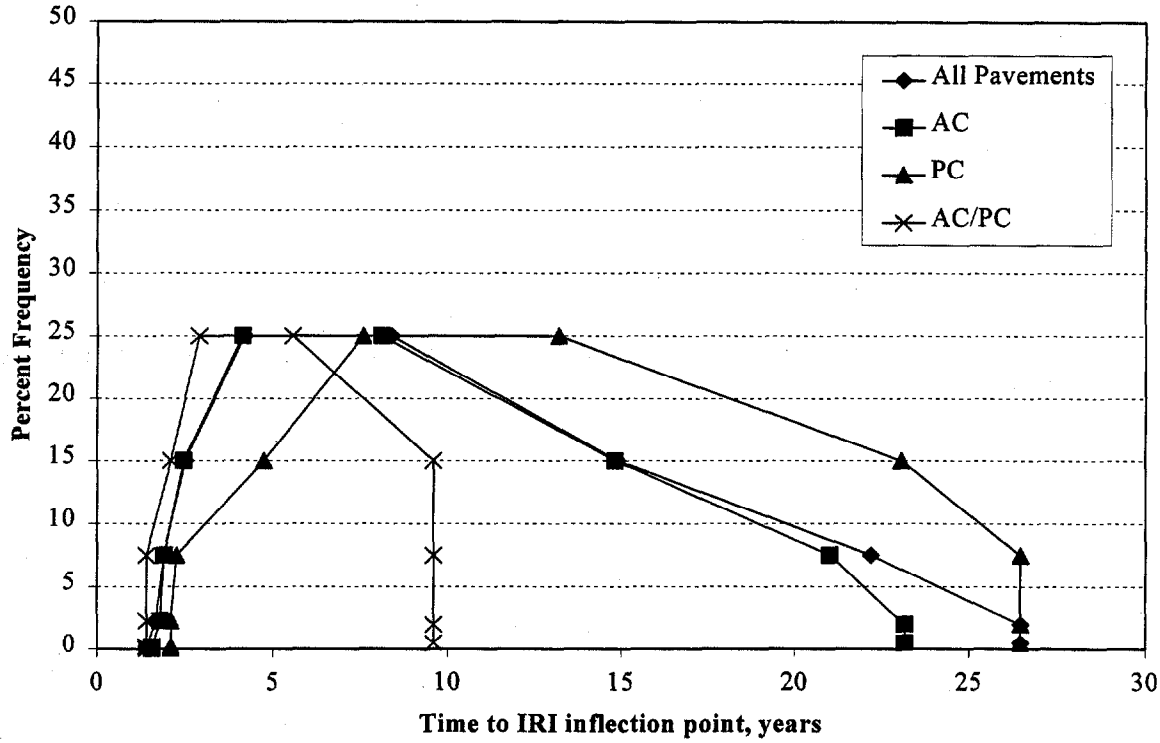


Figure 23. Histogram of IRI inflection point time by surface type.

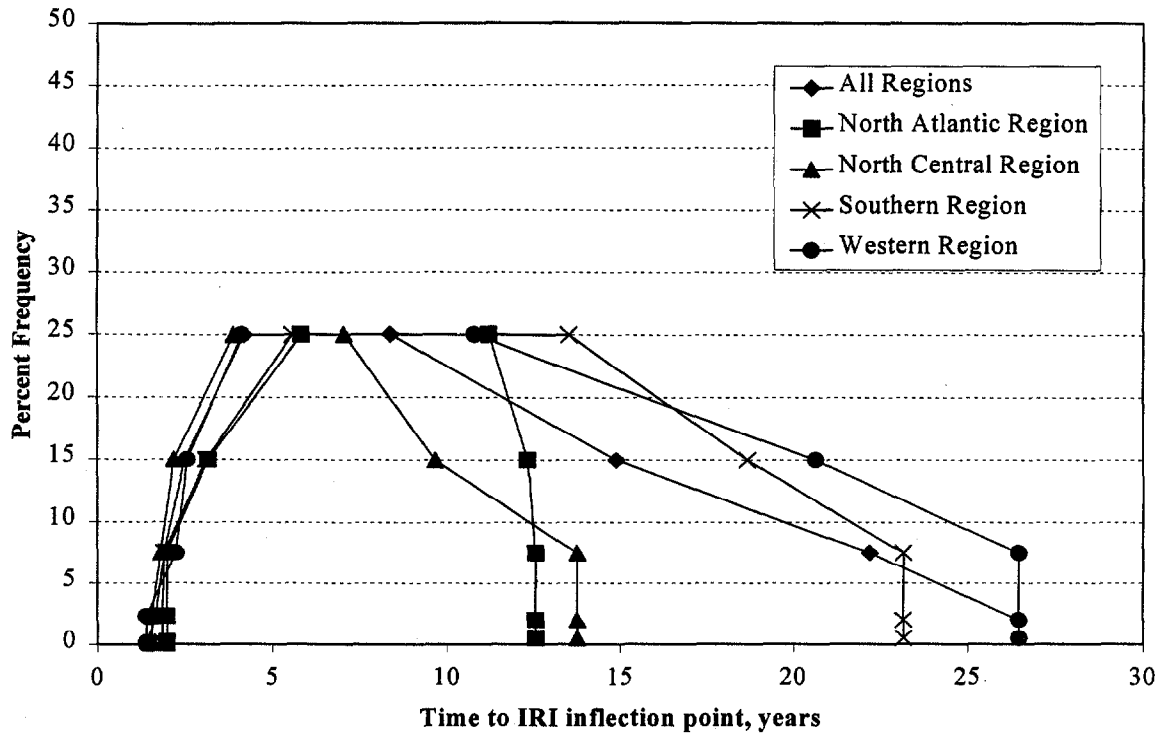


Figure 24. Histogram of IRI inflection point time by region.

IRI Time-History Slopes

Another attempted approach to finding conditions where increased testing frequency may be necessary was to identify specific overall differences in the IRI versus time slope before and after any perceived inflection point. Initially, this procedure was run on the 99 selected test sections with promising results. However, further statistical review of all sections indicated that their use was inappropriate because of the lack of statistically identifiable inflection points in the most promising data.

In the statistical review, only sites having more than three visits within a construction period and only the greatest 16 percent of IRI versus time slopes from simple linear regression were used. The response variable was the mean of the transformed IRI values. Then a quadratic polynomial was fitted for each of the identified 187 sites. Those with fewer than 4 visits prior to rehabilitation were omitted, cutting the number of sites to 116. Trends for these sections are shown in figures 25 and 26. There is obviously an increasing trend for IRI with time for most of these sections. However, there is little indication of inflection points where the rate of IRI change increases rapidly. Of these equations, 48 had negative coefficients for the second power term and 59 equations had negative coefficients for the first power term. Negative coefficients indicate a decreasing rate of change, rather than a more rapid increase.

Because of the lack of a trend indicating that the IRI increased more rapidly following a certain time in a pavement's life, this approach was abandoned. However, it is possible that such a trend does exist in pavement performance, but that the sections included in the study have not reached a deterioration level that would allow it to be identified. Another possible reason for the lack of

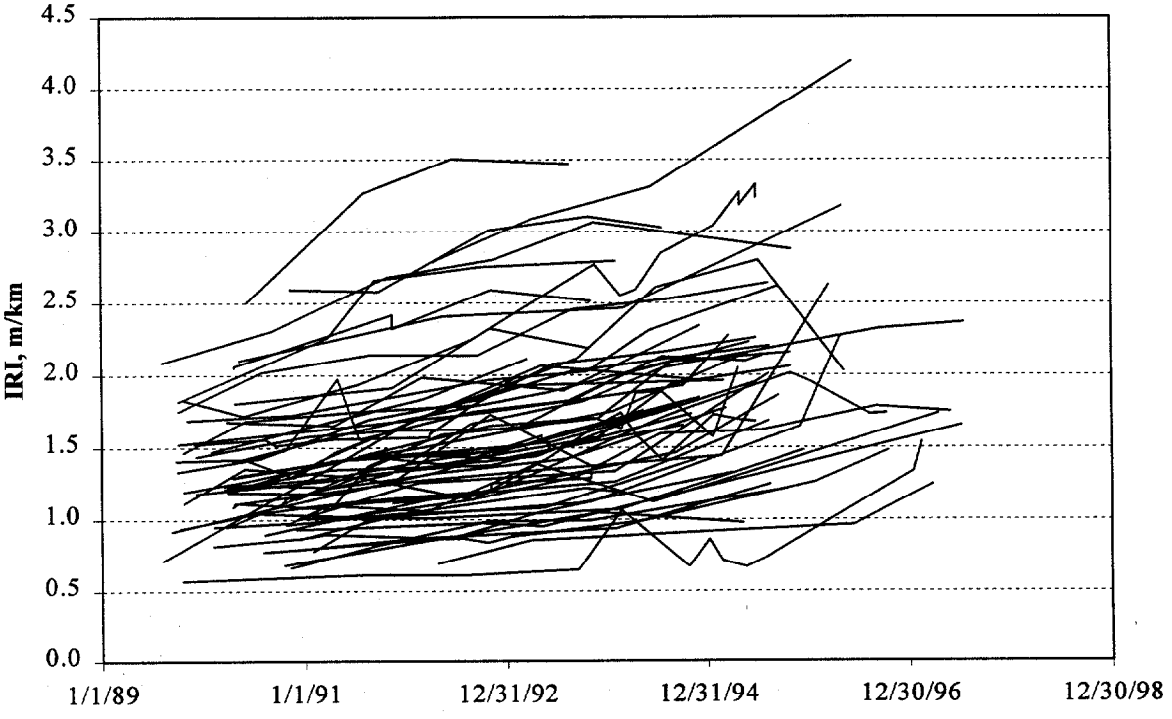


Figure 25. IRI trends for 60 selected GPS sections.

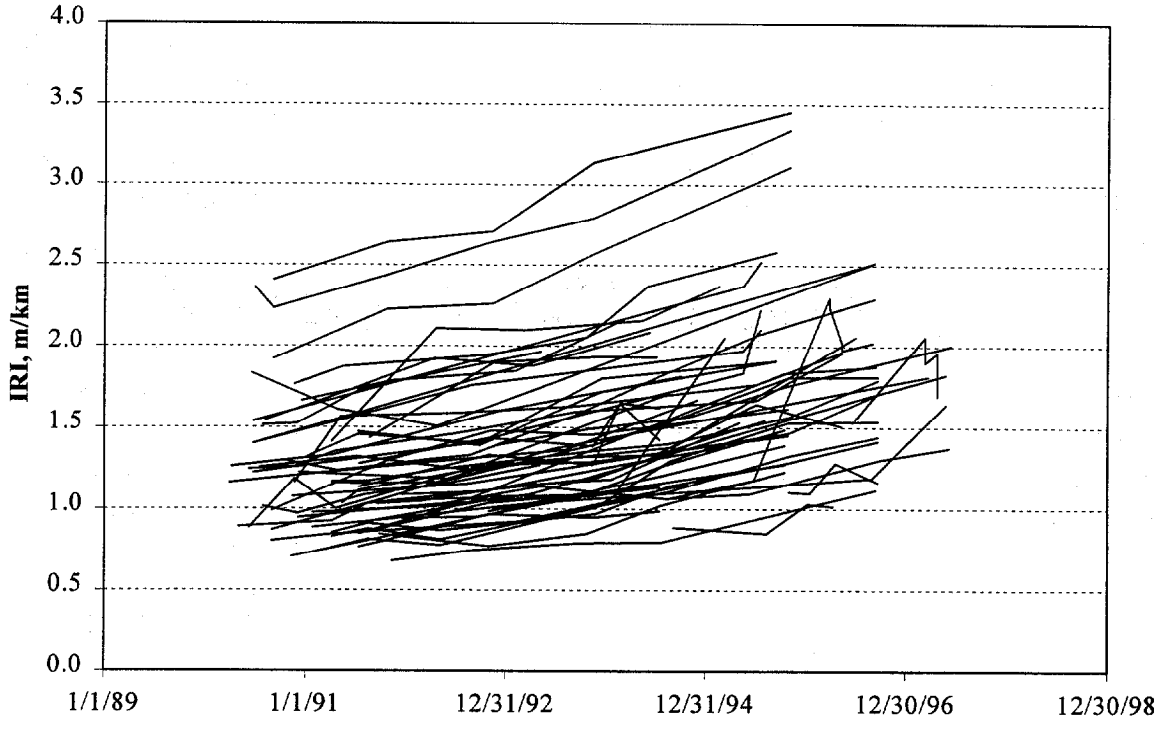


Figure 26. IRI trends for 56 SPS sections.

inflection points is that maintenance efforts have reduced the rapid increase sometimes associated with increased pavement deterioration.

IRI Roughness Level Slopes

The third approach used to identify trigger values for increased testing frequency was to find an IRI roughness level where the yearly change in IRI is significantly greater than that of lower IRI levels. This is based on the assumption that pavements deteriorate more rapidly when they get rougher.[4] To begin this analysis, the yearly change in IRI was computed using all adjacent average IRI values for sections that had more than one visit within a construction period. Figure 27 shows the resulting relationship. Because of the significant effect of short site visit intervals on an IRI rate of change, section visits that were tested less than 6 months apart were not included in the analysis. Also, 16 visits where the projected IRI was less than 0.5 m/km were eliminated because of the unreasonableness of the data. The data show a linear trend with a slope of 5.8 percent per year and a correlation coefficient (r^2) of 0.07.

These results do not indicate a significant increase in IRI at a certain level of roughness, rendering this third approach inappropriate. Although inflection points were not apparent, the linear trend between IRI level and yearly change in IRI simplified the identification of between-visit confidence limits. This trend, and the lack of change between regions and experiment types, allows for the development of confidence intervals for quality control.

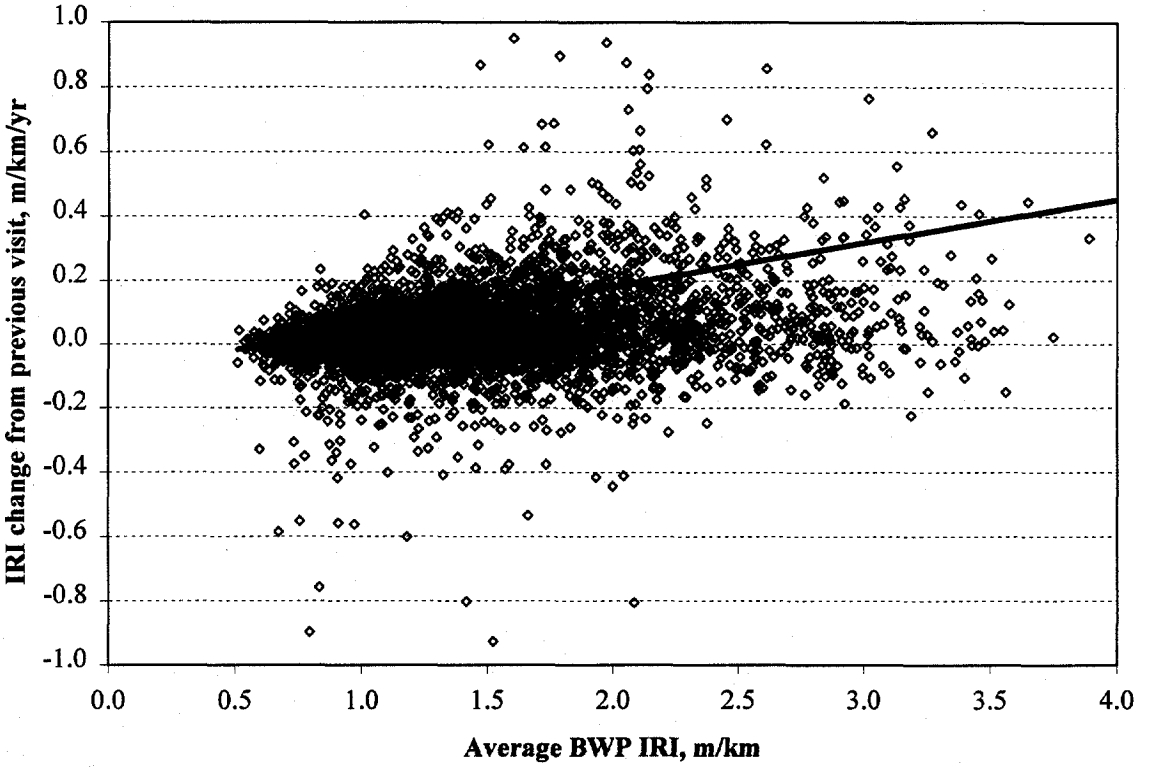


Figure 27. Change in IRI between visits.

Between-Visit Variability

Differentiating the variability associated with factors such as seasonal effects and daily temperature changes is difficult when the variability associated with wheelpath location within the data is unknown. However, seasonal and daily change effects can be isolated somewhat and evaluated within the 66 LTPP seasonal sections. These PC and AC sections were tested three or four times each year between 1992 and 1997. In many cases, the PC sections were also tested in the early morning, mid-morning, and late afternoon to identify the effects of curling on roughness. IRI values from the five runs at each of these seasonal visits provided a good estimate of these effects.

Seasonal Effects

Sufficient data was available from the 97 PC seasonal site visits and the 170 AC visits to provide 19 PC and 44 AC segments of 3 or 4 seasons within a year's time. Fifty-one percent of these seasonal groupings include data from four seasons. The average yearly IRI change for these groupings is 0.03 m/km, indicating that the IRI changes across the 5 to 12 months that these seasonal groups extended was not greatly related to pavement deterioration. This allowed for analysis of the effect of seasonal variability on IRI.

Within this subset of the LTPP database, the average IRI standard deviation for each visit was 0.014 m/km. This compares well with the standard deviation of the entire data set shown in

figure 17. About 95 percent of these seasonal sections are from GPS sections and 80 percent of these sections are from the North Atlantic, North Central, and Southern Regions. The seasonal standard deviation compares well with the overall standard deviation of 0.013 m/km for GPS sections in these three regions, indicating that the seasonal data are representative of all data in this larger data set.

Standard deviations for the collection of the three and four seasonal visits in these yearly data sets give an indication of the effect of seasonal changes on expected IRI variability. Shown in figure 28 are the percentile rankings for the single-season and across-season standard deviations. They indicate that about 68 percent of the single-visit standard deviations are less than 0.014 m/km. IRI standard deviations between the seasons are about six times greater (0.089 m/km). The conclusion can be drawn that testing within the same season of the year should reduce the seasonally related variability by up to six times.

Daily Change Effects

FHWA has asked RCOC's to collect profiles during seasonal PC section data collection two or three times in a single day—in the early morning, mid-morning, and late afternoon. This is intended to capture the effect of slab curling on pavement roughness. The variability within a single time period versus that of an entire day provides insight into the effect of curling on IRI variability.

Data used in this comparison include IRI values from 12 seasonal GPS PC sites collected on 32 days. Multiple sets of profile testing were completed on all of these days. When the hours were

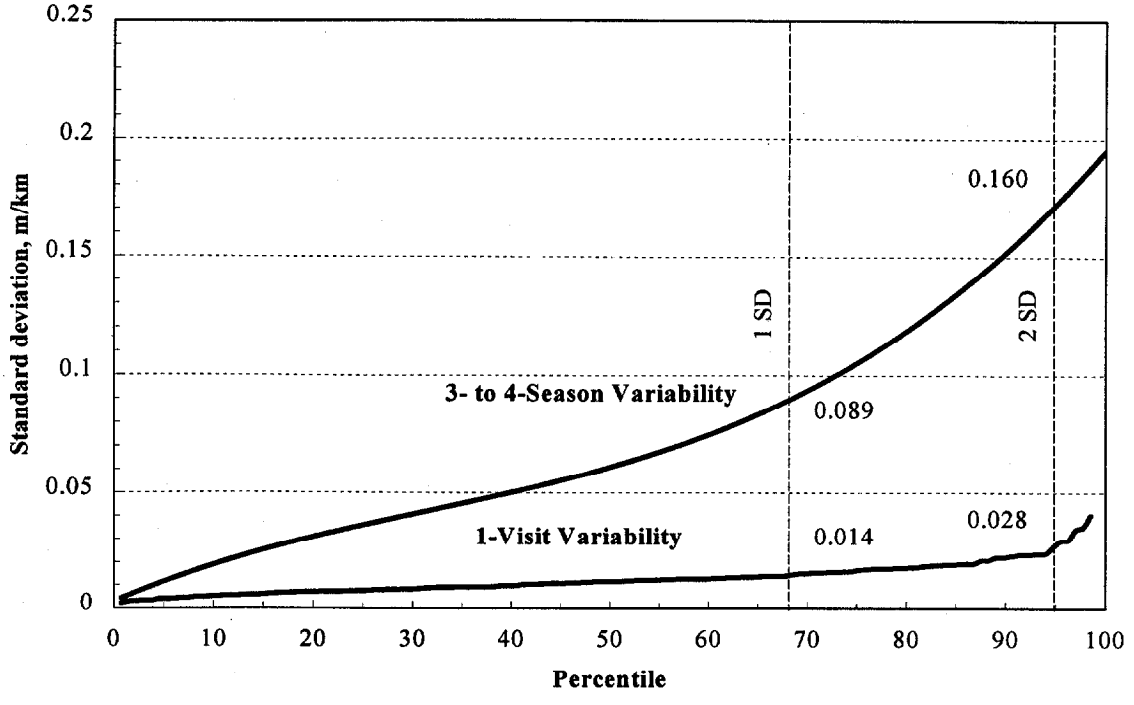


Figure 28. Seasonal effect on variability.

divided into three representative time groups (4 a.m. to 10 a.m., 10 a.m. to 3 p.m., and 3 p.m. to 10 p.m.), there remained 20 days in which two time groups were tested and 7 days when three time groups were profiled. On 5 days, the multiple sets were collected in the same time group. If only two groups were tested, one of the groups was the early morning time.

Standard deviations for the individual visits and the daily IRI values are shown in figure 29. For GPS PC sections in the entire IMS database, the average standard deviation is 0.017 m/km. In this seasonal data subset, the standard deviation is 0.019 m/km. The standard deviation for all runs collected at different times of the day is 0.047, compared to 0.019 m/km for the individual runs collected at a single time. This indicates that an increase in variability of up to 2.5 times is added to GPS PC sections when tested at different times of the day. Based on this trend, it is evident that striving to collect profiles from PC sections at the same time of day will reduce IRI variability, although not as much as by testing during the same season of the year.

Between-Visit Confidence Limits

The linear trend in IRI slope data allows, with additional analysis, the development of confidence limits for the expected change in average IRI values in consecutive visits. Differences in this change for SPS and GPS sections and for regional contractors were not statistically significant. The mean IRI slopes of the AC, PC, and APC pavement types were significantly different, requiring that confidence limit models be developed for each pavement type.

A review of the IRI slope data indicated 124 visits where the negative change in IRI between visits was greater than 0.180 m/km. These visits (2.4 percent of the data set) are outside the 90-

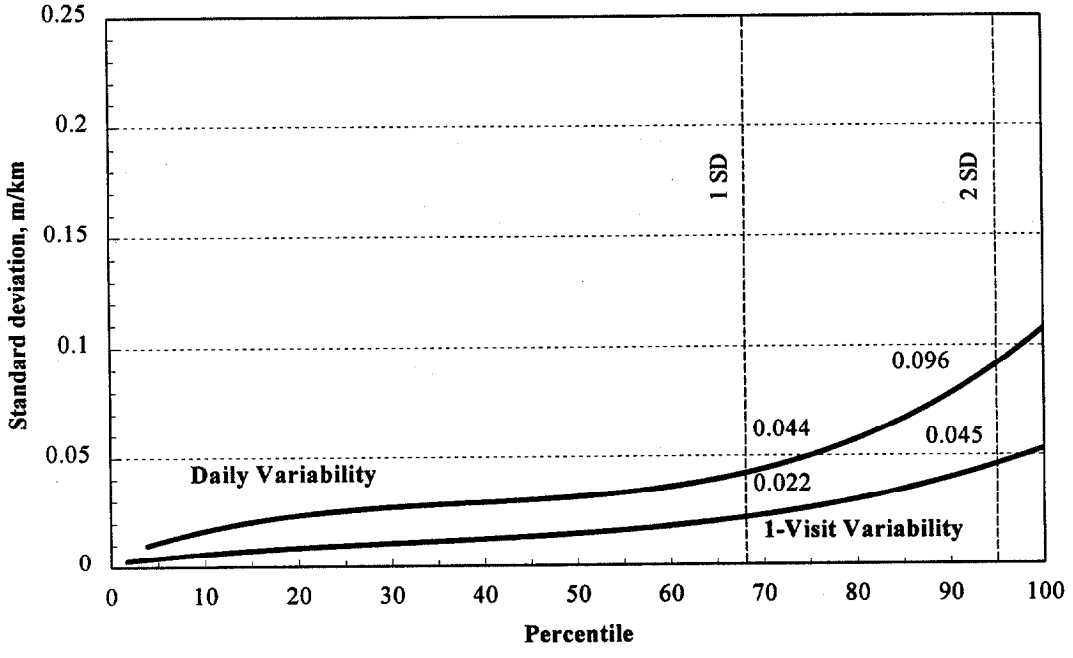


Figure 29. Daily effect on IRI variability.

percent confidence interval for yearly IRI standard deviation in the seasonal data set. Because this seasonal set includes an entire range of variability between runs, at different times of the day, and across seasons, it seemed reasonable to exclude these visits from the analysis.

For each pavement type, the IRI slopes within 0.5-m/km intervals from 0.5 to > 3.0 m/km were compared statistically. The slopes for each pavement type fell into three statistically distinct grouping intervals (according to the Duncan multiple-comparison procedure), shown in table 11. Mean and standard deviation slope values for each interval provide sufficient information to develop confidence limits for each roughness level. Data points, mean slopes, and confidence limits for AC, PC, and APC pavements are shown in figures 30, 31, and 32, respectively. These were developed using a 95-percent confidence level.

Table 11. Statistically different slopes for IRI intervals.

Grouping[1]	IRI range, m/km		
	AC	AC/PC	PC
A	0.5 to 1.5	0.5 to 1.5	0.5 to 1.5
B	1.5 to 2.5	1.5 to 2.5	1.5 to 2.5
C	>2.5	>2.5	>2.5

[1]Statistically different at 95-percent confidence level.

Formulas that can be used in quality control software or in manual quality checks are listed below for each pavement type. These models are considered accurate for AC pavements within the IRI range of 0.5 to 4.0 m/km, for PC between 0.5 and 3.5 m/km, and for APC between 0.5 and 3.0 m/km. Because of the small denominator, they are not recommended for use when the time between section tests is less than 6 months.

AC Pavements:

Upper Limit: $$IRI_E = IRI_P + \Delta T\,(0.1984\,IRI_P - 0.0273) \quad (9)$$

Lower Limit: $$IRI_E = IRI_P + \Delta T\,(-0.0282\,IRI_P - 0.0995) \quad (10)$$

PC Pavements:

Upper Limit: $$IRI_E = IRI_P + \Delta T\,(0.1532\,IRI_P + 0.0094) \quad (11)$$

Lower Limit: $$IRI_E = IRI_P + \Delta T\,(-0.1158\,IRI_P - 0.0686) \quad (12)$$

AC/PC Pavements:

Upper Limit: $$IRI_E = IRI_P + \Delta T\,(0.3244\,IRI_P - 0.1538) \quad (13)$$

Lower Limit: $$IRI_E = IRI_P + \Delta T\,(-0.1158\,IRI_P - 0.0006) \quad (14)$$

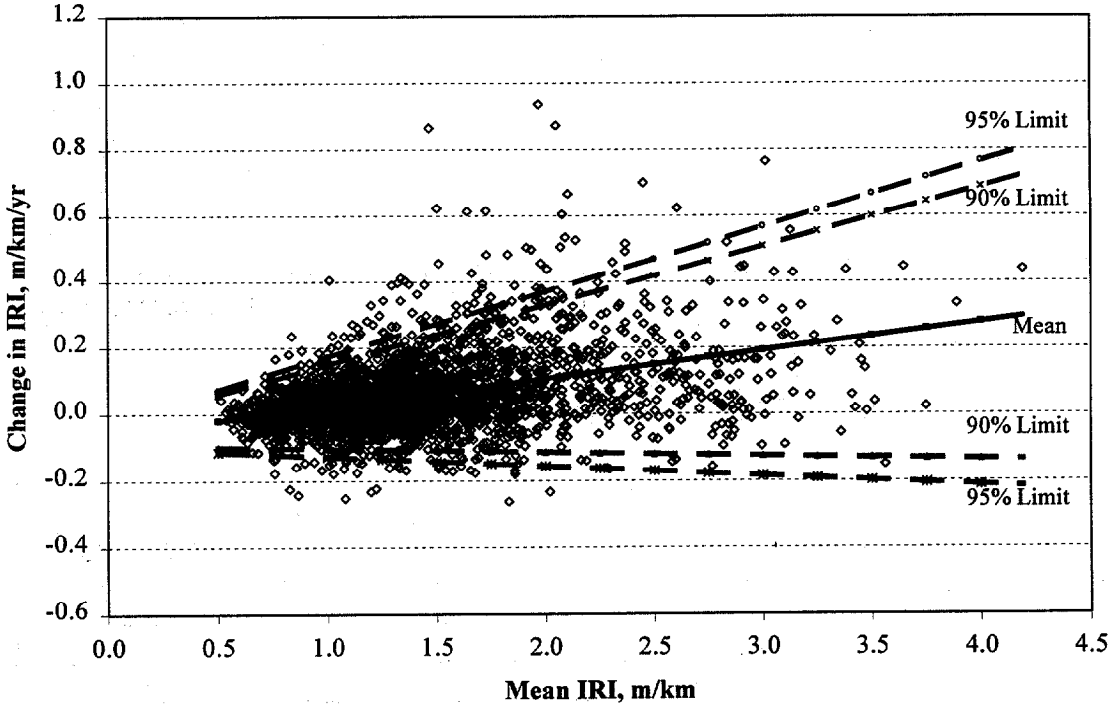


Figure 30. Confidence limits for AC IRI change.

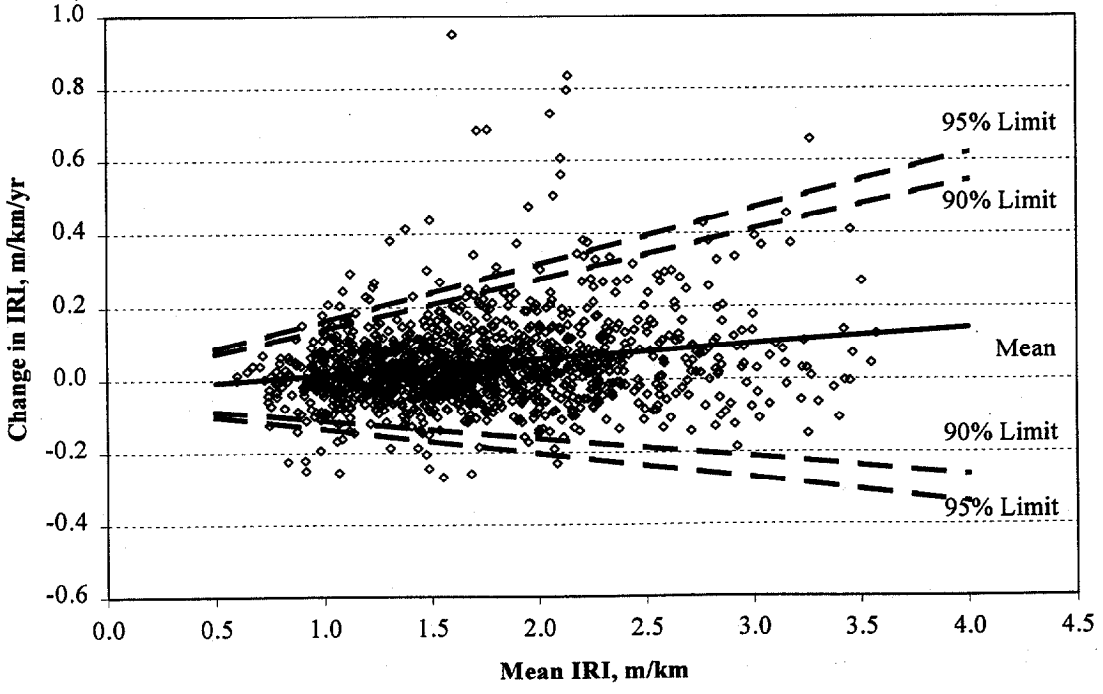


Figure 31. Confidence limits for PC IRI change.

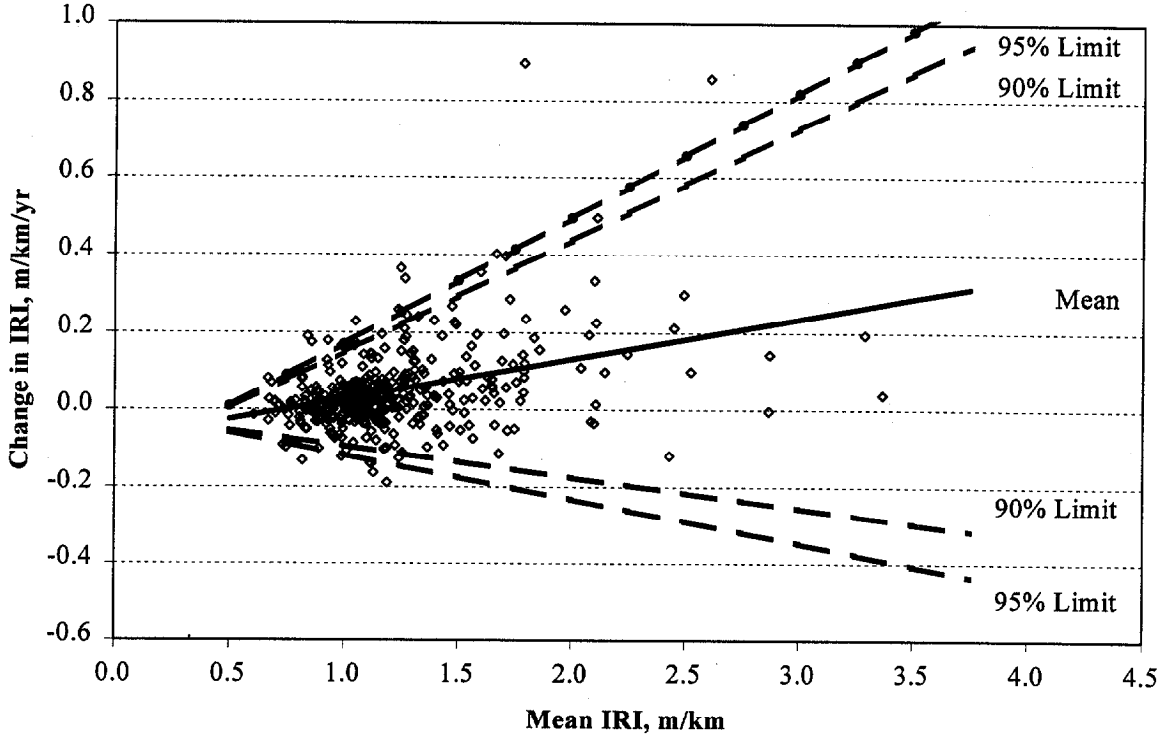


Figure 32. Confidence limits for APC IRI change.

Where:

IRI_E = Expected IRI, m/km
IRI_P = Previous IRI, m/km
ΔT = Time since previous visit, yrs

In contrast to the ±10 percent limit currently used to check for expected IRI values, these confidence limits adjust for the different variability and IRI changes associated with different roughness levels. Between IRI levels of 0.75 and 3.5 m/km, the AC confidence limits correspond to average allowable yearly reductions of 8.6 percent and allowable increases of 18.2 percent. For PC sections, the average allowable reduction and increase are 10.7 and 15.9 percent, respectively. Finally, the allowable yearly reduction for APC sections is 11.6 percent, with an allowable increase of 23.5 percent.

These limits are intended to provide guidelines for future profile data collection. IRI changes outside the upper limits are not unreasonable; however, changes below the lower limits may indicate problems in data collection or unreported maintenance or rehabilitation. These confidence levels should be used as a quality control guide. If limits are exceeded, it is recommended that the newly collected profiles be reviewed and compared with profiles from previous visits. Also, the pavement section should be visually surveyed to identify changes in its condition.

Summary of Between-Visit Variability

Through this analysis, researchers have drawn several conclusions that can be applied to the future collection of profile data. Several of the previously discussed key findings are provided below:

- Linear trends in the LTPP IRI data currently prohibit the identification of inflection points for development of incremented collection frequency guidelines.

- IRI standard deviations associated with seasonal effects are about 0.089 m/km. This is about six times the variability of the single-visit standard deviations for the same data.

- Daily cycling of IRI roughness on PC sections results in an average standard deviation of 0.047 m/km for the PC GPS seasonal sections in the LTPP database. The individual standard deviation for these sections at each time of day is 0.019 m/km. This indicates that the increased standard deviation typically associated with daily cycling of PC pavement sections is up to 0.028 m/km.

- Confidence limits for AC, PC, and APC pavements have been developed using the data from the LTPP database. These limits can be used as quality control checks for future profile data collection.

CHAPTER 6. ADDITIONAL ANALYSIS RESULTS

In addition to the visual review and statistical analysis, data processing analysis and field testing have been conducted. Since unreported saturation spikes have been identified on 1,810 test site profile runs, the effect of unedited saturation spikes on IRI using spikes of various amplitude was analyzed.

The shifting of profiles more than 5 m from the true 152.4-m location was also noted on 1,728 test site profile runs. Using PC and AC pavement sections ranging in IRI from 0.85 to 2.34 m/km, the effect on IRI of profile location shifts up to 15 m was also evaluated.

Variation of wheelpath location was also reviewed. Since no information is available regarding the effect of transverse vehicle location on IRI, field testing was completed on three sections with an IRI ranging from 1.18 to 2.87 m/km. The location of the profile sensors was shifted 0.3 m to the left and right of the wheelpath location, and IRI variability was summarized. The results of these and other analyses are described in this chapter.

Effect of Saturation Spikes

The effect of the unreported saturation spikes (noted in profiles from about 5 percent of the section profile runs) on IRI and other smoothness indices is unknown. To document this effect, spikes of various amplitudes were inserted at the start of the profile for Illinois section 5217 collected on June 15, 1991. The IRI average for both wheelpaths when no spikes were present was 2.4 m/km. Figure 33 shows the effect of spikes with amplitudes of 5 to 75 mm.

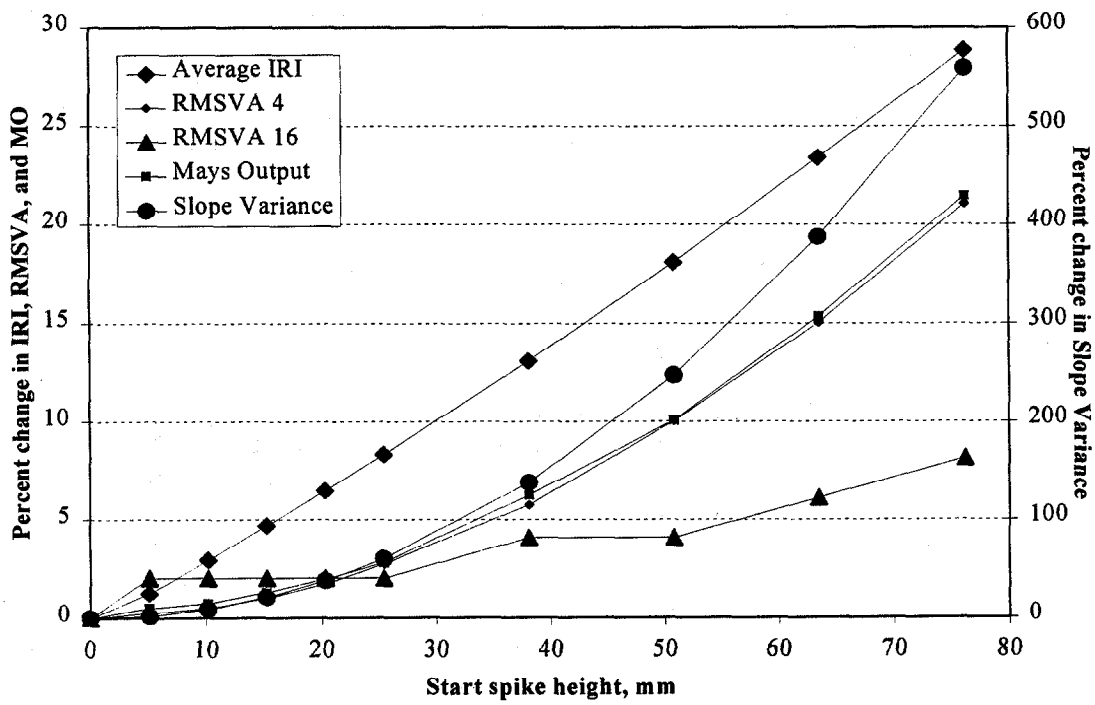


Figure 33. Effect of spike height on smoothness statistics.

The relationship between spike amplitude and IRI is nearly linear, with a 1.8-percent increase in average IRI for every 5-mm increase in spike amplitude. Average effects on slope variance values are much more dramatic, with a 24-percent increase for every 5-mm spike height increase. Other smoothness statistics are less sensitive to the presence and amplitude of spikes. For each 5-mm increase in spike height, the average increases in Root Mean Squared Vertical Acceleration (RMSVA) with a 1.2-m (4-ft) baselength (RMSVA 4), RMSVA 16 (4.9-m baselength), and Mays Output were 1.0, 0.5, and 1.0 percent, respectively.

This evaluation shows that the effects of spikes in the typical 12- to 75-mm range on IRI and other smoothness statistics can be dramatic, and it reinforces the importance of not including saturation spikes greater than 5 mm in profile smoothness statistics computation from profiles in the LTPP database.

Effect of Shifted Profiles

The problem of shifted profile start locations is particularly important given that about 3.6 percent of the LTPP section profile runs are shifted more than 5 m. IRI values ranging from 0.5 to 4.5 m/km were computed for 25 AC and PC SPS sections. The start and end locations of each profile were shifted backward 15, 12, 9, 6, and 3 m, and the IRI values were recomputed on the shifted profiles. Comparing the IRI values for the shifted profiles with those of the original profile, it was noted that the difference from the true IRI value ranged from 0 to 28 percent. Figure 34 shows the results of this analysis. The importance of testing a section at the same location is evident. For profiles shifted 12 m, normalized statistics indicate that about 70 percent of the shifted IRI values were within 5 percent of the true IRI.

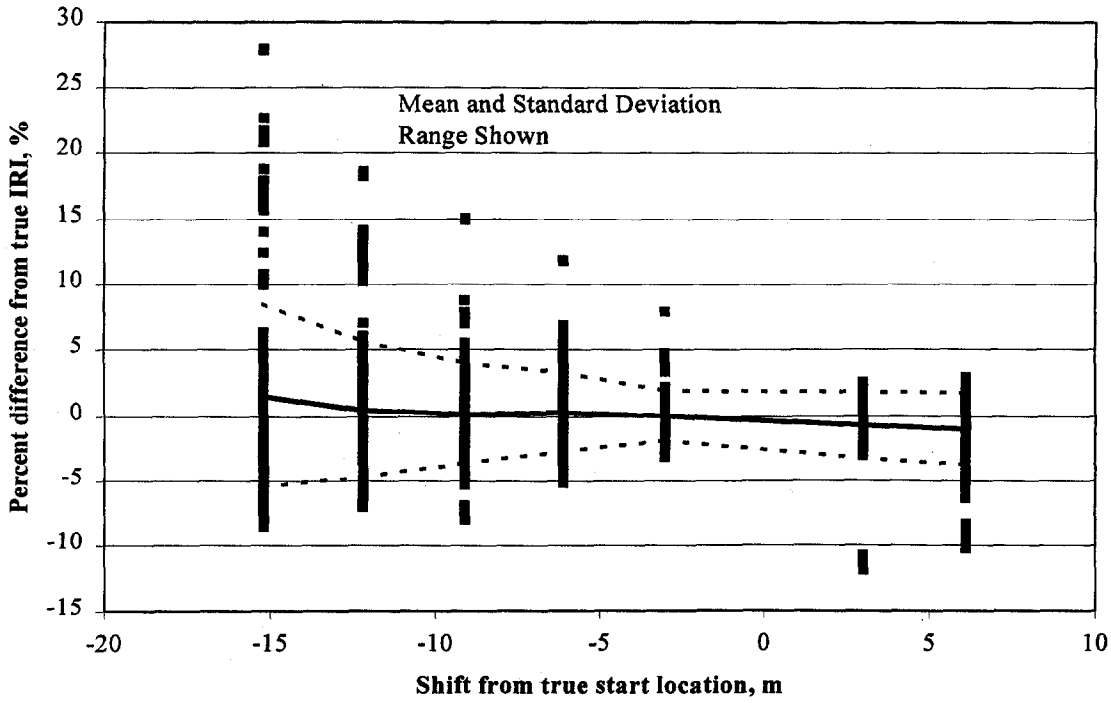


Figure 34. Effect of shifted profile start locations.

For profiles shifted 15, 9, 6, and 3 m from the original location, about 70 percent were within 7.0, 3.8, 3.0, and 1.9 percent, respectively.

However, the average effect on IRI from shifted profiles is negligible because the profile sections added or deleted from the beginning and end of the true profile location can be smoother or rougher than the true section. A random selection results in no average IRI change.

For quality control, the data indicate that profiles shifted up to 3 m can be expected to be within 3.7 percent of the true IRI values in 95 percent of the data. This is well within the effect of seasons on IRI variability. However, profiles shifted more than 3 m can be expected to greatly affect the IRI values and should be avoided.

Effect of Wheelpath Location

No definitive evaluation of the effect of the transverse location (i.e., wheelpath location) of testing longitudinal profiles has been completed by FHWA. It has been FHWA policy to allow the LTPP Profilometer operators to visually define the wheelpath location to be tested at each visit. This has raised questions about the effect on IRI if different operators in different years measure the profiles in a slightly different wheelpath location.

To help study this effect, in February 1998, the Texas Department of Transportation assisted in the location and marking of three AC test sites of different roughness levels. Sites 1 and 2 are located on westbound SH 71, approximately 31 km east of Interstate 35 in Austin, Texas. The third site is on Pope Bend South Road, a service road adjacent to sites 1 and 2 in the westbound direction. Air temperatures were between 22 and 26°C, and the skies were clear to partly cloudy. Five repeat runs were made at each site for the center of the wheelpaths and 300 mm left and right of the center using the Southern Region's K.J. Law T-6600 Profilometer.

Figure 35 shows the average of five runs for each site and wheelpath location. Shifting transverse location left or right 300 mm for smooth, medium, and rough AC pavement sites resulted in average left and right wheelpath IRI changes of 7.1, 15.3, and 4.0 percent, respectively. Tables 12, 13, and 14 list the results of ANOVA and Tukey multiple comparison of average values analysis. The ANOVA indicated that, for each site and wheelpath, there is a significant difference between one or more of the shifted profile IRI values. P-values listed on these tables all indicate good statistical results. Mean values for each location are shown in the tables, along with the Tukey significance-level groupings defining data sets that are significantly different. Based on the mean and variability of the five runs left, right, and center of the true wheelpath, these significance-level groupings identify locations where the IRI values are statistically the same. For example, in the left wheelpath of site 1, there is no significant difference at the 95-percent confidence level between runs taken at the center of the wheelpath and 300 mm to the right of center. However, the IRI values measured 300 mm left of center are significantly greater.

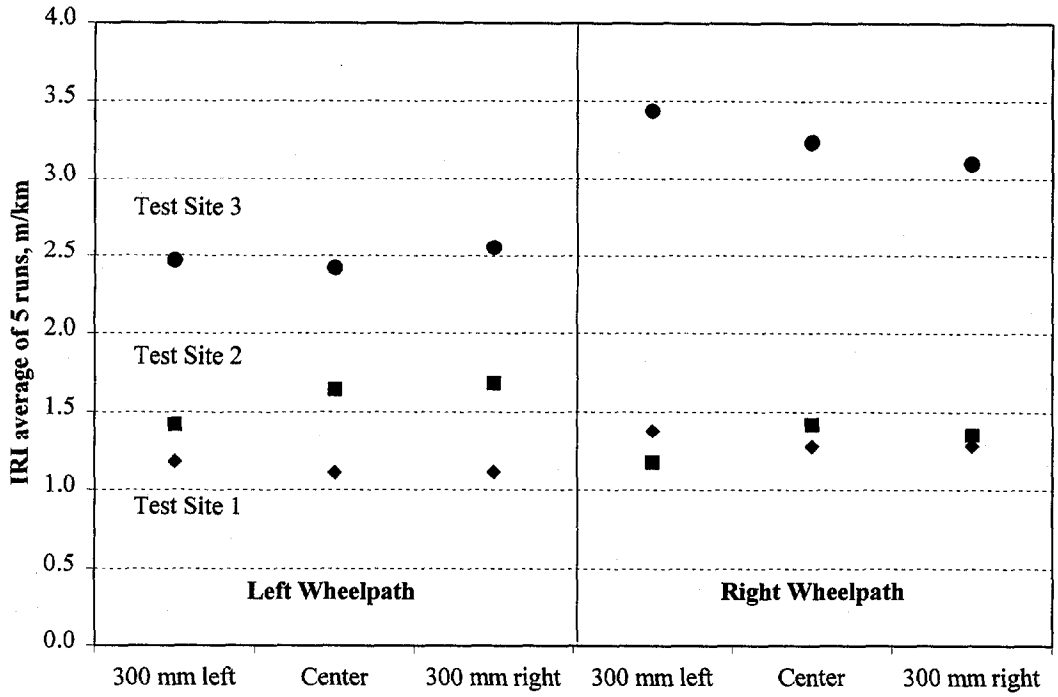


Figure 35. Effect of wheelpath wander on AC pavement IRI.

Table 12. Summary of wheelpath effect analysis on site 1.

	Left wheelpath			Right wheelpath			Both wheelpaths		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
Mean IRI	1.179	1.109	1.114	1.378	1.278	1.282	1.279	1.194	1.198
Level[1]	A	B	B	A	B	B	A	B	B
p-value	0.0001			0.0001			0.0001		

[1] Significance-level groupings.

Table 13. Summary of wheelpath effect analysis on site 2.

	Left wheelpath			Right wheelpath			Both wheelpaths		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
Mean IRI	1.420	1.641	1.683	1.176	1.420	1.352	1.298	1.530	1.51
Level[1]	B	A	A	B	A	A	B	A	A
p-value	0.0014			0.0002			0.0001		

[1] Significance-level groupings.

Table 14. Summary of wheelpath effect analysis on site 3.

	Left wheelpath			Right wheelpath			Both wheelpaths		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
Mean IRI	2.466	2.421	2.556	3.433	3.235	3.101	2.950	2.828	2.828
Level[1]	B	B	A	A	B	C	A	B	B
p-value	0.0003			0.0001			0.0002		

[1] Significance-level groupings.

Site 2 IRI values from runs 300 mm right of and in the center of the left and right wheelpaths are significantly greater than those collected 300 mm left of the wheelpath center. Additional differences are evident between shifted wheelpaths for rough AC site 3.

When grouped together, the IRI standard deviation from both wheelpaths of the two shifted and one true location was 0.041 m/km for site 1, 0.125 m/km for site 2, and 0.068 m/km for site 3. This compares with standard deviations for the true wheelpath location of 0.099 m/km for site 1, 0.098 m/km for site 2, and 0.030 m/km for site 3. The increase in standard deviation resulting from wheelpath wander is about 0.032 m/km for each site. This rather consistent change in standard deviation makes it even more critical that the wheelpath be followed on both rough and smooth pavements, because the magnitude of variability change relative to the IRI mean is greater in smoother pavements. Significant differences between the grouped and true average IRI data were only noted for the smooth site 1.

A conclusion that can be drawn from this analysis is the need to better control the location of the profile sensors from run to run and for between-site visits. As operators change from year to year, and even as single operators are unable to match the same wheelpath on repeat runs, additional variability is added to the data, making it more difficult to draw meaningful conclusions.

Technology is available to improve the repeatability of the wheelpath testing location between runs and operators and should be investigated. For example, the Transportation Research Laboratory in the United Kingdom has used a light-emitting diode (LED) system to tell operators whether or not they are in the wheelpath. This system used a video camera display of the lane-shoulder stripe as a baseline and provided an array of red and green lights to alert operators to the profiler's position relative to the estimated wheelpath. Reported driver distraction and the use of a new rut bar that fills the entire lane width resulted in this system being discontinued. However, a head-up display or audible system output may be applicable to LTPP operations.

Effect of Incorrect IRI Coefficients

During the development of the Profile Viewer software, it was discovered that the coefficients used in computing IRI for ProQual 1.4 and early ProQual 2.0 versions were not correct. The PR1 coefficient used in ProQual 1.4 was 0.0030962100 instead of the 0.0013096210 value recommended in the World Bank 45 report.[5] All coefficients for the early second releases of ProQual (2.0 through 2.06) use the same spacing-related coefficients included in ProQual 1.4, although the spacing for the new profilers is 150 mm instead of 152.4 mm.

The effect of the coefficient difference in version 1.4 was analyzed by Soil and Materials Engineers, Inc. in November 1997. Average IRI values for these four sites ranged from 0.7 to 2.2 m/km. Observed left and right wheelpath IRI differences from the correct IRI ranged from 0.04 to 0.95 percent. Table 15 presents the results of this comparison. Because of the small magnitude of the error, correction of the data was not recommended.

Table 15. Effect of incorrect coefficients on IRI.

Site Number	IRI, m/km		IRI, m/km		Percent difference	
	Version 1.4 coefficients		True coefficients			
	Left whp.	Right whp.	Left whp.	Right whp.	Left whp.	Right whp.
1	0.7169	0.6782	0.7238	0.6837	0.95	0.80
2	1.8705	1.8371	1.8741	1.8465	0.19	0.51
3	2.0079	2.2943	2.0108	2.2933	0.14	-0.04
4	1.7995	1.6865	1.8028	1.6893	0.18	0.17

Stantec, Inc. completed an informal analysis in October 1997 of the effect of the 152.4-mm coefficients used in versions 2.0 through 2.06. Again, the range in IRI difference was in the 0- to 1-percent range. No analysis of either of these effects was completed for this study.

Effect of the Number of Runs per Visit

The effect of the number of runs per visit (number of repeat measurements of IRI per visit) on the closeness or agreement between the measured mean IRI and the true reference value (i.e., population mean) was evaluated as part of this study. This was done using analysis and procedures based on the central limit theorem, which states that:

If random samples of n measurements are repeatedly drawn from a population with a finite mean, μ, and a standard deviation, σ, then, when n is large, the relative frequency histogram for the sample means (calculated from the repeated samples) will be approximately normal with a mean, μ, and standard deviation, $\sigma/n^{0.5}$.

The central limit theorem thus implies that if the number of mean IRI values (calculated from different sample sizes) is large enough, the distribution of mean IRI will be normal. Basic characteristics of the normal distribution curve shows that 95 percent of the sample means will be within 1.96 times the standard error ($\sigma/n^{0.5}$) of the overall mean IRI, which is the average value of all the sample means calculated.

We would also expect that, for any given combination of number of visits and runs per visit for which a mean IRI is calculated, the mean sample IRI will be within $1.96\sigma/n^{0.5}$ of the population mean, μ. The closeness in magnitude of sample and population means depends on the magnitude of $1.96\sigma/n^{0.5}$. We will call this value the absolute error. When the absolute error is zero, this implies that the sample mean is equal to the population mean. The procedure used to assess the effect of sample size on absolute error for the left, right, and average wheelpath data was as follows:

1. Categorize data into visits where five runs of IRI measurements were obtained. (Only data from visits where five runs of IRI data were available were used in the analysis.)

2. From the data obtained in step 1, randomly select sample sizes of two, three, four, and five IRI measurements.

3. For a given sample size, or number (n) of IRI measurements, calculate the IRI mean and standard deviation. For example, if we have 10 sets of data with 2 IRI measurements in each set, the objective is to compute X_{M1} to X_{M10} and σ_1 to σ_{10} (X_M = mean of variable X, σ = standard deviation).

4. Determine the mean of all the standard deviations obtained in step 3, i.e., σ_{M2} = mean (σ_1, σ_2, σ_3..... σ_{10}), σ_M = mean standard deviation.

5. Repeat steps 3 and 4 for the randomly selected samples with three, four, and five runs or observations.

6. Using the results from steps 3 through 5, estimate $1.96\sigma_{Mi}/n^{0.5}$ for i = 3, 4, and 5.

The results of this analysis are shown in table 16 and figure 36. They show clearly that there is a decrease in absolute error as the sample size increases from two to five. The maximum difference in absolute error among different sample sizes (number of runs) for the different wheelpaths was 0.02 m/km. This is a relatively small value, given that the mean IRI value for all of the data was 1.41 m/km. The difference in mean IRI when two runs instead of five are collected is on the order of 1.4 percent.

Table 16. Absolute error for mean IRI.

Number of runs per visit	Left wheelpath error	Right wheelpath error	Average wheelpath error
2	0.060445	0.061901	0.041808
3	0.05456	0.054789	0.040453
4	0.046788	0.046608	0.034191
5	0.041971	0.041186	0.030185

The advantage of maintaining profile data from at least five runs for a site visit is confirmed by this analysis. However, in the event that one or two runs need to be removed from the database during quality review, only a small amount of additional error will be included in that data set.

Effects of Moist and Wet Pavement

The 1999 *LTPP Manual for Profile Measurement*[3] indicates that it may be possible to collect surface profiles on damp pavement. To further study the effects of damp pavement on IRI, the North Central Region Profilometer was run over AC section 7040 in Nebraska on May 6, 1999, immediately following a short rainstorm. The pavement surface was wet, and passing truck tires

were throwing up water spray, but there was no standing water. Forty-five minutes later, during the second test, the pavement surface was still damp; however, truck tires were not picking up spray. Finally, after 1.3 h, the pavement was tested again. The wheelpaths were dry as a result of traffic and had changed to a lighter color.

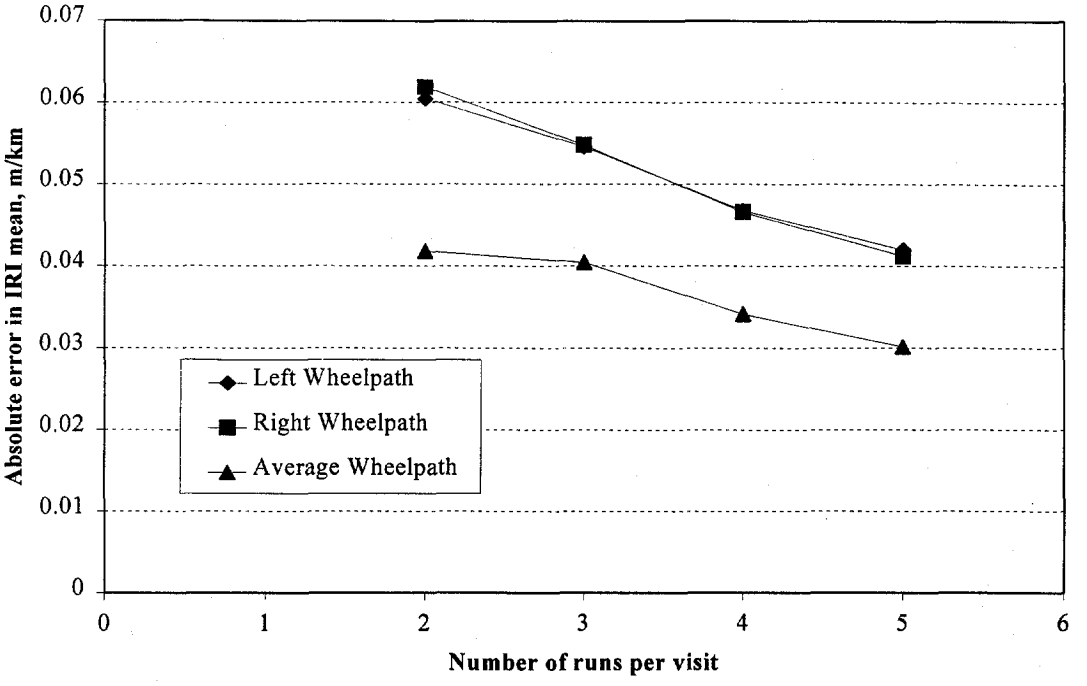


Figure 36. Absolute error in IRI mean with runs per visit.

The results of seven repeat runs under these conditions are shown in figure 37. IRI values for testing on wet pavement are significantly greater due to equipment-related spikes in the profiles. Also, comparing profiles collected at 25-mm intervals indicates that elevation differences between wet and dry pavement are on the order of 2 to 3 mm. Typical elevation differences for the same data filtered with a 300-mm moving average are in the range of 0.5 to 1 mm.

These results indicate that the recommendation in the manual is appropriate — that good IRI data and profiles can be collected on damp pavement. Water on a pavement surface greatly affects profiles collected using the T-6600 Profilometers, and extreme care should be taken to ensure that damp pavements have no effect on collected profiles. This can be achieved by overlaying profiles from consecutive visits and by evaluating the change in IRI.

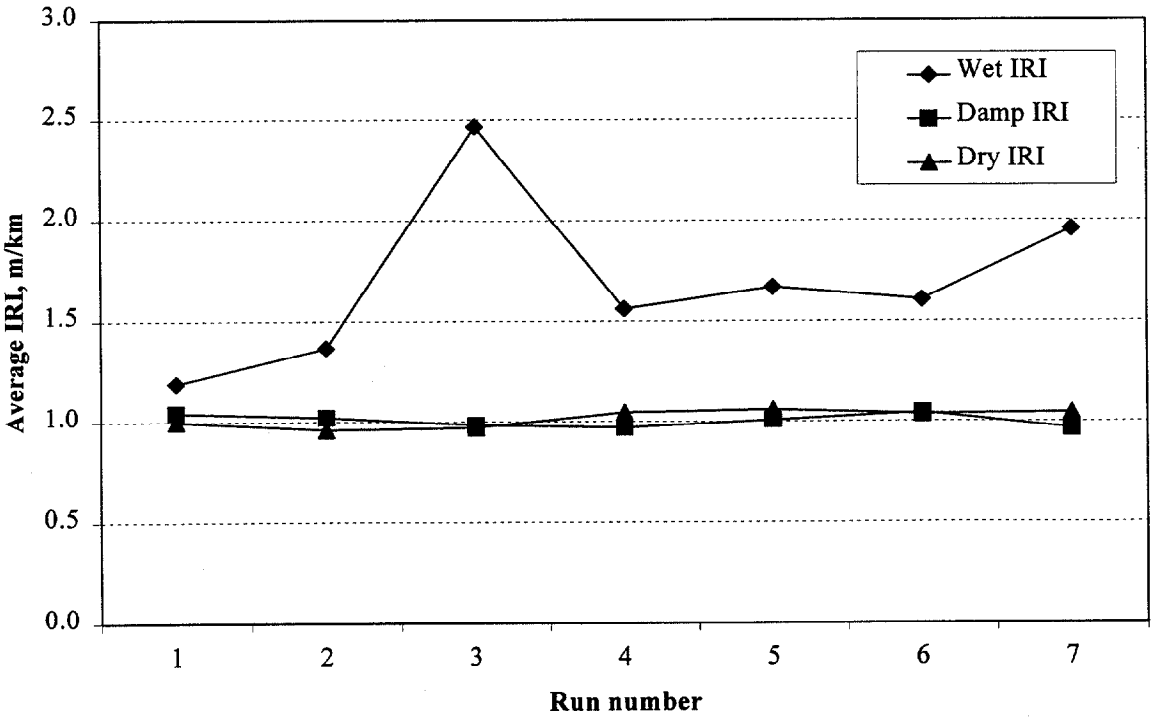


Figure 37. Effect of surface moisture on average IRI.

CHAPTER 7. CONTINUING EFFORTS

Regional contractors deleted bad profile data, replaced spike data, and reprocessed and replaced profiles tested in the wrong location by September 1999. Because the data set used in this analysis contains IMS profile data loaded prior to October 1, 1997, a 2-year set of IMS profile data was not reviewed under this analysis and was not reviewed using new quality control methods. An evaluation of the new data began in September 1999. That evaluation identified several additional problems, which are listed in Appendix M. These data should be deleted, reprocessed, and replaced by September 2000.

New quality control methods were implemented for LTPP profile data collection in January 1999, based on the recommendations of this study. Several other methods and software tools may also be implemented following this research.

Two software products were developed in conjunction with this project — Profile Viewer and Profile Extractor. These tools may be available for regional use, after modification, to assist with quality assurance. The North Central Region also developed a third software tool (DejaView) for improved quality control and data review by Profilometer operators and RCOC reviewers. This tool overlays current and previous profiles, displays IRI histories, identifies spike locations, checks for compliance with American Society for Testing and Materials (ASTM) E 950, and allows for detailed inspection of shifted profiles and DMI miscalibration. The characteristics of this tool may be incorporated into the LTPP ProQual software to provide more efficient, thorough quality control of profile collection.

CHAPTER 8. RECOMMENDATIONS

Several quality control (QC)-related recommendations have surfaced during this analysis. The recommendations include improved methods for field evaluation of profile data quality, confidence limits for IRI values for consecutive runs, and confidence limits for the expected yearly change in IRI. In addition, suggestions for RCO review of profile data are provided, a recommendation on the number of runs to be tested is made, and suggestions for further improvement of the Profilometer equipment are provided.

Field Evaluation of Profiles

Suggested recommendations regarding quality control for profile data collection are listed below. Several of these items have already been implemented or are scheduled for implementation:

- Operators should visually review overlaid plots of each test section prior to leaving the location of the site. Items to be looked for include those listed in Appendix A. Locations of spikes should be shown clearly on these plots. The option to quickly zoom into the profiles at the start and end of the section or at any location of interest is also needed for analysis of spikes and DMI calibration.
- Operators should have a visual history of the left and right wheelpath IRI values—past and present IRI values for each section at the time of testing. This helps to identify variability related to season and time of day.
- Operators should have automated software to check the confidence limits for run-to-run comparisons developed under this analysis.
- Operators should have automated software to check the confidence limits for expected yearly change in IRI. If the limits are exceeded, the operator should review all other profiles, statistics, and the pavement surface to ensure that no equipment- or operator-related problems are present.
- Operators should have software that allows for immediate review and overlay of current and previous test section profiles.
- Timeliness is critical to the efficiency of field review of the profile data. Therefore, field QC software must be intuitive in presenting its results, eliminating unnecessary repetitive operations and not requiring excessive amounts of time for data retrieval and database upkeep. For example, utilities can be written to extract all information needed for past profile and IRI history database files from the IMS or from RIMS uploaded files.
- Operators in the North Atlantic and North Central Regions should consider avoiding profile collection in the early spring and should more carefully review profiles from this time period to ensure good-quality data.
- Unreported section maintenance and rehabilitation make analysis of smoothness trends very difficult. Since Profilometer operators generally visit test sites more frequently than other data collection crews, it is recommended that the operators use photos, video, small site

maps, or other methods to report the presence of new maintenance and rehabilitation operations.

Office Review of Profile Data

If field review is adequately completed, new problems identified in RCOC office review should be minimal. Recommended procedures for office review are similar to those for the field operators, with a few additions. Most of the following procedures have been, or can be, automated to improve efficiency and accuracy:

- Visual review of overlaid left, right, and center profiles from all runs.
- Visual review of overlaid current and previous profiles.
- Visual review of mean left and right wheelpath IRI values from the current and previous visits.
- Comparison of standard deviation with run-to-run confidence limits.
- Comparison of previous and current mean IRI values with visit-to-visit confidence limits.
- Checking that data and comments are complete, that all indices are within the IMS limits, and that no profiles are added to the IMS with RCO codes other than "1" unless confirmed and commented on.
- Confirmation of all pavement section maintenance and rehabilitation with agency Strategic Highway Research Program (SHRP) contacts and updating of the IMS database as quickly as possible.

IMS Database Design and Procedures

Two more issues that make analysis of IRI data difficult can be addressed by changing IMS database design and practices.

First, if profile sections are tested more than once on the same day, it is not possible to search the IMS database and accurately determine the individual sets of five test runs for all visits. This is because sorting by time and increasing run number can be incorrect when runs 2 or 3 were collected after runs 4 and 5. Also, it is possible for runs 1 through 4 to be in the database for the morning visit and runs 5 through 9 to be present for the mid-day visit with the time between runs nearly evenly spaced. There are several sets of five runs that were collected on consecutive days, making it impossible to be assured that a single testing date and one to five runs identify a single visit. One solution to this problem is to create a single visit code for each section visit (typically five runs).

The second issue is the tracking of maintenance and rehabilitation. Because IRI can be greatly affected by patching, crack sealing, grinding, overlays, and other repairs, knowing the status of pavement repairs and maintenance is critical to analysis of LTPP smoothness data. A concerted effort is needed by RCOC's to identify maintenance/rehabilitation events, contact agency

representatives, and update the IMS maintenance and rehabilitation tables quickly. However, even if this maintenance information is in the database, it is not easy to determine whether maintenance has occurred between visits. The construction number field is used to easily identify a construction event on a pavement. Having a similar type of number for maintenance events that affect profile (possibly excluding shoulder treatments) would be helpful to researchers using the LTPP smoothness database.

Repeatability of K.J. Law Profilometer

Repeatability of the T-6600 Profilometers' IRI values is not statistically different from that of the 690DNC Profilometers in most regions, based on comparison of a large amount of 690DNC data with a small amount of T-6600 data. The exception is in the Western Region, where problems with the DMI led to increased variability with the 690DNC.

However, visual review of the overlaid profiles from single and multiple visits collected indicates that, generally, the profile repeatability of the 690DNC is better than that of the T-6600. Profiles collected on the same day by the 690DNC, in many cases, overlay so well that the five traces appear to be a single trace. This is not typically the case with the T-6600. Also, when overlaid on the same scale, traces from the same site collected on different dates by the old and new profilers in the North Central Region frequently do not match well in the longer wavelengths.

Improving the profile repeatability of the T-6600 Profilometer should be pursued. Insufficient data was available in the current data set to determine whether the IRI repeatability of the new profilers is as good as, or better than, that of the old equipment. Such assurances can only be developed in a statistically designed comparison. LTPP studies in 1996 compared the output from the old and new profilers in each region. The conclusions indicated that profiles from the T-6600 Profilometers from each region are similar to those obtained using the North Central Region 690DNC.[6] Point-to-point comparison of repeated T-6600 profiles in that study indicated that all four vehicles passed the LTPP requirements (six-sample standard deviation $\leq$ 0.64 mm) on the two AC sections. Three of the four vehicles passed the requirements on PC pavements, and only one vehicle passed the requirements on a chip seal section.

In addition, a 1998 comparison of all four regional T-6600 Profilometers concluded that the IRI output from each profiler is not statistically different.[7] When compared with Dipstick IRI values, all four profilers met the precision criteria ($\pm$ 0.16 m/km relative to Dipstick IRI) on three of the four sites. One wheelpath of one profiler did not meet the criteria for the fourth site — a rough AC pavement.

Single-Visit Variability Confidence Limits

Analysis of the variability of the transformed GPS and SPS run-to-run IRI values indicates that single confidence limits can be recommended that are applicable to all roughness levels. These confidence limits can be used by Profilometer operators to flag data sets with potential equipment- or operator-related problems. This will allow the operator to look more closely at the

profile data, the test section, and previous profile information from the test section to ensure the quality of the newly collected data.

For GPS sections, the recommended field-use confidence limit is a transformed standard deviation of five runs that is less than 0.32. A limit of 0.40 is recommended for the SPS sections. This limit does not indicate that the data are bad. It simply alerts the operator to look more closely at the data to ensure its quality.

Between-Visit Confidence Limits

Quality control checks of the IRI versus time slopes between visits for unrehabilitated sections can be accomplished using the equations listed below. These equations are based on currently available data and should be used only as an indicator that further evaluation of the section profiles or pavement condition is needed to confirm data quality.

The ranges of applicability for these equations are — 0.5 to 4.0 m/km for AC, 0.5 to 3.0 m/km for AC/PC, and 0.5 to 3.5 m/km for PC. Because of the small denominator, it is not always appropriate to apply these equations when the time between testing is less than 6 months. (These equations were first presented earlier in this report.)

AC Pavements:

Upper Limit: $IRI_E = IRI_P + \Delta T\,(0.1984\,IRI_P - 0.0273)$ (9)

Lower Limit: $IRI_E = IRI_P + \Delta T\,(-0.0282\,IRI_P - 0.0995)$ (10)

PC Pavements:

Upper Limit: $IRI_E = IRI_P + \Delta T\,(0.1532\,IRI_P + 0.0094)$ (11)

Lower Limit: $IRI_E = IRI_P + \Delta T\,(-0.1158\,IRI_P - 0.0686)$ (12)

AC/PC Pavements:

Upper Limit: $IRI_E = IRI_P + \Delta T\,(0.3244\,IRI_P - 0.1538)$ (13)

Lower Limit: $IRI_E = IRI_P + \Delta T\,(-0.1158\,IRI_P - 0.0006)$ (14)

Where:

IRI_E = Expected IRI, m/km
IRI_P = Previous IRI, m/km
ΔT = Time since previous visit, yrs

Calibration of DMI

The current methods for calibrating DMI systems appear to have addressed the problem of DMI miscalibration. Overlaying profiles from year to year is a good way to immediately notice and address this potential problem. Software that allows the operator to zoom in on the starting and ending stations of all runs from current and previous visits can assist with this evaluation. Also, as Profilometers become older, past performance indicates that it will be more critical for profiles to be overlaid and checked for DMI problems.

Number of Runs in the IMS

Maintaining five runs in the IMS database reduces variability and should be continued in order to maintain the current level of absolute error. However, if runs must be eliminated from the IMS due to equipment- or operator-related problems, the maximum difference in error between two and five runs is typically less than 1.4 percent of the average LTPP test section IRI. Therefore, there should be little concern about the statistical usefulness of reduced data sets.

APPENDIX A. DESCRIPTION OF PROFILE PROBLEMS

Descriptions of Questionable Profiles

During the profile review, several questionable profile characteristics were noted. Many of these characteristics were described by RCOC profiler operators and data reviewers in the RCO comments listed in the IMS database MON_PROFILE_MASTER table. Others do not appear to have been noted during field data collection or final evaluation. The general descriptions of these characteristics are listed in table 17, and supplemental descriptions and example profiles are provided in subsequent sections of this appendix. The SPS and GPS profiles exhibited the same questionable profile characteristics.

Table 17. Questionable profile characteristics noted.

Profile characteristic	Percentage of profile runs
Reparable profile runs:	-
RCO-noted saturation spikes	0.6
Unnoted saturation spikes	3.8
Irreparable profile runs:	-
Lost lock	3.9
Out of study	0.4
Pending profile runs:	-
Early start (5-10 m)	1.6
Early start (>10 m)	2.0
Miscalibrated DMI	1.0
Collected in wrong location	1.2
Total problem runs noted:	14.6

Saturation Spikes

Until July 1996, all profile data in the LTPP database were collected using K.J. Law 690DNC Profilometers equipped with optical vertical height sensors that bounce a beam of white light off the pavement surface. Using an accelerometer and the angle at which the light returns to the collection vehicle, the vertical pavement surface profile is measured quite accurately in two pavement wheelpaths. Because the sensors used white light, the pavement surface beneath the sensors was shaded using a shroud to prevent sunlight from diluting the light entering the sensor receivers.

If too much light was reflected into the optical sensor receiver, the receiver became saturated with the light. In practice, this typically resulted when the profile sensor passed over the white paint or reflective tape placed at the start and end of LTPP test sections. Depending on the intensity setting of the optical sensor light source, passing over reflective stripes occasionally produced "saturation spikes" in the profile data that could be more than 10 times the original profile elevation. Such spikes sometimes resulted in large changes in IRI values for a test section.

When saturation spikes were noted in LTPP profiles, regional engineers were instructed not to use these data points in IRI computations and to provide comments for any saturated profile runs. If the saturation was detected immediately after evaluation, regional operators were instructed to mark the spikes in the profile, adjust the Profilometer sensors, and, if possible, complete additional runs until undistorted profiles were obtained. However, without the recently available option of overlaying the profiles from multiple runs for visual review, it was difficult to detect all saturated profiles or profiles containing spikes.

Undetected saturation spikes result in computed smoothness indices (e.g., IRI, slope variance, Mays Output, RMSVA) that are many times greater than the true indices. Even if the saturation spikes had been detected initially by the operators and ignored in the IRI computation, the ProQual 1.4 software used to analyze the pre-1996 data replaced the ignored data points with zero values that skewed the other computed indices. As a result, it is necessary to recompute indices for all profiles that exhibit saturation spikes.

Saturation spikes have been noted in 4.5 percent of the LTPP profile runs. An example of such spikes is shown in figure 38. At this site, saturation spikes occurred at the start and end of all runs. These spikes were noted in the comments, but were not marked and were ignored during IRI computation.

Lost Lock in Profiles

When the optical sensors do not receive enough returned light to determine an elevation, the profile elevation is based solely on the accelerometer readings. This phenomenon has been described as "complete lost lock." It generally occurs when the Profilometer passes over a very dark pavement (e.g., a new AC overlay) and there is not enough light reflected to the vertical optical sensor receivers to provide an accurate surface profile. The ability to manually adjust the light intensity to adjust for dark pavements was provided with the 690DNC Profilometer; however, the effect of lost lock was somewhat difficult to detect during data collection. If the vertical optical sensors were disabled by lost lock, the measured profile only included the long wavelength profile measured by the accelerometers. Such a profile generally appears very smooth, lacking the small surface variations common to most pavement profiles. Runs 1 through 5 in figure 39 illustrate complete lost lock resulting from a dark pavement surface.

Another condition under which lost lock can occur is when sunlight or headlight beams pass beneath the shrouds, making the ambient light condition too bright for the sensors to determine an elevation accurately. This can occur in any condition where the vertical optical sensor light beams are too weak to trigger the receiver sensors properly. If the lost lock is intermittent, two types of profile distortions may occur—rapidly intermittent and occasionally intermittent lost lock. Occasionally intermittent lost lock will allow portions of the profile to remain unaffected, adequately reproducing profiles from subsequent runs along portions of the site length. However, when lost lock occurs, the areas of lost lock in the profile will deviate noticeably from unaffected runs. The effect of occasionally intermittent lost lock on pavement profiles is shown in figure 40.

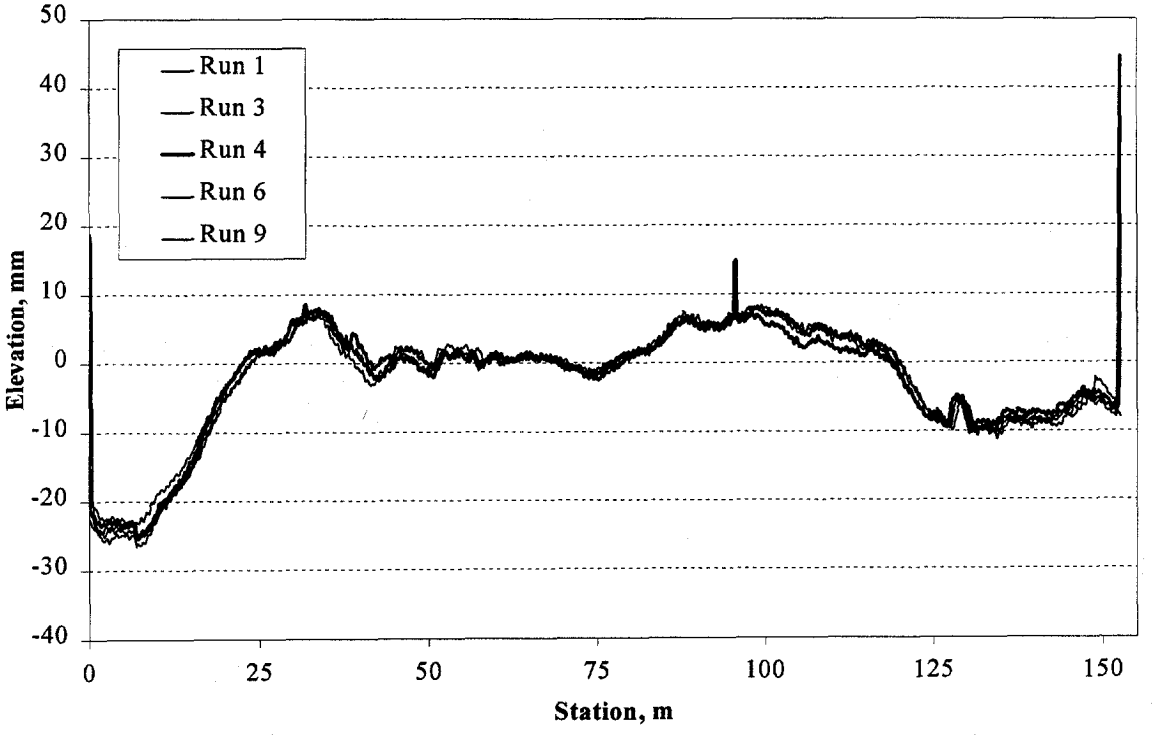


Figure 38. Unnoted saturation spike in right wheelpath profile from Ontario.

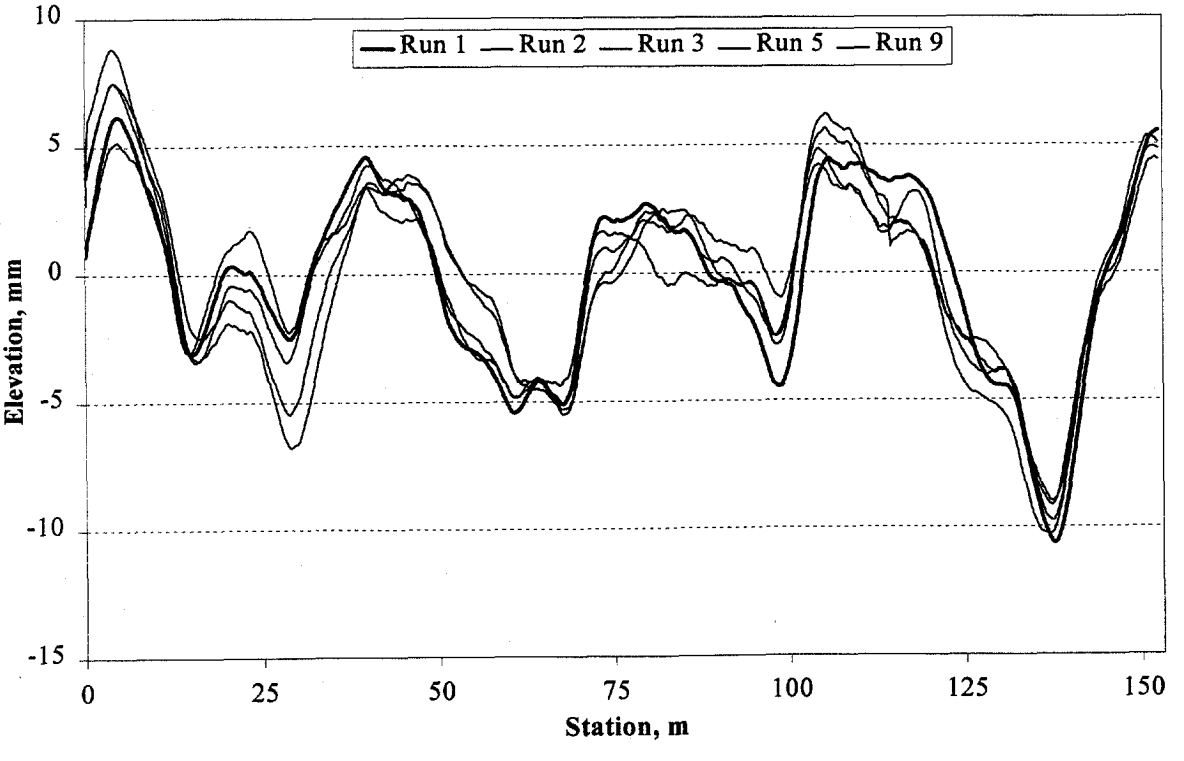


Figure 39. Lost lock in left wheelpath of Illinois site.

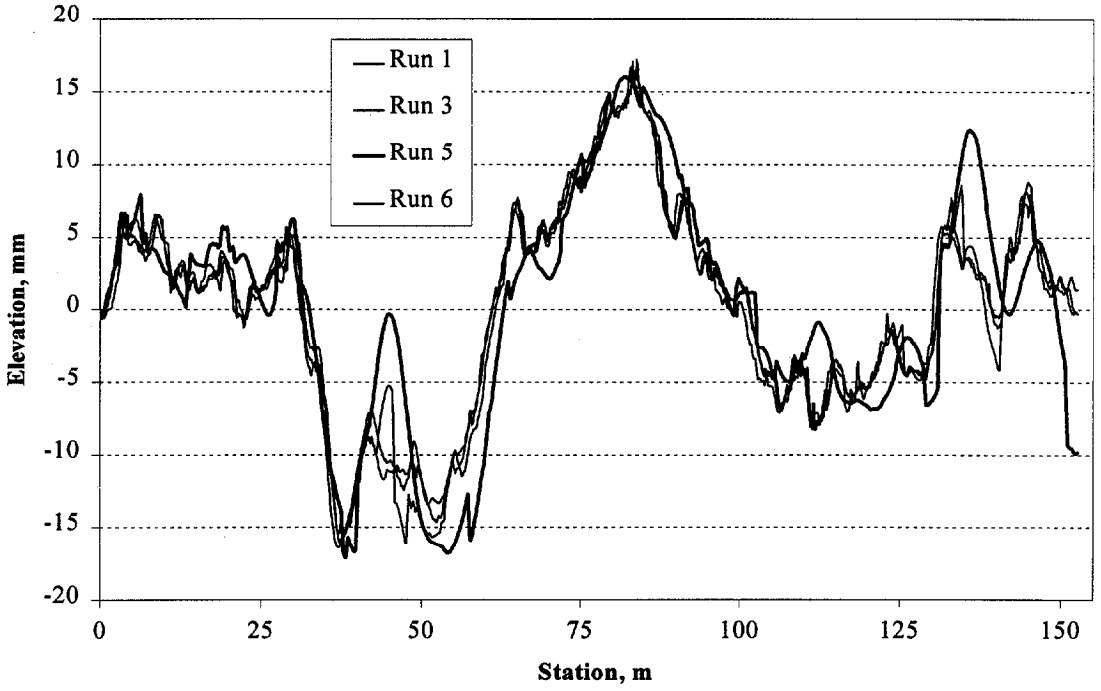


Figure 40. Occasionally intermittent lost lock in North Carolina profiles.

Rapidly intermittent lost lock can occur when the receiver sensors are receiving good and bad optical source input at regular intervals. This results in the fine sawtooth-type profile shown in figure 41. Generally, higher IRI values result from occasionally and rapidly intermittent lost lock as a result of the rapid changes in profile elevation. Occasional and full lost lock have been noted in 2.9 percent of the SPS profile visits. Rapidly intermittent lost lock has been identified in 3.2 percent of the profile visits.

Another potential cause for sawtooth-type profiles is the malfunction of an optical sensor, caused by an intermittent grounding wire connection or other electronic failure. Such an equipment-related problem should occur only in one wheelpath. Profilometer maintenance records can be used to identify the regional equipment and the dates when these damaged sensors were repaired, allowing for closer study of the profiles obtained immediately prior to sensor repair.

Incorrect Start Location

The process of collecting profiles from SPS sections requires that an entire set of section profiles be collected in a single pass. Following profile collection, the operator must manually identify the start location of each SPS section and create a subset of the profile for individual evaluation. This process makes it more likely for profile start locations to be incorrectly identified for SPS sections than for GPS sections. In some cases, it may result in a shift of the start location for a test section from year to year. An example of this type of shift is shown in figure 42. IRI values for the 1990 left wheelpath were 2.4 percent larger than for the subsequent 1992 profile,

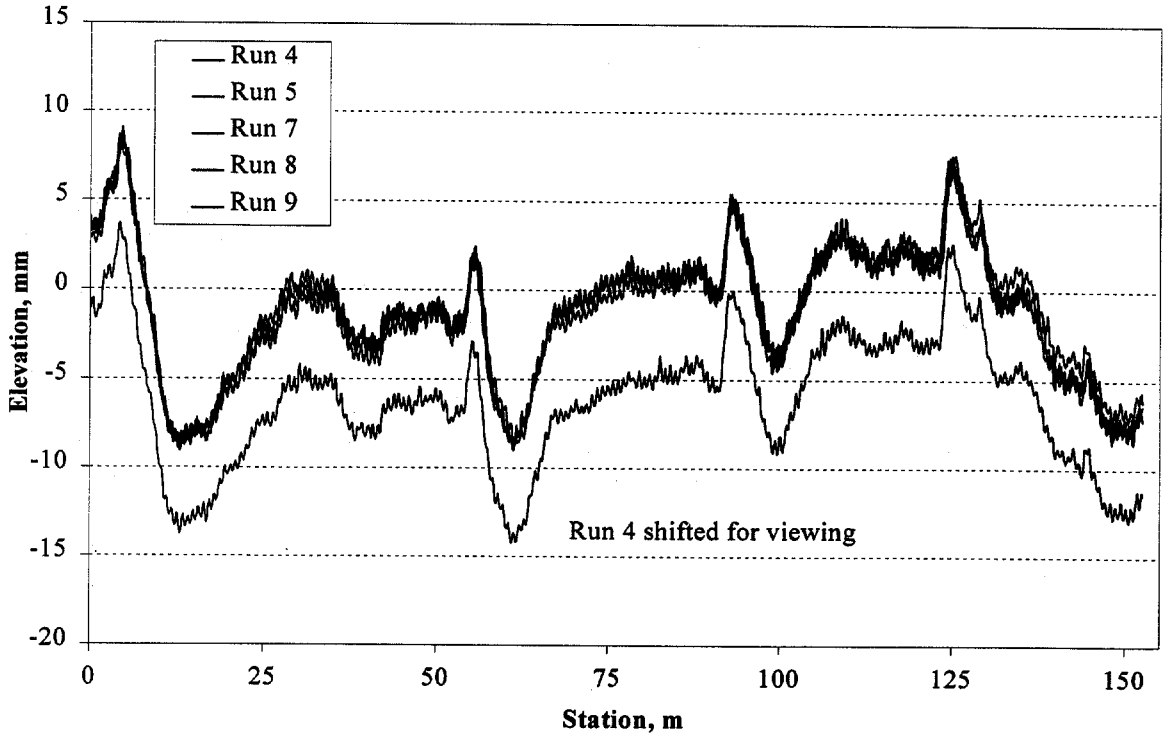


Figure 41. Rapidly intermittent lost lock in Maine profiles.

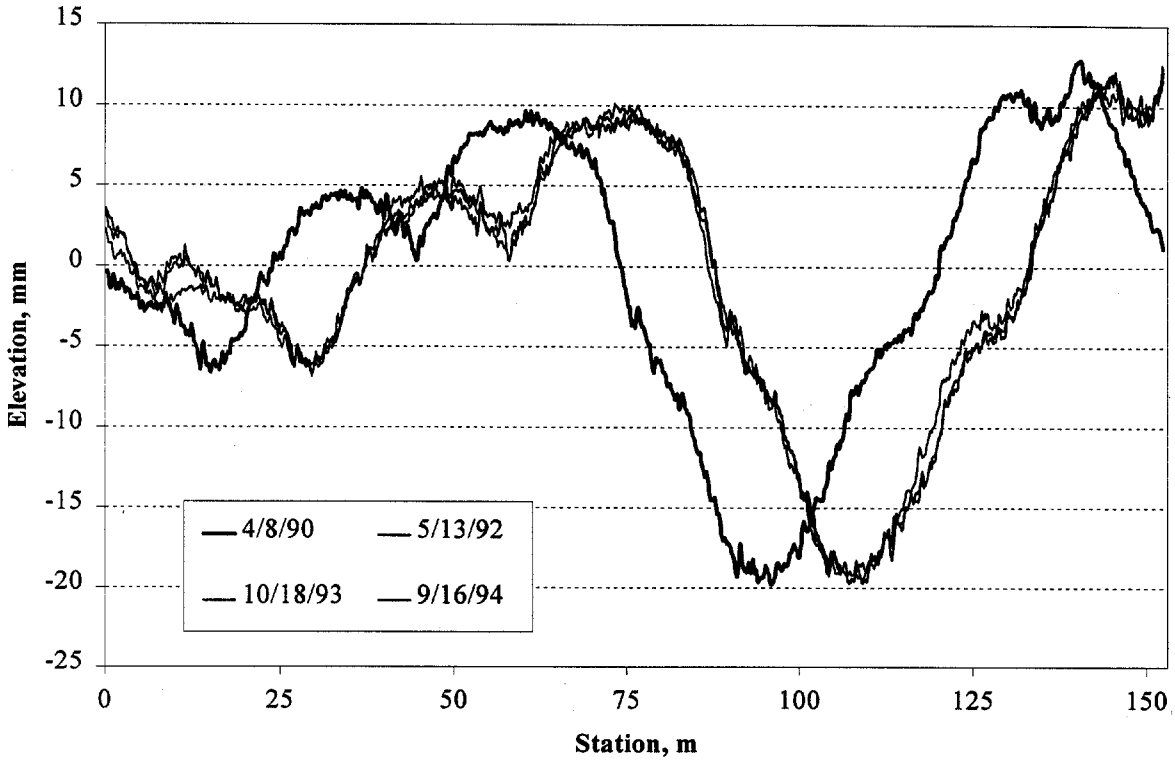


Figure 42. Shifted start for 1990 profiles in Iowa.

indicating a reduction in IRI over time and making performance modeling difficult. Shifted start locations greater than 5 m were noted in 3.6 percent of the section profile runs.

Unreported Maintenance

Although not associated with profile data quality, the maintenance that occurs on test sections is critical to analysis using the data. Highway agencies often do not report maintenance to RCOC's in a timely manner. Although no maintenance may be recorded in the LTPP records, some noted profile characteristics can indicate that maintenance has been conducted between profile visits. Figure 43 indicates that a major change in the first 46 m of profile occurred between the August 1991 and August 1992 visits, even though comments provided by the Profilometer operators do not indicate that maintenance was performed. The IRI for the left wheelpath for 1991, 1992, and 1993 was 1.4 m/km, indicating that the IRI was unaffected. It is unknown how computation of other smoothness indices from these different profiles would be affected.

Unreported Rehabilitation

Unreported test section rehabilitation is also unrelated to profile data quality, but it can significantly affect the conclusions drawn from smoothness data. Participating agencies may not report rehabilitation quickly. If different operators measure profiles at a site in consecutive years, or if previous profiles are not referenced, it is possible that rehabilitation of an LTPP section can go unnoticed for several years. Figure 44 provides an example of incorrectly

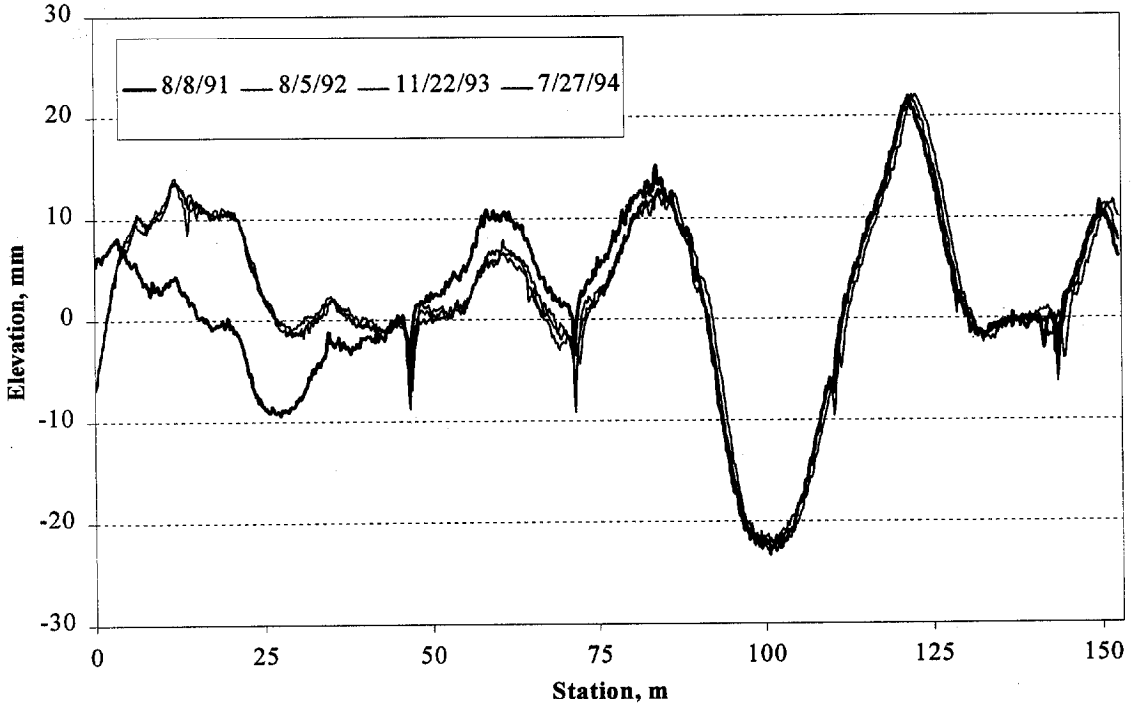


Figure 43. Possible unreported maintenance at Minnesota section.

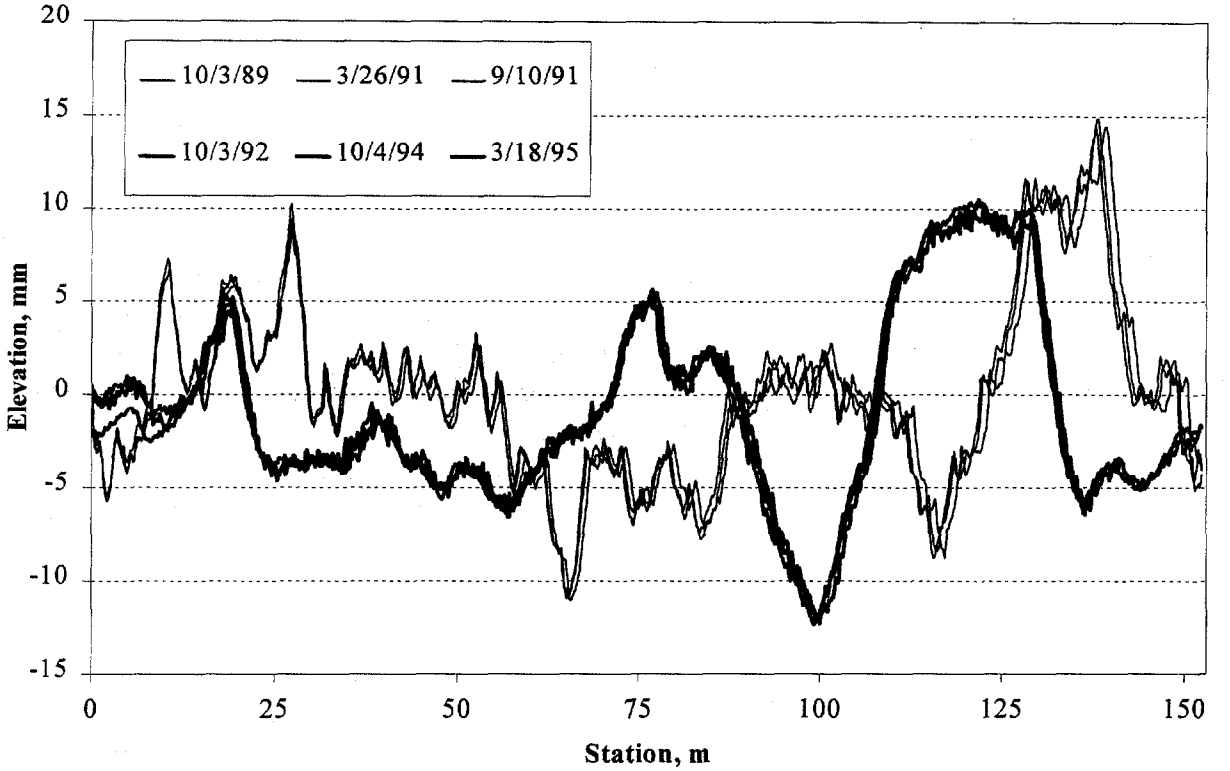


Figure 44. Possible incorrectly reported rehabilitation at Indiana section.

reported rehabilitation. Although the section profile obviously changes drastically between the September 1991 and October 1992 evaluations, the IMS database does not indicate a rehabilitation event until the October 1994 evaluation. Further investigation of sections with this type of profile change is needed to update or correct the database.

Testing at a Different Location

It is surprisingly simple to collect a profile at the wrong location. Site numbers can be entered incorrectly, resulting in the wrong location for a profile in the database. Lead-in stripes, painted 152 m before the start stripe, or other pavement markings can trigger data collection prior to the start of the test section. In SPS sections, if the start station is entered incorrectly during subsectioning, the entire section could be analyzed at the wrong location. For example, although the reason for the different location is not obvious, figure 45 shows the five right wheelpath runs for a site collected in March 1993. Although the IRI values do not show it, indications are that runs 2, 3, and 4 are not collected at the same location as the remaining runs. Runs 1 and 5 actually match the profiles of the 1992 and 1994 profile data collection. The IRI values for the right wheelpath ranged from 1.9 to 2.2 m/km, and the profiles from the wrong location produced IRI values of 2.0 and 2.1 m/km. Standard IRI quality control methods would not have identified this test location discrepancy.

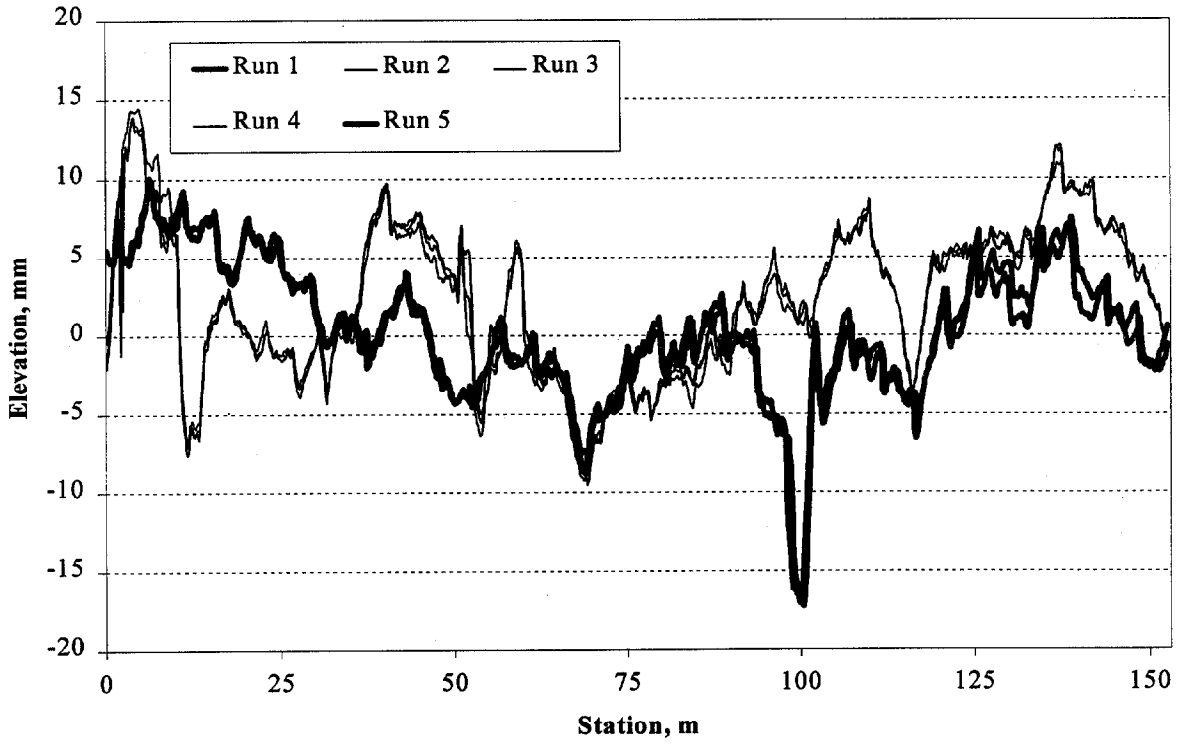


Figure 45. Incorrect testing location at Kansas test section.

DMI Miscalibrated

The DMI's for the LTPP Profilometers are mounted on the left front wheel and must be calibrated against a measured test section length to ensure accuracy. Early in the data collection operation, it appears that several site visits were conducted with a DMI that was miscalibrated. This miscalibration generally results in a "squeezing" of the profile so that its data points are collected at slightly more than 152.4 m. As figure 46 shows, such profiles contain slightly more profile than the actual section length.

If the pavement following that test section is consistently rough, it is possible that a miscalibrated DMI that includes additional pavement length could result in IRI values that are greater than the true values. DMI miscalibration greater than 6 m was noted in 3.1 percent of the profile runs from one region and 1.0 percent of all profile runs.

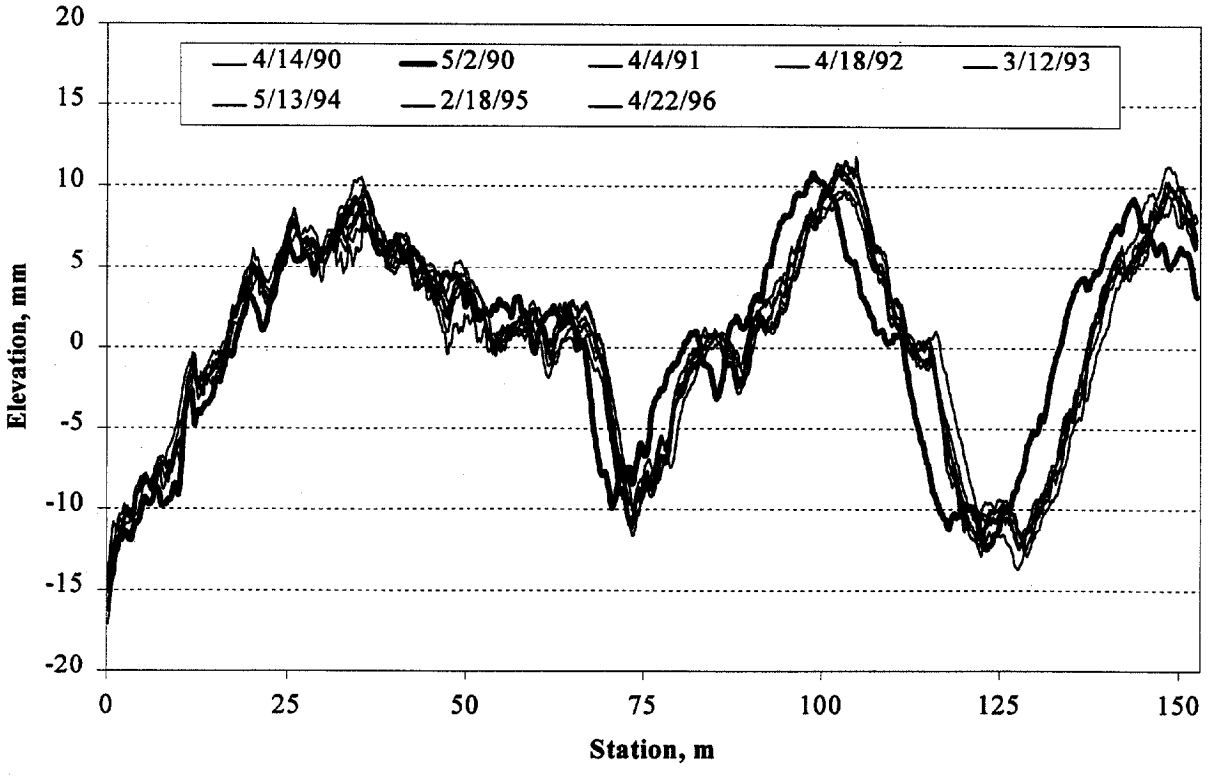


Figure 46. Miscalibrated DMI in Kansas section.

APPENDIX B. RECOMMENDED ACTIONS FOR ADDRESSING QUESTIONABLE PROFILE DATA

In January 1999, the following strategy was approved by FHWA for addressing the problem of questionable profiles in the LTPP database. This strategy is intended to meet the objectives of this study with the least possible delay. Because of the quick response from the RCOC's, the actions were completed by June 1999.

Saturation Spikes

Saturation spikes in SPS and GPS profiles have been identified for each region's profile data. These visits were summarized and reported in feedback reports NC-02 on August 14, 1998, and NC-04 on September 28, 1998. To complete the actions recommended in the feedback reports, the Profile Data Extractor software, described in Appendix D, was developed for extracting profile files from the IMS database and converting them to a form that can be reprocessed using the LTPP ProQual software. The following LTPP contractor actions were recommended in an effort to eliminate the effect of saturation spikes on IRI data in the IMS database:

1. Obtain ProQual input files using the Profile Extractor software.

2. Reprocess these files using ProQual Version 2.08a software (delete spikes, add comments and RCO codes).

3. Send reprocessed RIMS files, archive files, and paper files to RCOC's to replace runs with saturation spikes in the IMS database, as directed by FHWA.

4. Modify the data analysis data set with revised IRI values.

Lost Lock

Profiles that are affected by complete lost lock are irreparably damaged and can only serve to add equipment-related variability to the IMS database. Occasionally intermittent lost lock should be dealt with on a case-by-case basis. If only a small length of profile is affected (e.g., 5 m), smoothness index data from this profile may be unaffected. However, nearly all intermittent lost lock cases listed in feedback report NC-05 are significant. Lost lock that is rapidly intermittent adds short wavelength noise to pavement profiles, generally increasing the IRI values. This noise cannot be removed easily, and removal is not a guarantee of adequate profile quality. Recommended actions for dealing with these data included the following:

1. Provide RCOC's with lists of sections and dates for deletion of IMS section run data where either wheelpath exhibits complete or significant intermittent lost lock.

2. Ask RCOC's to delete these profiles and replace them with available profile run data that are not affected by lost lock for the designated test date.

Shifted Profiles

The effect of shifted profiles on IRI is shown in figure 34. It indicates that the change in IRI is typically less than 3 percent when profiles are shifted less than 5 m. Shifting more than 10 m results in an unpredictable increase or decrease in IRI of 0 to 28 percent. If this shifted start location is a result of improper SPS subsectioning, these data can be returned to good quality by reprocessing the original profile files. As a result, the following recommendations were provided for dealing with shifted profiles in the IMS database:

1. Send a list to RCOC's and IMS management contractor of runs to delete if shifted more than 10 m.

2. Request that RCOC's review files to see if shifted profiles can be resubsectioned.

3. Ask RCOC's to resubsection and reload profiles shifted more than 5 m.

4. Do nothing with profiles shifted 1 to 5 m.

5. Obtain ProQual input files using Profile Data Extractor software if profiles are shifted at least 5 m and no more than 10 m. Do this only on profiles that cannot be resubsectioned by RCOC's. Reprocess and add comments and RCO code of "2" to runs shifted 5 to 10 m using ProQual. Send RIMS files to RCOC's to replace shifted runs in IMS.

Miscalibrated DMI

Profiles affected by miscalibrated DMI cannot be repaired easily. A rigorous method of deleting extra profile data and stretching the profiles could be completed; however, it is not seen as being necessary at this time. Following the approach used for shifted profiles, several steps are presented below for ensuring good quality data and flagging profiles with significantly miscalibrated DMI's:

1. Obtain ProQual input files using Profile Data Extractor software if DMI miscalibration is greater than 5 m.

2. Do nothing with runs shifted $\leq$ 5 m.

3. Delete runs if miscalibrated more than 10 m.

4. Add comments to runs miscalibrated 5 to 10 m using ProQual.

5. Send reprocessed files to RCOC's to replace commented runs in IMS.

Unreported Rehabilitation

Unreported rehabilitation is not a problem of profile collection, but one of associated data collection. For analysis purposes, noting rehabilitation operations is critical to correctly modeling pavement performance. This problem can be repaired through updating the IMS database with correct rehabilitation information. The following steps were recommended for dealing with unreported rehabilitation identified in the visual profile review:

1. Prepare a feedback report listing possible rehabilitation sections for each RCOC.

2. Request RCOC response within 30 days.

3. Update the IMS database and the analysis data set with revised information.

Unreported Maintenance

Maintenance information will not typically be used in standard IRI data analysis. However, visual profile review helped to identify potentially unreported maintenance, which can be used to update maintenance tables and improve IMS data quality. To return this information to the RCOC's for review and database modification, the following steps were recommended:

1. Prepare a feedback report for RCOC's listing sections that have indications of possible unreported maintenance.

2. Request RCOC response within 30 days.

3. Update the IMS database and the analysis data set with revised information.

Wrong Testing Location

Profiles collected in the wrong location should be removed from the database. If the mislocation is a result of improper subsectioning or incorrect file naming, the data may be reprocessed and returned to the IMS database. Actions recommended for profiles that appear to have been collected in the wrong location are listed below:

1. Prepare a feedback report for RCOC's listing pavement sections for which profile testing was completed at the wrong location.

2. Request that RCOC's reprocess and replace these profiles with available good data.

3. Update the analysis data set with revised information.

APPENDIX C. PROFILE VIEWER DESCRIPTION

To complete the initial review of profile data quality, Microsoft Windows-based software, unofficially named "Profile Viewer," was developed to provide the first detailed look at the LTPP profiles. This software displays overlaid profiles from single and multiple years, allowing reviewers to identify consistency in wheelpath location, start position, sensor functionality, and other factors. It also computes IRI and displays operator and RCO comments for each run.

The main Profile Viewer interface screen is shown in figure 47. Data used by the program are extracted from the MON_PROFILE_MASTER and MON_PROFILE_DATA tables in the Oracle-based IMS database and are imported into Microsoft Access database tables. A Microsoft Visual Basic interface allows the operator to select the State, section number, test data, wheelpath, and run numbers for plotting. Two general viewing options are available. First, the operator can view the first run from one or all section profile dates, as shown in figure 47. This allows for year-to-year comparison of the run location, IRI values, DMI accuracy, and rehabilitation/maintenance operations. The asphalt overlay prior to the second visit is obvious from this view.

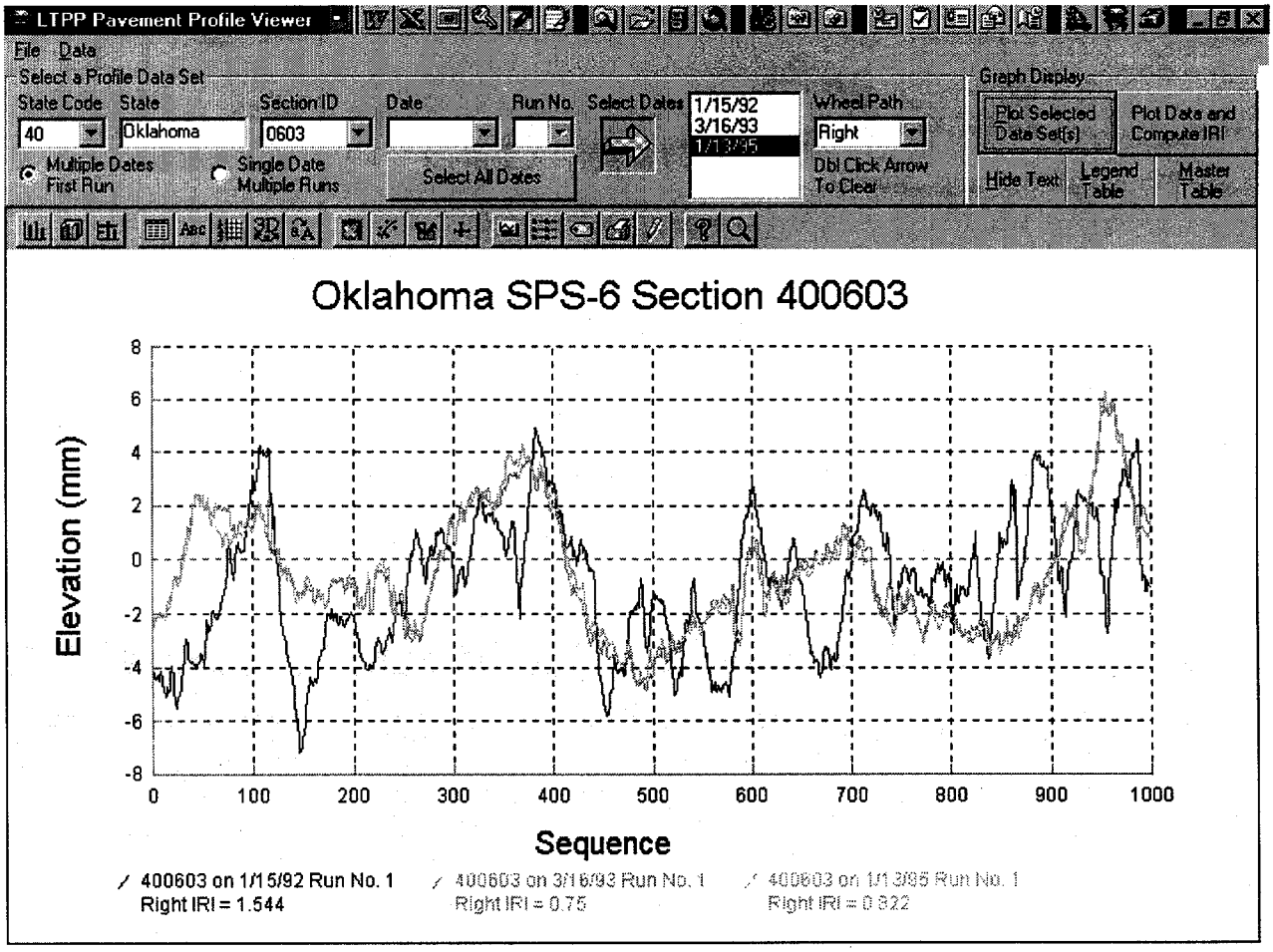


Figure 47. Multi-date view from Profile Viewer software.

The second option is to view selected runs from a single date and wheelpath. This option, shown in figure 48, helps the operator review run-to-run repeatability, saturation spikes, lost lock, and shifted profile locations.

To provide the reviewer with operator comments, climatic information, testing times, and other information, Profile Viewer shows MON_PROFILE_MASTER table information (figure 49) on screen for the section being reviewed. Other options include batch printing, complete modification of the plotting display, and expansion of the plotted profile screen.

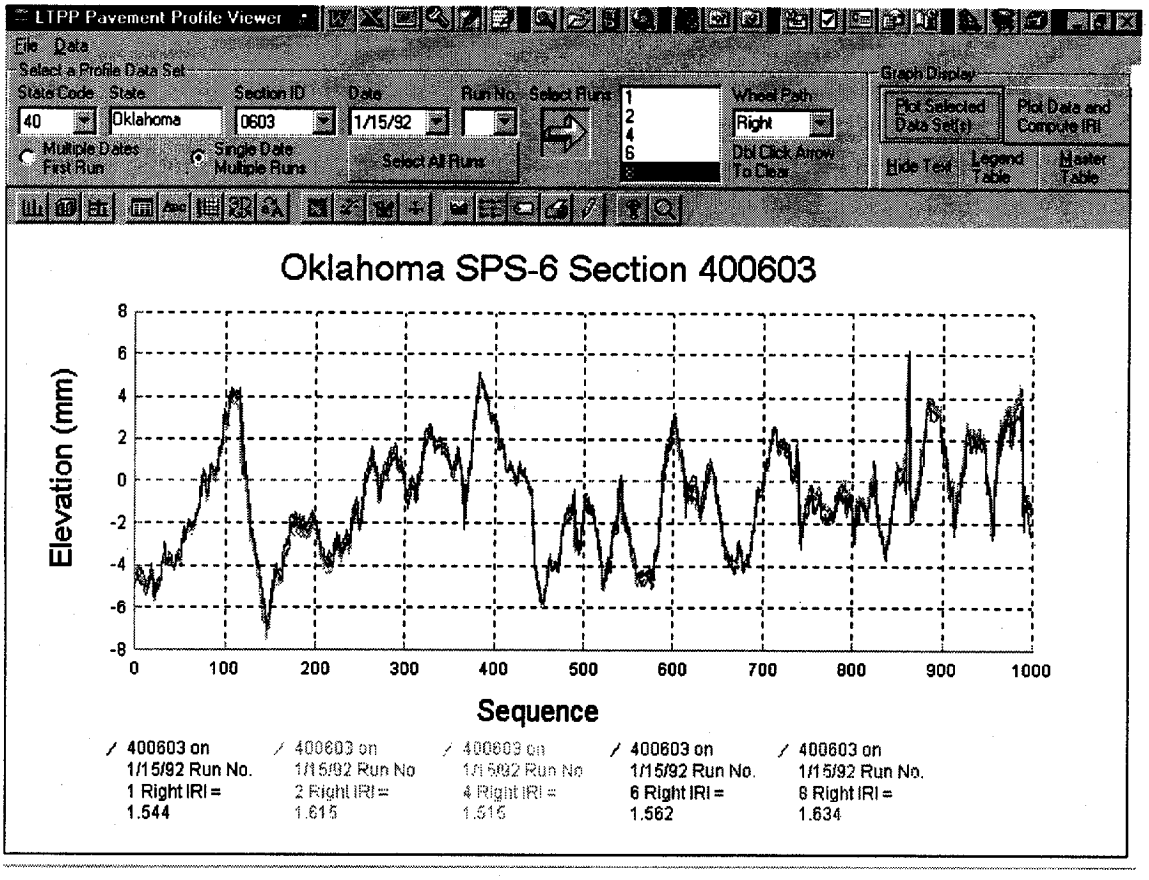
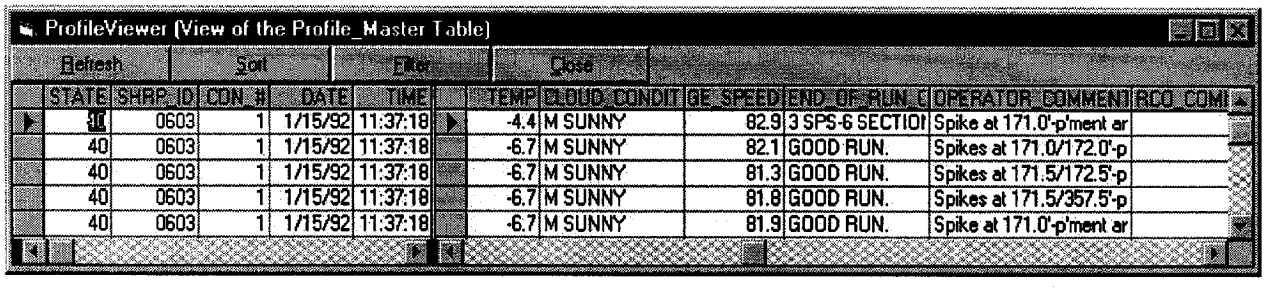


Figure 48. Multiple-run output from Profile Viewer software.



STATE	SHRP_ID	CON_#	DATE	TIME	TEMP	CLOUD_CONDIT	GE_SPEED	END_OF_RUN_C	OPERATOR_COMMENT	RCO_COMI
40	0603	1	1/15/92	11:37:18	-4.4	M SUNNY	82.9	3 SPS-6 SECTIOI	Spike at 171.0'-p'ment ar	
40	0603	1	1/15/92	11:37:18	-6.7	M SUNNY	82.1	GOOD RUN.	Spikes at 171.0/172.0'-p	
40	0603	1	1/15/92	11:37:18	-6.7	M SUNNY	81.3	GOOD RUN.	Spikes at 171.5/172.5'-p	
40	0603	1	1/15/92	11:37:18	-6.7	M SUNNY	81.8	GOOD RUN.	Spikes at 171.5/357.5'-p	
40	0603	1	1/15/92	11:37:18	-6.7	M SUNNY	81.9	GOOD RUN.	Spike at 171.0'-p'ment ar	

Figure 49. Master table output from Profile Viewer software.

APPENDIX D. PROFILE DATA EXTRACTOR DESCRIPTION

Introduction

The "Profile Data Extractor" software developed for this study was primarily intended for downloading profile data from the LTPP IMS database in a format that can be readily reprocessed and uploaded using the ProQual profile processing software. The software utility was developed using Visual Basic 5.0 and runs under the Windows 95 operating system. It extracts profile data from the LTPP IMS database through Oracle using an Open Database Connectivity (ODBC) link. Output files are in FoxPro 2.5 database format.

Hardware and System Requirements

To run the Profile Data Extractor application, the host computer must have the following hardware and software:

- 80486 or higher microprocessor.
- Hard disk with at least 30 megabytes of available space.
- VGA or higher resolution.
- 16 megabytes of RAM.
- CD-ROM drive.
- Microsoft Windows 95 or Microsoft Windows NT 3.51 or later.
- Oracle SQL Plus 3.3 for Windows 95.
- 32-bit Oracle73 ODBC driver.
- FHWA-LTPP IMS database link.

Starting the Profile Data Extractor Application

The user begins the application by selecting *Profile Extractor* from the Programs menu following installation. After selection, the System Access dialogue is displayed, allowing the user to link to the FHWA-LTPP IMS database. The user must provide the correct user ID, password, and data source name to complete the connection.

Using the Profile Data Extractor Application

When the application is started, the screen shown in figure 50 will be displayed. To create a selection filter, the user enters a State code or a list of State codes and the desired range of survey dates. Selecting the search option prompts the utility to display a source list with SHRP ID's and test dates for all IMS profile data within the search range. The user can then select one, a few, or all of the selected data for export into FoxPro format. File names are automatically generated for the data, including visit codes for each time the section is tested. These selected file names are used in exporting the data to individual ProQual-compatible files, and are shown on the export screen in figure 51.

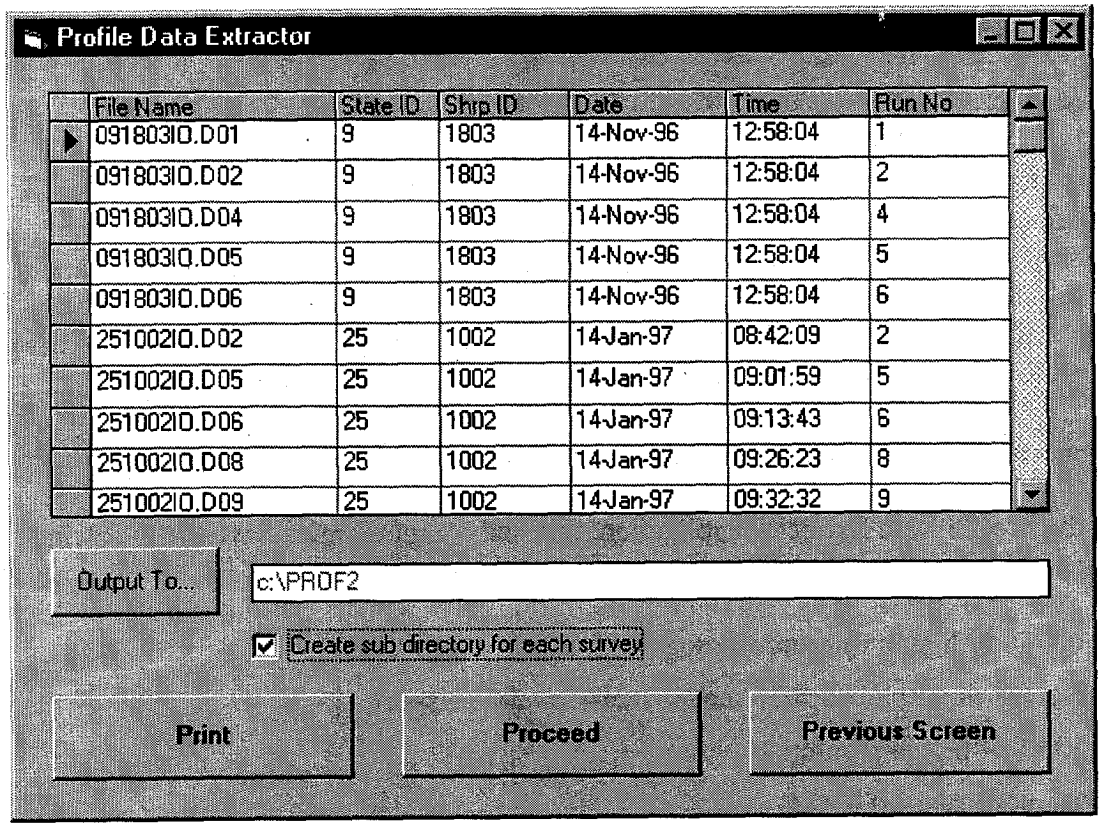


Figure 50. Source list from Profile Data Extractor utility.

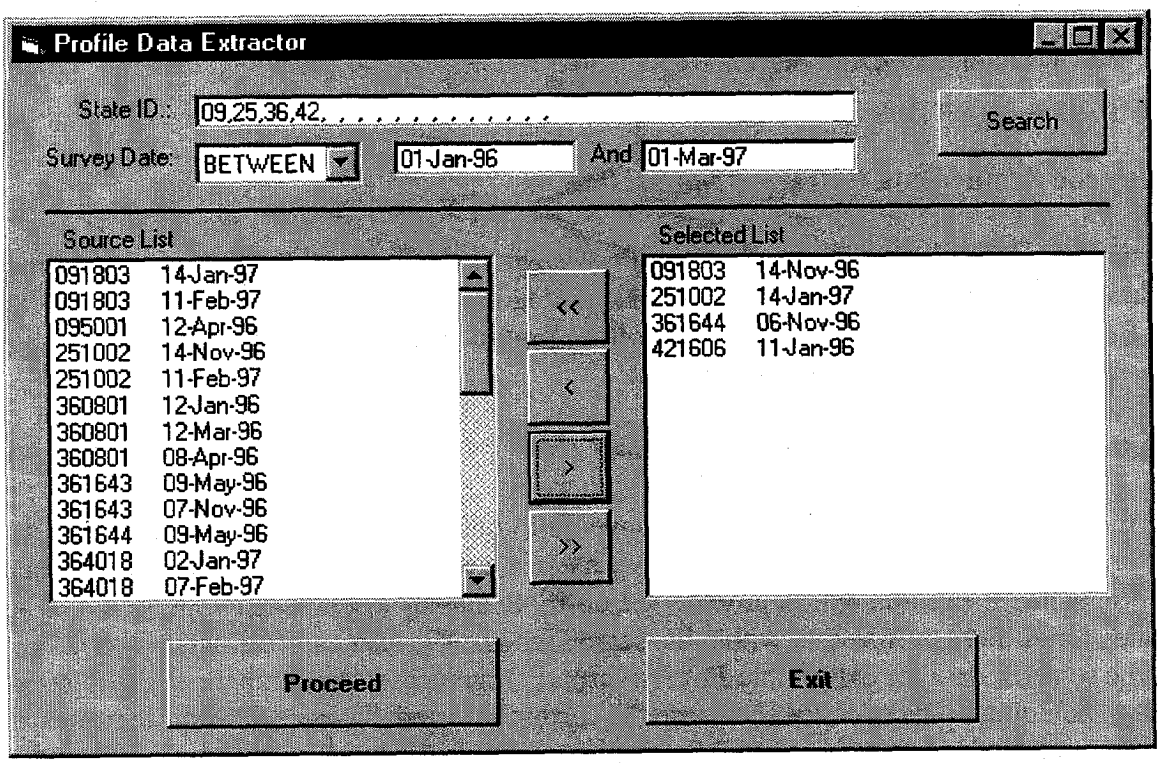


Figure 51. Selected list from Profile Data Extractor utility.

APPENDIX E. SUMMARY OF ALL SATURATION SPIKES

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
SR	1	1001	13-Jan-93			2	2									2
SR	1	3028	16-Feb-94			2	2								2	
SR	1	4073	08-May-90			2	2									2,5
SR	1	4073	08-May-90			5	5									2,5
SR	1	0161	10-Jan-96			3	3								3	
SR	1	0163	10-Jan-96			1	1								1,2,3	
SR	1	0163	10-Jan-96			2	2								1,2,3	
SR	1	0163	10-Jan-96			3	3								1,2,3	
SR	1	0504	10-Aug-94			5	5								5	
SR	1	0509	10-Aug-94			2	2								2	
SR	1	0563	10-Aug-94			4	4								4	
SR	1	A320	07-Jun-90			9	9								9	
SR	1	B350	08-Aug-94			1	1								1	
SR	1	C320	10-Apr-96			5	5								5	
WR	4	1016	25-Feb-93			4	4								4	
WR	4	1021	30-Mar-90			4	4								4	
WR	4	1021	19-Feb-92			6	6									6,7
WR	4	1021	19-Feb-92			7	7									6,7
WR	4	1034	03-Feb-93			2	2								2,3	
WR	4	1034	03-Feb-93			3	3								2,3	
WR	4	1036	08-Aug-89			9	9								9	
WR	4	1036	28-Feb-95			4	4								4	
WR	4	6055	25-Mar-90			4	4									4
WR	4	6055	18-Feb-93			1	1								1	
WR	4	0114	02-Dec-95			3	3									3
WR	4	0123	27-Feb-95			4	4								4	4
WR	4	0160	27-Feb-95			5	5									5
WR	4	0161	27-Feb-95			3	3								3	3
WR	4	0216	05-Mar-95			4	4								4	
WR	4	0261	25-Jan-94			4	4								4	
WR	4	0263	05-Mar-95			3	3								3	
WR	4	0264	05-Mar-95			3	3								3,4	
WR	4	0264	05-Mar-95			4	4								3,4	
WR	4	0501	21-Sep-90			1	1								1,7,8	
WR	4	0501	21-Sep-90			7	7								1,7,8	
WR	4	0501	21-Sep-90			8	8								1,7,8	
WR	4	0506	21-Sep-90			2	2								2	
WR	4	0660	27-Feb-92			1	1								1	
WR	4	A310	28-Mar-90			5	5									5
WR	4	A330	28-Feb-95			2	2								2	
WR	4	C310	17-Nov-94			1	1								1	
WR	4	C330	17-Nov-94			4	4								4	
WR	4	C350	17-Nov-94			2	2								2	
WR	4	D350	13-Jan-92			6	6								I	I
SR	5	2042	21-Sep-94			5	5								5	
SR	5	A602	11-Sep-96			2	2								2	5,7,9
SR	5	A602	11-Sep-96			5	5								2	5,7,9
SR	5	A602	11-Sep-96			7	7								2	5,7,9
SR	5	A602	11-Sep-96			9	9								2	5,7,9
SR	5	A604	11-Sep-96			5	5								5	
SR	5	A605	11-Sep-96			2	2								2	
SR	5	A607	11-Sep-96			5	5								5	
WR	6	1253	06-Dec-89			1	1									1,3
WR	6	1253	06-Dec-89			3	3									1,3
WR	6	2002	11-May-91			2	2								2	
WR	6	2040	20-Apr-92			4	4								4	
WR	6	2040	06-Jun-94			4	4								4	
WR	6	2041	25-Mar-93			1	1								1,4,7	2,4
WR	6	2041	25-Mar-93			2	2								1,4,7	2,4
WR	6	2041	25-Mar-93			4	4								1,4,7	2,4
WR	6	2041	25-Mar-93			7	7								1,4,7	2,4
WR	6	2041	06-Jun-94			1	1								1,2,3,4	
WR	6	2041	06-Jun-94			2	2								1,2,3,4	
WR	6	2041	06-Jun-94			3	3								1,2,3,4	
WR	6	2041	06-Jun-94			4	4								1,2,3,4	
WR	6	2647	13-Jun-94			3	3								3	
WR	6	3019	17-Mar-93			3	3								3	
WR	6	3042	08-May-96			2	2								2	
WR	6	7455	22-Mar-93			5	5								5	
WR	6	0502	11-Feb-92			2	2									2
WR	6	0503	11-Feb-92			1	1									1,4

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
WR	6	0503	11-Feb-92			4	4									1,.4
WR	6	0504	11-Feb-92			2	2									2
WR	6	0505	11-Feb-92			3	3									3
WR	6	0506	11-Feb-92			2	2									2,4
WR	6	0506	11-Feb-92			4	4									2,4
WR	6	0506	04-Apr-95			4	4								4	
WR	6	0507	11-Feb-92			1	1									1,5
WR	6	0507	11-Feb-92			5	5									1,5
WR	6	0508	11-Feb-92			1	1									1,4
WR	6	0508	11-Feb-92			4	4									1,4
WR	6	0509	11-Feb-92			1	1									1,2,4,5
WR	6	0509	11-Feb-92			2	2									1,2,4,5
WR	6	0509	11-Feb-92			4	4									1,2,4,5
WR	6	0608	06-Apr-93			1	1								1	
WR	6	0660	11-Jun-96			1	1									1,3,4,5
WR	6	0660	11-Jun-96			3	3									1,3,4,5
WR	6	0660	11-Jun-96			4	4									1,3,4,5
WR	6	0660	11-Jun-96			5	5									1,3,4,5
WR	6	A320	06-Apr-93			5	5								5	
WR	6	A321	06-Apr-93			4	4								4	
WR	6	A330	06-Apr-93			3	3								3	
WR	6	A350	10-Jun-94			4	4								4	
WR	6	A351	06-Apr-93			1	1								1,4	
WR	6	A351	06-Apr-93			4	4								1,4	
WR	6	A351	10-Jun-94			5	5								5	
WR	6	A361	10-Jun-94			8	8								8	
WR	6	A362	06-Apr-93			2	2								2	
WR	6	A363	06-Apr-93			3	3								3,4	
WR	6	A363	06-Apr-93			4	4								3,4	
WR	6	B420	02-May-91			3	3									3
WR	6	B420	18-Mar-92			3	3									3,5
WR	6	B420	18-Mar-92			5	5									3,5
WR	8	7035	14-Apr-94			2	2									2,6
WR	8	7035	14-Apr-94			6	6									2,6
WR	8	7776	28-Oct-93			2	2									2,3,4,5
WR	8	7776	28-Oct-93			3	3									2,3,4,5
WR	8	7776	28-Oct-93			4	4									2,3,4,5
WR	8	7776	28-Oct-93			5	5									2,3,4,5
WR	8	0214	13-Apr-94			4	4								4	
WR	8	0219	13-Apr-94			3	3								3	
WR	8	0259	13-Apr-94			2	2								2	
WR	8	0560	28-May-91			3	3								3	3
WR	8	A340	08-Nov-92			6	6								6	
WR	8	B320	05-Nov-92			4	4								4	
NAR	9	1803	30-Aug-90		2,3,4	1	1								1	
NAR	9	4008	27-Oct-89		1,4	1	1								1	
NAR	9	4008	25-Jul-91			6	6								6	
NAR	9	4020	30-Aug-90			2	2								2	
NAR	9	4020	26-Jul-93			2	2									2
NAR	9	5001	27-Oct-89		2	2	2								2	2
NAR	9	5001	29-Aug-90		5	5	5								5	
NAR	10	1201	27-Mar-90			4	4								4,5,6	
NAR	10	1201	27-Mar-90			5	5								4,5,6	
NAR	10	1201	27-Mar-90			6	6								4,5,6	
NAR	10	1450	14-Jun-91			2	2								2	
NAR	10	4002	24-Jun-92			5	5								5	
NAR	10	5005	27-Mar-90			1	1								1,2,3,5	
NAR	10	5005	27-Mar-90			2	2								1,2,3,5	
NAR	10	5005	27-Mar-90			3	3								1,2,3,5	
NAR	10	5005	27-Mar-90			5	5								1,2,3,5	
NAR	10	5005	15-Jun-94			4	4									4
NAR	10	0102	24-Feb-96			3	3								3	
NAR	11	1400	19-Jun-94			3	3								3	
SR	12	4101	19-May-94			5	5								5	5
SR	12	4103	18-Jun-92			5	5									5
SR	12	4108	11-Jun-90			4	4								4	
SR	12	4153	12-Jul-90			3	3								3	
SR	12	9054	19-Jun-90			3	3									3
SR	12	0562	25-May-94			3	3								3	
SR	12	A321	17-Jul-92			6	6								6	
SR	12	B352	03-Jul-91			7	7								7	
SR	12	C321	16-Jul-90			All	All								All	
SR	12	C350	21-Jul-92			6	6								6	
SR	12	C350	05-Sep-94			1	1								1,5	
SR	12	C350	05-Sep-94			5	5								1,5	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
SR	13	1005	13-Jan-93			3	3								3	
SR	13	1005	03-Apr-96			4	4								4	
SR	13	1031	06-May-94			2	2								2	
SR	13	1031	25-Jan-96			2	2								All	All
SR	13	1031	25-Jan-96			4	4								All	All
SR	13	1031	25-Jan-96			6	6								All	All
SR	13	1031	25-Jan-96			8	8								All	All
SR	13	1031	04-Apr-96			3	3								3,6,7,8	
SR	13	1031	04-Apr-96			6	6								3,6,7,8	
SR	13	1031	04-Apr-96			7	7								3,6,7,8	
SR	13	1031	04-Apr-96			8	8								3,6,7,8	
SR	13	1031	12-Aug-96			All	All								5	
SR	13	3019	17-Oct-96			2	2								2	
SR	13	4093	11-Jun-92			All	All								All	All
SR	13	4093	13-May-94			All	All								All	All
SR	13	4093	21-May-96			All	All								All	All
SR	13	0509	01-Mar-93			3	3								3	
WR	16	3023	30-Apr-92			All	All								All	
WR	16	A310	17-Jul-90		2,3,4,6	2	2								4,6	2,3,4,6
WR	16	A310	17-Jul-90		2,3,4,6	3	3								4,6	2,3,4,6
WR	16	A310	17-Jul-90		2,3,4,6	4	4								4,6	2,3,4,6
WR	16	A310	17-Jul-90		2,3,4,6	6	6								4,6	2,3,4,6
WR	16	A320	17-Jul-90		2,3,4,5	All	All								4	All
WR	16	A320	14-Jul-95			3	3								3	
WR	16	A330	17-Jul-90		2,3,6	2	2								4,6	2,3,6
WR	16	A330	17-Jul-90		2,3,6	3	3								4,6	2,3,6
WR	16	A330	17-Jul-90		2,3,6	4	4								4,6	2,3,6
WR	16	A330	17-Jul-90		2,3,6	6	6								4,6	2,3,6
WR	16	A350	17-Jul-90		All	All	All								4,6	All
WR	16	C330	20-Jul-90			8	8								8	
WR	16	C350	05-Oct-90			5	5									5
NCR	17	1002	16-Dec-91			3	3									3
NCR	17	4082	07-Oct-92		2	2	2								2	
NCR	17	5020	06-Mar-91			2	2								2,4,5	
NCR	17	5020	06-Mar-91			4	4								2,4,5	
NCR	17	5020	06-Mar-91			5	5								2,4,5	
NCR	17	5453	14-Jun-91			3	3								3,4,5	
NCR	17	5453	14-Jun-91			4	4								3,4,5	
NCR	17	5453	14-Jun-91			5	5								3,4,5	
NCR	17	5843	12-Jun-90			All	All									All
NCR	17	5843	23-Jun-91			All	All								All	
NCR	17	5849	15-Jun-91			1	1								1,2,3,5	
NCR	17	5849	15-Jun-91			2	2								1,2,3,5	
NCR	17	5849	15-Jun-91			3	3								1,2,3,5	
NCR	17	5849	15-Jun-91			5	5								1,2,3,5	
NCR	17	5849	09-Oct-92		2,6,7	All	All								All	
NCR	17	5854	12-Mar-95			1	1								1	
NCR	17	0601	13-Dec-90			6	6								6,9	6,7,8
NCR	17	0601	13-Dec-90			7	7								6,9	6,7,8
NCR	17	0601	13-Dec-90			8	8								6,9	6,7,8
NCR	17	0601	13-Dec-90			9	9								6,9	6,7,8
NCR	17	0601	17-Dec-91			1	1									1,3
NCR	17	0601	17-Dec-91			3	3									1,3
NCR	17	0602	13-Mar-94			7	7									7
NCR	17	0603	13-Dec-90			All	All								All	
NCR	17	0607	13-Dec-90			7	7								7,8,9	
NCR	17	0607	13-Dec-90			8	8								7,8,9	
NCR	17	0607	13-Dec-90			9	9								7,8,9	
NCR	17	0608	13-Dec-90			All	All								All	All
NCR	17	0659	17-Dec-91			2	2								2	
NCR	17	0660	17-Dec-91			All	All							01-Sep-90	3,5,6,7	3,4
NCR	17	0660	09-Oct-92			8	8								8	
NCR	17	0661	17-Dec-91			3	3							01-Sep-90		3,4
NCR	17	0661	17-Dec-91			4	4							01-Sep-90		3,4
NCR	17	0662	13-Dec-90			6	6								6,8	6,8
NCR	17	0662	13-Dec-90			8	8								6,8	6,8
NCR	17	0662	17-Dec-91			2	2								2	2
NCR	17	0663	13-Dec-90			2	2								2,3,5	5
NCR	17	0663	13-Dec-90			3	3								2,3,5	5
NCR	17	0663	13-Dec-90			5	5								2,3,5	5
NCR	17	0663	13-Mar-95			3	3								3	
NCR	17	0664	13-Dec-90			6	6								6,8	6
NCR	17	0664	13-Dec-90			8	8								6,8	6
NCR	17	A320	18-Dec-91			4	4								4	
NCR	17	A320	07-Oct-92			7	7								7	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NCR	17	A330	18-Dec-91			8	8								8,9	
NCR	17	A330	18-Dec-91			9	9								8,9	
NCR	18	1028	15-Jan-94			3	3								3,7	
NCR	18	1028	15-Jan-94			7	7								3,7	
NCR	18	1037	03-Dec-89		All	All	All									All
NCR	18	3002	03-Apr-96			3	3								3,8	3,4,5
NCR	18	3002	03-Apr-96			4	4								3,8	3,4,5
NCR	18	3002	03-Apr-96			5	5								3,8	3,4,5
NCR	18	3002	03-Apr-96			8	8								3,8	3,4,5
NCR	18	3002	06-Sep-96		1	1	1								1	
NCR	18	3003	01-Oct-92			6	6								6	
NCR	18	3003	01-Feb-94		All	All	All								All	
NCR	18	3030	06-Oct-94		4,7,8	4	4								4,7,8	
NCR	18	3030	06-Oct-94		4,7,8	7	7								4,7,8	
NCR	18	3030	06-Oct-94		4,7,8	8	8								4,7,8	
NCR	18	3031	12-Jun-91			5	5								5	
NCR	18	3031	06-Oct-92		2,4,6	2	2								2,4,6	
NCR	18	3031	06-Oct-92		2,4,6	4	4								2,4,6	
NCR	18	3031	06-Oct-92		2,4,6	6	6								2,4,6	
NCR	18	4021	03-Oct-89			1	1								1,3,4,5	
NCR	18	4021	03-Oct-89			3	3								1,3,4,5	
NCR	18	4021	03-Oct-89			4	4								1,3,4,5	
NCR	18	4021	03-Oct-89			5	5								1,3,4,5	
NCR	18	4021	26-Mar-91			All	All								All	
NCR	18	4021	05-Feb-94			4	4								4,5,7,9	
NCR	18	4021	05-Feb-94			5	5								4,5,7,9	
NCR	18	4021	05-Feb-94			7	7								4,5,7,9	
NCR	18	4021	05-Feb-94			9	9								4,5,7,9	
NCR	18	4021	05-Oct-94			2	2								2,3,4,5	
NCR	18	4021	05-Oct-94			3	3								2,3,4,5	
NCR	18	4021	05-Oct-94			4	4								2,3,4,5	
NCR	18	4021	05-Oct-94			5	5								2,3,4,5	
NCR	18	4042	03-Dec-89		1,2,3,4	All	All								All	
NCR	18	4042	03-Oct-94			3	3								3,6	
NCR	18	4042	03-Oct-94			6	6								3,6	
NCR	18	4042	15-Mar-95			2	2								2,3,5	
NCR	18	4042	15-Mar-95			3	3								2,3,5	
NCR	18	4042	15-Mar-95			5	5								2,3,5	
NCR	18	5528	09-Mar-95			All	All								All	All
NCR	18	0602	01-Oct-92			All	All								All	
NCR	18	0602	23-Aug-94			6	6								6	
NCR	18	0604	04-Apr-90			3	3								3	
NCR	18	0604	14-Dec-90			5	5								5	
NCR	18	0606	14-Dec-90			5	5								5	
NCR	18	0606	01-Oct-92			4	4								4,5	
NCR	18	0606	01-Oct-92			5	5								4,5	
NCR	18	0606	29-Mar-95			1	1								1,5	
NCR	18	0606	29-Mar-95			5	5								1,5	
NCR	18	0607	29-Mar-95			1	1								1,2,3,5	
NCR	18	0607	29-Mar-95			2	2								1,2,3,5	
NCR	18	0607	29-Mar-95			3	3								1,2,3,5	
NCR	18	0607	29-Mar-95			5	5								1,2,3,5	
NCR	18	0608	14-Dec-90			3	3								3	
NCR	18	0608	29-Mar-95			1	1								1,5	1
NCR	18	0608	29-Mar-95			5	5								1,5	1
NCR	18	0660	01-Oct-92			All	All								All	
NCR	18	0661	29-Mar-95			2	2								2,3	2,3
NCR	18	0661	29-Mar-95			3	3								2,3	2,3
NCR	18	0662	01-Oct-92			4	4								4,5,8	
NCR	18	0662	01-Oct-92			5	5								4,5,8	
NCR	18	0662	01-Oct-92			8	8								4,5,8	
NCR	18	0662	01-Feb-94			3	3								3	
NCR	18	0667	02-Oct-92			2	2								2	
NCR	18	0667	29-Mar-95			4	4								4,5	
NCR	18	0667	29-Mar-95			5	5								4,5	
NCR	18	0669	02-Oct-92			3	3								3,4,5	
NCR	18	0669	02-Oct-92			4	4								3,4,5	
NCR	18	0669	02-Oct-92			5	5								3,4,5	
NCR	18	0671	29-Mar-95			All	All								All	
NCR	18	0672	29-Mar-95			1	1								1,4	
NCR	18	0672	29-Mar-95			4	4								1,4	
NCR	18	A330	15-Jan-94			4	4								4,7	
NCR	18	A330	15-Jan-94			7	7								4,7	
NCR	18	A340	15-Jan-94			2	2								2,3,4	
NCR	18	A340	15-Jan-94			3	3								2,3,4	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NCR	18	A340	15-Jan-94			4	4								2,3,4	
NCR	18	A350	15-Jan-94			2	2								2,7	
NCR	18	A350	15-Jan-94			7	7								2,7	
NCR	18	A410	06-Oct-92			4	4								4,5,7	
NCR	18	A410	06-Oct-92			5	5								4,5,7	
NCR	18	A410	06-Oct-92			7	7								4,5,7	
NCR	18	A410	15-Mar-95			5	5								5	
NCR	18	A430	15-Mar-95			1	1								1,2,4	
NCR	18	A430	15-Mar-95			2	2								1,2,4	
NCR	18	A430	15-Mar-95			4	4								1,2,4	
NCR	19	1044	15-Sep-94		5	4	4								4,5	
NCR	19	1044	15-Sep-94		5	5	5								4,5	
NCR	19	3006	14-Sep-94			4	4								4,5,7	
NCR	19	3006	14-Sep-94			5	5								4,5,7	
NCR	19	3006	14-Sep-94			7	7								4,5,7	
NCR	19	3028	15-Sep-94			1	1								1,4,7	
NCR	19	3028	15-Sep-94			4	4								1,4,7	
NCR	19	3028	15-Sep-94			7	7								1,4,7	
NCR	19	3033	01-Dec-93			8	8								8	
NCR	19	3033	14-Sep-94		2	2	2								2	
NCR	19	5042	12-May-92			3	3								3,4	
NCR	19	5042	12-May-92			4	4								3,4	
NCR	19	5042	16-Sep-94			6	6								6,7	
NCR	19	5042	16-Sep-94			7	7								6,7	
NCR	19	5046	19-Jun-90			1	1									1,2
NCR	19	5046	19-Jun-90			2	2									1,2
NCR	19	5046	18-Oct-93			5	5								5,6,7,9	
NCR	19	5046	18-Oct-93			6	6								5,6,7,9	
NCR	19	5046	18-Oct-93			7	7								5,6,7,9	
NCR	19	5046	18-Oct-93			9	9								5,6,7,9	
NCR	19	6150	17-Sep-94		1,3	1	1								3,4,5,8	1
NCR	19	6150	17-Sep-94		1,3	3	3								3,4,5,8	1
NCR	19	6150	17-Sep-94		1,3	4	4								3,4,5,8	1
NCR	19	6150	17-Sep-94		1,3	5	5								3,4,5,8	1
NCR	19	6150	17-Sep-94		1,3	8	8								3,4,5,8	1
NCR	19	9116	13-May-92			1	1								1	
NCR	19	0214	16-Apr-96			3	3								3	
NCR	19	0216	16-Apr-96			3	3									3
NCR	19	0217	16-Apr-96			1	1								1	
NCR	19	0219	16-Apr-96			3	3									3
NCR	19	0220	16-Apr-96		5	2	2									2,5,9
NCR	19	0220	16-Apr-96		5	5	5									2,5,9
NCR	19	0220	16-Apr-96		5	9	9									2,5,9
NCR	19	0221	16-Apr-96			1	1								1,3,5	
NCR	19	0221	16-Apr-96			3	3								1,3,5	
NCR	19	0221	16-Apr-96			5	5								1,3,5	
NCR	19	0222	16-Apr-96			6	6								6	
NCR	19	0259	16-Feb-95			2	2								2,7	
NCR	19	0259	16-Feb-95			7	7								2,7	
NCR	19	0259	16-Apr-96			1	1								1,5,7,9	
NCR	19	0259	16-Apr-96			5	5								1,5,7,9	
NCR	19	0259	16-Apr-96			7	7								1,5,7,9	
NCR	19	0259	16-Apr-96			9	9								1,5,7,9	
NCR	19	0601	19-Jun-91			3	3								3,4,8	
NCR	19	0601	19-Jun-91			4	4								3,4,8	
NCR	19	0601	19-Jun-91			8	8								3,4,8	
NCR	19	0603	19-Jun-91			1	1								1,6,7	
NCR	19	0603	19-Jun-91			6	6								1,6,7	
NCR	19	0603	19-Jun-91			7	7								1,6,7	
NCR	19	0604	19-Jun-91			5	5								5,6	
NCR	19	0604	19-Jun-91			6	6								5,6	
NCR	19	0608	19-Jun-91			1	1								1,3,4	
NCR	19	0608	19-Jun-91			3	3								1,3,4	
NCR	19	0608	19-Jun-91			4	4								1,3,4	
NCR	19	A310	17-Sep-94			2	2								2	
NCR	19	A340	20-Jun-91			2	2								2,3	
NCR	19	A340	20-Jun-91			3	3								2,3	
NCR	19	A410	16-Sep-94		4,5	4	4								4,5	
NCR	19	A410	16-Sep-94		4,5	5	5								4,5	
NCR	19	A430	21-Jun-91		4,6	All	All								All	
NCR	19	A430	16-Sep-94		1	1	1								1,2,4	
NCR	19	A430	16-Sep-94		1	2	2								1,2,4	
NCR	19	A430	16-Sep-94		1	4	4								1,2,4	
NCR	20	1005	24-Apr-96			2	2									2,7
NCR	20	1005	24-Apr-96			7	7									2,7

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NCR	20	3013	11-Apr-90			2	2								2,5	
NCR	20	3013	11-Apr-90			5	5								2,5	
NCR	20	3015	04-Apr-91			1	1								1	
NCR	20	3015	22-Apr-96			3	3									3
NCR	20	3060	07-Mar-93		1,4,6,8	1	1								1,4,6,8	
NCR	20	3060	07-Mar-93		1,4,6,8	4	4								1,4,6,8	
NCR	20	3060	07-Mar-93		1,4,6,8	6	6								1,4,6,8	
NCR	20	3060	07-Mar-93		1,4,6,8	8	8								1,4,6,8	
NCR	20	3060	25-Apr-96			1	1								1,2,4	
NCR	20	3060	25-Apr-96			2	2								1,2,4	
NCR	20	3060	25-Apr-96			4	4								1,2,4	
NCR	20	4016	09-Mar-93			7	7								7,8	
NCR	20	4016	09-Mar-93			8	8								7,8	
NCR	20	4016	24-Apr-96		2,3,4,5	2	2								2,3,4,5	
NCR	20	4016	24-Apr-96		2,3,4,5	3	3								2,3,4,5	
NCR	20	4016	24-Apr-96		2,3,4,5	4	4								2,3,4,5	
NCR	20	4016	24-Apr-96		2,3,4,5	5	5								2,3,4,5	
NCR	20	4052	31-Mar-91			All	All								All	
NCR	20	4052	13-Mar-93			4	4								4,7	
NCR	20	4052	13-Mar-93			7	7								4,7	
NCR	20	4054	10-Mar-93			2	2								2	
NCR	20	4054	15-May-94			5	5								5	
NCR	20	4054	24-Oct-95			All	All								All	
NCR	20	4054	26-Oct-95			1	1								1,6,7	
NCR	20	4054	26-Oct-95			6	6								1,6,7	
NCR	20	4054	26-Oct-95			7	7								1,6,7	
NCR	20	4054	21-Apr-96			All	All								All	
NCR	20	6026	11-Mar-93			All	All								All	
NCR	20	7073	10-Mar-93		2	2	2								2	
NCR	20	7085	08-Mar-93		2,7	2	2								2,5,7,9	
NCR	20	7085	08-Mar-93		2,7	5	5								2,5,7,9	
NCR	20	7085	08-Mar-93		2,7	7	7								2,5,7,9	
NCR	20	7085	08-Mar-93		2,7	9	9								2,5,7,9	
NCR	20	7085	17-Feb-95			All	All								All	
NCR	20	9037	09-Mar-93		5	1	1								1,5	
NCR	20	9037	09-Mar-93		5	5	5								1,5	
NCR	20	0104	18-Feb-95			1	1								1,2,4	
NCR	20	0104	18-Feb-95			2	2								1,2,4	
NCR	20	0104	18-Feb-95			4	4								1,2,4	
NCR	20	0110	18-Feb-95			2	2									2,3,4,5
NCR	20	0110	18-Feb-95			3	3									2,3,4,5
NCR	20	0110	18-Feb-95			4	4									2,3,4,5
NCR	20	0110	18-Feb-95			5	5									2,3,4,5
NCR	20	0111	18-Feb-95			All	All								All	
NCR	20	0161	19-Feb-95			1	1								1,2,6	
NCR	20	0161	19-Feb-95			2	2								1,2,6	
NCR	20	0161	19-Feb-95			6	6								1,2,6	
NCR	20	0201	10-Mar-93			6	6								6	
NCR	20	0202	14-Aug-92			All	All								All	
NCR	20	0202	10-Mar-93			7	7								7	
NCR	20	0202	15-May-94			5	5								5	
NCR	20	0203	18-Feb-95			1	1								1,3,4,6	
NCR	20	0203	18-Feb-95			3	3								1,3,4,6	
NCR	20	0203	18-Feb-95			4	4								1,3,4,6	
NCR	20	0203	18-Feb-95			6	6								1,3,4,6	
NCR	20	0204	10-Mar-93		4	1	1								1,2,3,4	
NCR	20	0204	10-Mar-93		4	2	2								1,2,3,4	
NCR	20	0204	10-Mar-93		4	3	3								1,2,3,4	
NCR	20	0204	10-Mar-93		4	4	4								1,2,3,4	
NCR	20	0205	10-Mar-93		4,7	3	3								3,4,7	
NCR	20	0205	10-Mar-93		4,7	4	4								3,4,7	
NCR	20	0205	10-Mar-93		4,7	7	7								3,4,7	
NCR	20	0205	18-Feb-95			1	1								1,5	
NCR	20	0205	18-Feb-95			5	5								1,5	
NCR	20	0205	20-Apr-96			3	3								3,7	
NCR	20	0205	20-Apr-96			7	7								3,7	
NCR	20	0206	14-Aug-92			6	6								6	
NCR	20	0206	10-Mar-93			6	6								6	
NCR	20	0206	18-Feb-95			3	3								3	
NCR	20	0207	10-Mar-93		8	8	8								8	
NCR	20	0207	20-Apr-96			3	3								3	
NCR	20	0208	14-Aug-92			3	3								3	
NCR	20	0208	18-Feb-95			7	7								7	
NCR	20	0208	20-Apr-96			2	2								2,4,5	
NCR	20	0208	20-Apr-96			4	4								2,4,5	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NCR	20	0208	20-Apr-96			5	5								2,4,5	
NCR	20	0209	15-May-94			2	2								2	
NCR	20	0209	18-Feb-95			1	1								1	1
NCR	20	0210	14-Aug-92			1	1								1,2,4	
NCR	20	0210	14-Aug-92			2	2								1,2,4	
NCR	20	0210	14-Aug-92			4	4								1,2,4	
NCR	20	0210	10-Mar-93			1	1								1	
NCR	20	0210	18-Feb-95			5	5								5,8	
NCR	20	0210	18-Feb-95			8	8								5,8	
NCR	20	0211	20-Apr-96			3	3								3,5	
NCR	20	0211	20-Apr-96			5	5								3,5	
NCR	20	0212	14-Aug-92			1	1								1,2,3,4	
NCR	20	0212	14-Aug-92			2	2								1,2,3,4	
NCR	20	0212	14-Aug-92			3	3								1,2,3,4	
NCR	20	0212	14-Aug-92			4	4								1,2,3,4	
NCR	20	0212	10-Mar-93			2	2								2	
NCR	20	0259	15-May-94			4	4								4	
NCR	20	A330	31-Mar-91			3	3								3	
NCR	20	A410	10-Mar-93			2	2								2,3,6	
NCR	20	A410	10-Mar-93			3	3								2,3,6	
NCR	20	A410	10-Mar-93			6	6								2,3,6	
NCR	20	A410	21-Apr-96			1	1								1,6	
NCR	20	A410	21-Apr-96			6	6								1,6	
NCR	20	A411	21-Apr-96			3	3								3	5
NCR	20	A411	21-Apr-96			5	5								3	5
NCR	20	A430	10-Mar-93			3	3								3,5	
NCR	20	A430	10-Mar-93			5	5								3,5	
NCR	20	A430	18-Feb-95			4	4								4,5,6,7	
NCR	20	A430	18-Feb-95			5	5								4,5,6,7	
NCR	20	A430	18-Feb-95			6	6								4,5,6,7	
NCR	20	A430	18-Feb-95			7	7								4,5,6,7	
NCR	20	B310	22-Apr-96			6	6								6	
NCR	20	B330	04-Apr-91			9	9								9	
NCR	20	B340	18-Feb-95			6	6								6	
NCR	20	B410	24-Apr-96			1	1								1,2	2,5
NCR	20	B410	24-Apr-96			2	2								1,2	2,5
NCR	20	B410	24-Apr-96			5	5								1,2	2,5
NCR	20	B430	15-May-94			3	3								3	
NCR	21	3016	04-Dec-89		All	All	All									All
NCR	21	3016	26-Mar-91			1	1								1,2,5	
NCR	21	3016	26-Mar-91			2	2								1,2,5	
NCR	21	3016	26-Mar-91			5	5								1,2,5	
NCR	21	4025	05-Nov-91		5	5	5								5	
NCR	21	A310	03-Feb-93			9	9								9	
NCR	21	A410	04-Feb-93			1	1								1	
NCR	21	A430	06-Nov-91			3	3									3
NAR	23	1012	14-Aug-91			1	1								1	
NAR	23	1012	24-Aug-94			5	5									5
NAR	23	1012	19-Aug-95			1	1								1	1
NAR	23	1028	16-Aug-91			3	3								3	
NAR	23	1028	28-Apr-94			8	8									8
NAR	23	3013	19-Oct-89			4	4								4	
NAR	23	3013	20-Sep-93			All	All									All
NAR	23	3014	19-Oct-89			2	2								2,5	5
NAR	23	3014	19-Oct-89			5	5								2,5	5
NAR	23	3014	15-Aug-91			2	2								2	
NAR	23	3014	28-Sep-92			5	5									5,6
NAR	23	3014	28-Sep-92			6	6									5,6
NAR	23	3014	20-Sep-93			1	1									1,4
NAR	23	3014	20-Sep-93			4	4									1,4
NAR	23	3014	23-Aug-94			3	3									3,5,7
NAR	23	3014	23-Aug-94			5	5									3,5,7
NAR	23	3014	23-Aug-94			7	7									3,5,7
NAR	24	1634	26-Mar-90		2	2	2								2	
NAR	24	1634	05-Dec-90		1	1	1								1	
NAR	24	1634	24-Jun-92			1	1								1,6	
NAR	24	1634	24-Jun-92			6	6								1,6	
NAR	24	2401	04-Dec-89		5	1	1								2,5	1,5
NAR	24	2401	04-Dec-89		5	2	2								2,5	1,5
NAR	24	2401	04-Dec-89		5	5	5								2,5	1,5
NAR	24	5807	05-Dec-89		1	1	1								1,2,3	
NAR	24	5807	05-Dec-89		1	2	2								1,2,3	
NAR	24	5807	05-Dec-89		1	3	3								1,2,3	
NAR	24	5807	17-Jun-94			4	4									4,7,8
NAR	24	5807	17-Jun-94			7	7									4,7,8

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NAR	24	5807	17-Jun-94			8	8									4,7,8
NAR	24	0501	24-Jan-92			8	8								8	
NAR	24	0501	11-Jun-92			5	5								5	
NAR	24	0503	05-Nov-90			7	7								7	
NAR	24	0504	06-Dec-95			4	4								4,5	4,5
NAR	24	0504	06-Dec-95			5	5								4,5	4,5
NAR	24	0505	24-Jan-92			8	8								8	
NAR	24	0507	09-Aug-91			8	8								8	
NAR	24	A311	19-Jun-91			1	1								1	
NAR	24	A320	18-Jun-94			3	3								3	
NAR	24	A331	05-Dec-90		4	4	4								4	
NAR	24	A340	26-Mar-90		4	4	4								4	
NAR	24	A340	05-Dec-90			3	3								3	
NAR	24	A340	19-Jun-91		9	9	9								9	
NAR	24	A340	25-Jun-92			3	3								3	
NAR	25	1002	24-Oct-89		1,5	5	5									5
NAR	25	1002	24-Sep-93			8	8								8	
NCR	26	1001	09-Jan-90			All	All								All	
NCR	26	1001	08-Jan-91			1	1								1,2	
NCR	26	1001	08-Jan-91			2	2								1,2	
NCR	26	1001	10-Jul-91			1	1								1,6	
NCR	26	1001	10-Jul-91			6	6								1,6	
NCR	26	1001	13-Dec-94			5	5								5,9	
NCR	26	1001	13-Dec-94			9	9								5,9	
NCR	26	1010	04-Jan-91			1	1									
NCR	26	1010	04-Jan-91			4	4									
NCR	26	1010	04-Jan-91			8	8									
NCR	26	1012	09-Oct-89			1	1								1,2,3	
NCR	26	1012	09-Oct-89			2	2								1,2,3	
NCR	26	1012	09-Oct-89			3	3								1,2,3	
NCR	26	1013	09-Oct-89			1	1								1,2,3,5	
NCR	26	1013	09-Oct-89			2	2								1,2,3,5	
NCR	26	1013	09-Oct-89			3	3								1,2,3,5	
NCR	26	1013	09-Oct-89			5	5								1,2,3,5	
NCR	26	1013	14-Sep-95			3	3								3,5,7,8	
NCR	26	1013	14-Sep-95			5	5								3,5,7,8	
NCR	26	1013	14-Sep-95			7	7								3,5,7,8	
NCR	26	1013	14-Sep-95			8	8								3,5,7,8	
NCR	26	3068	17-May-93			All	All								All	
NCR	26	3069	17-May-93			All	All								All	
NCR	26	4015	28-Nov-89			2	2								2,3,4	
NCR	26	4015	28-Nov-89			3	3								2,3,4	
NCR	26	4015	28-Nov-89			4	4								2,3,4	
NCR	26	4015	23-Jul-90			3	3									3,5
NCR	26	4015	23-Jul-90			5	5									3,5
NCR	26	4015	20-Aug-90			All	All								All	All
NCR	26	4015	27-Jun-91			4	4								4	
NCR	26	6016	10-Jul-91			3	3								3,4	
NCR	26	6016	10-Jul-91			4	4								3,4	
NCR	26	6016	15-Sep-95			4	4								All	
NCR	26	6016	15-Sep-95			5	5								All	
NCR	26	6016	15-Sep-95			7	7								All	
NCR	26	6016	15-Sep-95			8	8								All	
NCR	26	7072	29-Nov-89			1	1								1	
NCR	26	9029	08-Sep-94		1	1	1									1
NCR	26	9030	06-Oct-89			4	4								4	
NCR	26	9030	22-Apr-93			5	5								5,9	
NCR	26	9030	22-Apr-93			9	9								5,9	
NCR	26	0213	11-Aug-95		2,3,5	2	2								2,3,5	
NCR	26	0213	11-Aug-95		2,3,5	3	3								2,3,5	
NCR	26	0213	11-Aug-95		2,3,5	5	5								2,3,5	
NCR	26	0213	09-Apr-96			All	All								2,3,4,5	All
NCR	26	0214	11-Aug-95		1,4,5,7	4	4								4,5,7	
NCR	26	0214	11-Aug-95		1,4,5,7	5	5								4,5,7	
NCR	26	0214	11-Aug-95		1,4,5,7	7	7								4,5,7	
NCR	26	0214	09-Apr-96			2	2									2
NCR	26	0214	09-Apr-96			2	2									2,5
NCR	26	0214	09-Apr-96			5	5									2,5
NCR	26	0215	11-Aug-95		2,3	2	2								2,3	
NCR	26	0215	11-Aug-95		2,3	3	3								2,3	
NCR	26	0215	09-Apr-96			All	All								All	All
NCR	26	0216	09-Apr-96			All	All								All	All
NCR	26	0218	11-Aug-95		2,3,4,5	2	2								2,3,4,5	
NCR	26	0218	11-Aug-95		2,3,4,5	3	3								2,3,4,5	
NCR	26	0218	11-Aug-95		2,3,4,5	4	4								2,3,4,5	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NCR	26	0218	11-Aug-95		2,3,4,5	5	5								2,3,4,5	
NCR	26	0219	06-Sep-94			3	3								3	
NCR	26	0219	11-Aug-95		1,2,3	All	All								All	2,5
NCR	26	0219	09-Apr-96			3	3								3,4,6,7	3,4,6,7
NCR	26	0219	09-Apr-96			4	4								3,4,6,7	3,4,6,7
NCR	26	0219	09-Apr-96			6	6								3,4,6,7	3,4,6,7
NCR	26	0219	09-Apr-96			7	7								3,4,6,7	3,4,6,7
NCR	26	0220	09-Apr-96			2	2								2,3,4,6	4
NCR	26	0220	09-Apr-96			3	3								2,3,4,6	4
NCR	26	0220	09-Apr-96			4	4								2,3,4,6	4
NCR	26	0220	09-Apr-96			6	6								2,3,4,6	4
NCR	26	0221	09-Apr-96			All	All								5,7	All
NCR	26	0222	11-Aug-95		2,3,4,5	2	2								2,3,4,5	
NCR	26	0222	11-Aug-95		2,3,4,5	3	3								2,3,4,5	
NCR	26	0222	11-Aug-95		2,3,4,5	4	4								2,3,4,5	
NCR	26	0222	11-Aug-95		2,3,4,5	5	5								2,3,4,5	
NCR	26	0222	09-Apr-96			All	All								1,2,4	All
NCR	26	0223	11-Aug-95		2,3,4,5	2	2								2,3,4,5	
NCR	26	0223	11-Aug-95		2,3,4,5	3	3								2,3,4,5	
NCR	26	0223	11-Aug-95		2,3,4,5	4	4								2,3,4,5	
NCR	26	0223	11-Aug-95		2,3,4,5	5	5								2,3,4,5	
NCR	26	0223	09-Apr-96			1	1								2,3,5,	1,2,3,5
NCR	26	0223	09-Apr-96			2	2								2,3,5,	1,2,3,5
NCR	26	0223	09-Apr-96			3	3								2,3,5,	1,2,3,5
NCR	26	0223	09-Apr-96			5	5								2,3,5,	1,2,3,5
NCR	26	0224	11-Aug-95			1	1								1,4,5	
NCR	26	0224	11-Aug-95			4	4								1,4,5	
NCR	26	0224	11-Aug-95			5	5								1,4,5	
NCR	26	0224	09-Apr-96			6	6									6
NCR	26	0259	09-Apr-96			1	1								2	1
NCR	26	0259	09-Apr-96			2	2								2	1
NCR	26	0601	06-Jan-91			6	6								6	
NCR	26	0601	17-May-93		All	All	All								All	
NCR	26	0602	02-Apr-90			All	All								1,3,4	2,3,4,5
NCR	26	0602	06-Jan-91			All	All								All	1,2,6,7
NCR	26	0602	17-May-93		All	All	All								All	
NCR	26	0602	09-Sep-94			1	1									1,2,3,5
NCR	26	0602	09-Sep-94			2	2									1,2,3,5
NCR	26	0602	09-Sep-94			3	3									1,2,3,5
NCR	26	0602	09-Sep-94			5	5									1,2,3,5
NCR	26	0603	06-Jan-91			5	5								5	
NCR	26	0603	28-Jun-91			1	1								1,3,4,5	
NCR	26	0603	28-Jun-91			3	3								1,3,4,5	
NCR	26	0603	28-Jun-91			4	4								1,3,4,5	
NCR	26	0603	28-Jun-91			5	5								1,3,4,5	
NCR	26	0604	06-Jan-91			1	1								1,3,4,8	
NCR	26	0604	06-Jan-91			3	3								1,3,4,8	
NCR	26	0604	06-Jan-91			4	4								1,3,4,8	
NCR	26	0604	06-Jan-91			8	8								1,3,4,8	
NCR	26	0604	28-Jun-91			All	All								All	
NCR	26	0604	17-May-93		2,5	2	2								2,5	
NCR	26	0604	17-May-93		2,5	5	5								2,5	
NCR	26	0606	06-Jan-91			6	6								6	
NCR	26	0606	28-Jun-91			2	2								2,3,4,5	
NCR	26	0606	28-Jun-91			3	3								2,3,4,5	
NCR	26	0606	28-Jun-91			4	4								2,3,4,5	
NCR	26	0606	28-Jun-91			5	5								2,3,4,5	
NCR	26	0607	06-Jan-91			7	7								7,8,9	
NCR	26	0607	06-Jan-91			8	8								7,8,9	
NCR	26	0607	06-Jan-91			9	9								7,8,9	
NCR	26	0607	28-Jun-91			3	3								3	
NCR	26	0608	02-Apr-90			3	3									3
NCR	26	0608	06-Jan-91			4	4								4	
NCR	26	0608	28-Jun-91			All	All								All	
NCR	26	0608	25-Sep-92			All	All								All	
NCR	26	0659	28-Jun-91			3	3								3,4,5	
NCR	26	0659	28-Jun-91			4	4								3,4,5	
NCR	26	0659	28-Jun-91			5	5								3,4,5	
NCR	26	0659	17-May-93			3	3								3,4,7	
NCR	26	0659	17-May-93			4	4								3,4,7	
NCR	26	0659	17-May-93			7	7								3,4,7	
NCR	26	A310	09-Jul-91			2	2								2,5,8	
NCR	26	A310	09-Jul-91			5	5								2,5,8	
NCR	26	A310	09-Jul-91			8	8								2,5,8	
NCR	26	A310	14-Sep-95			All	All								All	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NCR	26	A320	14-Sep-95			All	All								All	
NCR	26	A321	07-Jan-91			All	All								All	
NCR	26	A321	26-Sep-92			All	All								All	All
NCR	26	A321	15-Dec-93			All	All								All	All
NCR	26	A321	14-Sep-95			All	All								All	
NCR	26	A330	14-Sep-95			All	All								All	
NCR	26	A340	14-Sep-95			2	2								2,3,5,6	
NCR	26	A340	14-Sep-95			3	3								2,3,5,6	
NCR	26	A340	14-Sep-95			5	5								2,3,5,6	
NCR	26	A340	14-Sep-95			6	6								2,3,5,6	
NCR	26	A350	09-Jul-91			2	2								2,5	
NCR	26	A350	09-Jul-91			5	5								2,5	
NCR	26	A350	14-Sep-95			All	All								All	
NCR	26	B310	15-Dec-93			1	1								1,2,6,8	
NCR	26	B310	15-Dec-93			2	2								1,2,6,8	
NCR	26	B310	15-Dec-93			6	6								1,2,6,8	
NCR	26	B310	15-Dec-93			8	8								1,2,6,8	
NCR	26	B321	07-Jan-91			2	2								2	
NCR	26	B321	09-Jul-91			4	4								4,7	
NCR	26	B321	09-Jul-91			7	7								4,7	
NCR	26	B321	15-Dec-93			1	1								1,8	
NCR	26	B321	15-Dec-93			8	8								1,8	
NCR	26	B321	08-Sep-94			5	5								5	
NCR	26	B321	14-Sep-95			3	3								3,5,6,7	
NCR	26	B321	14-Sep-95			5	5								3,5,6,7	
NCR	26	B321	14-Sep-95			6	6								3,5,6,7	
NCR	26	B321	14-Sep-95			7	7								3,5,6,7	
NCR	26	B330	14-Sep-95			All	All								All	
NCR	26	B340	15-Dec-93			All	All								All	
NCR	26	B340	08-Sep-94			5	5								5,6	
NCR	26	B340	08-Sep-94			6	6								5,6	
NCR	26	B340	14-Sep-95			All	All								All	
NCR	26	B350	09-Jul-91			3	3								3,4,8	
NCR	26	B350	09-Jul-91			4	4								3,4,8	
NCR	26	B350	09-Jul-91			8	8								3,4,8	
NCR	26	B350	15-Dec-93			3	3								3,6,7,8	
NCR	26	B350	15-Dec-93			6	6								3,6,7,8	
NCR	26	B350	15-Dec-93			7	7								3,6,7,8	
NCR	26	B350	15-Dec-93			8	8								3,6,7,8	
NCR	26	B350	14-Sep-95			All	All								All	
NCR	26	C310	10-Jul-91			9	9								9	
NCR	26	C310	13-Dec-94			2	2								2	
NCR	26	C320	10-Jul-91			1	1								1,8,9	
NCR	26	C320	10-Jul-91			8	8								1,8,9	
NCR	26	C320	10-Jul-91			9	9								1,8,9	
NCR	26	C320	25-Sep-92			3	3								3,4,7	
NCR	26	C320	25-Sep-92			4	4								3,4,7	
NCR	26	C320	25-Sep-92			7	7								3,4,7	
NCR	26	C330	13-Dec-94			3	3								3,5,7	
NCR	26	C330	13-Dec-94			5	5								3,5,7	
NCR	26	C330	13-Dec-94			7	7								3,5,7	
NCR	26	C340	10-Jul-91			1	1								1,8	
NCR	26	C340	10-Jul-91			8	8								1,8	
NCR	26	C340	13-Dec-94			5	5								5,8,9	
NCR	26	C340	13-Dec-94			8	8								5,8,9	
NCR	26	C340	13-Dec-94			9	9								5,8,9	
NCR	26	C350	10-Jul-91			1	1								1,2,4	
NCR	26	C350	10-Jul-91			2	2								1,2,4	
NCR	26	C350	10-Jul-91			4	4								1,2,4	
NCR	26	C351	10-Jul-91			6	6								6,8	
NCR	26	C351	10-Jul-91			8	8								6,8	
NCR	26	C351	25-Sep-92			3	3								3,6	
NCR	26	C351	25-Sep-92			6	6								3,6	
NCR	26	D310	24-Sep-92			4	4								4,9	
NCR	26	D310	24-Sep-92			9	9								4,9	
NCR	26	D320	04-Jan-91			All	All								All	All
NCR	26	D320	24-Sep-92			6	6								6	
NCR	26	D320	09-Dec-93			4	4								4	
NCR	26	D330	27-Jun-91			5	5								5	
NCR	26	D330	09-Dec-93			1	1								1,2,3,5	
NCR	26	D330	09-Dec-93			2	2								1,2,3,5	
NCR	26	D330	09-Dec-93			3	3								1,2,3,5	
NCR	26	D330	09-Dec-93			5	5								1,2,3,5	
NCR	26	D340	09-Dec-93			3	3								3,4,5	
NCR	26	D340	09-Dec-93			4	4								3,4,5	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NCR	26	D340	09-Dec-93			5	5								3,4,5	
NCR	26	D351	27-Jun-91			9	9								9	
NCR	26	D351	24-Sep-92			9	9								9	
NCR	26	D351	09-Dec-93			1	1								1,2,3,5	
NCR	26	D351	09-Dec-93			2	2								1,2,3,5	
NCR	26	D351	09-Dec-93			3	3								1,2,3,5	
NCR	26	D351	09-Dec-93			5	5								1,2,3,5	
NCR	27	1016	16-Nov-93			2	2								2,5,7	
NCR	27	1016	16-Nov-93			5	5								2,5,7	
NCR	27	1016	16-Nov-93			7	7								2,5,7	
NCR	27	1085	19-Oct-93			4	4									4
NCR	27	4050	25-Oct-89		All	All	All								All	
NCR	27	0505	16-Nov-93			1	1								1,4	
NCR	27	0505	16-Nov-93			4	4								1,4	
NCR	27	0701	20-Nov-93			7	7								7,8	
NCR	27	0701	20-Nov-93			8	8								7,8	
NCR	27	0701	28-Jul-94			4	4								4	
NCR	27	0703	09-Aug-91			4	4								4,5	
NCR	27	0703	09-Aug-91			5	5								4,5	
NCR	27	0706	28-Jul-94			5	5								5	
NCR	27	0910	23-Nov-93			6	6								6	
NCR	27	A310	16-Nov-93			All	All								All	
NCR	27	A320	16-Nov-93			4	4								4,7	
NCR	27	A320	16-Nov-93			7	7								4,7	
NCR	27	A330	16-Nov-93			3	3								3,4,5	
NCR	27	A330	16-Nov-93			4	4								3,4,5	
NCR	27	A330	16-Nov-93			5	5								3,4,5	
NCR	27	B310	13-Jul-91			2	2								2,5	
NCR	27	B310	13-Jul-91			5	5								2,5	
NCR	27	B310	16-Nov-93			All	All								All	
NCR	27	B320	21-Feb-94			All	All								All	
NCR	27	B340	16-Nov-93			2	2								2,3,5	
NCR	27	B340	16-Nov-93			3	3								2,3,5	
NCR	27	B340	16-Nov-93			5	5								2,3,5	
NCR	27	B350	16-Nov-93			1	1								1,5,8	
NCR	27	B350	16-Nov-93			5	5								1,5,8	
NCR	27	B350	16-Nov-93			8	8								1,5,8	
SR	28	1016	18-Oct-96			3	3								4	3,5
SR	28	1016	18-Oct-96			4	4								4	3,5
SR	28	1016	18-Oct-96			5	5								4	3,5
SR	28	1802	05-Jan-96			1	1								1,2	1,2
SR	28	1802	05-Jan-96			2	2								1,2	1,2
SR	28	3081	12-Feb-92			4	4									4
SR	28	3089	18-Feb-92			3	3									3
SR	28	3091	20-Feb-92			6	6									6
SR	28	3099	03-May-90			2	2								2	
SR	28	5805	04-Jun-90			6	6								6	
SR	28	7012	19-Jan-94			3	3							01-Sep-92	3	
SR	28	0509	03-May-90			All	All									All
SR	28	0509	14-Nov-90			6	6							25-Sep-90		6
SR	28	A320	04-Aug-94			3	3								3	
NCR	29	1002	14-Mar-93			2	2								2,3	
NCR	29	1002	14-Mar-93			3	3								2,3	
NCR	29	1010	15-Mar-93			2	2								2	
NCR	29	4036	06-Mar-93		All	All	All								All	
NCR	29	4069	08-Mar-93		All	All	All								All	
NCR	29	5403	06-Feb-93		All	All	All								All	
NCR	29	5413	06-Feb-93		All	All	All								All	
NCR	29	6067	07-Feb-93			6	6								6	
NCR	29	0601	18-May-94			4	4									4
NCR	29	0608	13-Mar-93			All	All								All	
NCR	29	0659	18-May-94			All	All								All	
NCR	29	0705	16-Mar-94			1	1									1
NCR	29	0707	16-Mar-97		3,4	3	3									3,4
NCR	29	0707	16-Mar-97		3,4	4	4									3,4
NCR	29	A351	12-Dec-90		3	3	3								3	
NCR	29	B351	12-Dec-90			9	9								9	
NCR	29	B410	05-Mar-93		2	All	All									All
NCR	29	B411	05-Mar-93			2	2									2,3,5
NCR	29	B411	05-Mar-93			3	3									2,3,5
NCR	29	B411	05-Mar-93			5	5									2,3,5
NCR	29	B430	05-Mar-93			All	All								6	All
WR	30	1001	10-Nov-91			1	1								1	
WR	30	6004	24-Aug-92			All	All								All	1,4
WR	30	7076	08-Oct-90			4	4									4

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
WR	30	8129	08-Nov-91			4	4								4	
WR	30	8129	29-Sep-93			3	3								3	
WR	30	0501	03-May-90			5	5								5	5
WR	30	0506	26-Aug-92			5	5								5	
WR	30	0506	29-Sep-93			4	4								4	
WR	30	0507	03-May-90			3	3								3	
WR	30	0507	29-Sep-93			4	4								4	
WR	30	0561	12-Sep-96			5	5									5
WR	30	0805	09-Nov-94			2	2								2	
WR	30	0806	09-Nov-94			4	4								4	
WR	30	A320	11-Oct-95			4	4								4	
WR	30	A330	05-May-90			5	5								5	
WR	30	A330	11-Oct-95			4	4								4,5	
WR	30	A330	11-Oct-95			5	5								4,5	
WR	30	A350	19-Oct-90			1	1								1	
NCR	31	1030	29-Oct-95			1	1								All	
NCR	31	1030	29-Oct-95			2	2								All	
NCR	31	1030	29-Oct-95			3	3								All	
NCR	31	1030	29-Oct-95			5	5								All	
NCR	31	3033	24-Oct-93			All	All								All	
NCR	31	6700	29-Oct-95			All	All								All	
NCR	31	6702	28-Oct-95		2	2	2								2	
NCR	31	7050	19-Sep-94			2	2								2	3
NCR	31	7050	19-Sep-94			3	3								2	3
NCR	31	0113	17-Apr-96			4	4								4	
NCR	31	0118	17-Apr-96			2	2								2	
NCR	31	0119	17-Apr-96			6	6								6	
NCR	31	0122	01-Nov-95			4	4								4	
NCR	31	0122	17-Apr-96			4	4								4	
NCR	31	0123	17-Apr-96			6	6								6	
NCR	31	0901	17-Apr-96			8	8								8	
NCR	31	0902	17-Apr-96			4	4								4,5,8	
NCR	31	0902	17-Apr-96			5	5								4,5,8	
NCR	31	0902	17-Apr-96			8	8								4,5,8	
NCR	31	0903	17-Apr-96			2	2								2	9
NCR	31	0903	17-Apr-96			9	9								2	9
NCR	31	A340	29-Oct-95			2	2								2,3,6	
NCR	31	A340	29-Oct-95			3	3								2,3,6	
NCR	31	A340	29-Oct-95			6	6								2,3,6	
NCR	31	A410	09-May-92			1	1								1	
NCR	31	B410	05-May-92			5	5								5	
WR	32	1020	09-Aug-89			6	6								6	
WR	32	1020	22-Mar-92			2	2								2	
WR	32	1020	01-Jul-94			5	5									5
WR	32	1030	08-Sep-90			1	1								1	
WR	32	A351	26-Apr-91			3	3									3
NAR	33	1001	16-Oct-89			3	3								3	
NAR	33	1001	20-Feb-94			All	All									
NAR	33	1001	08-Apr-97			All	All									
NAR	34	1003	24-Nov-89		All	All	All									3,5
NAR	34	1003	17-Jun-92			3	3								3	
NAR	34	1003	08-Jun-93			5	5								5	
NAR	34	1011	22-Jun-92			1	1									1
NAR	34	1031	15-Nov-90			6	6								6	
NAR	34	1033	18-Jun-92			7	7								7	
NAR	34	1033	09-Jun-93			1	1									1,3
NAR	34	1033	09-Jun-93			3	3									1,3
NAR	34	1034	10-Jun-94			5	5								5	
NAR	34	1638	30-Nov-89		4	4	4								4	
NAR	34	1638	20-Jun-92			3	3								3	
NAR	34	4042	29-Nov-89		4,5	4	4								4,5	
NAR	34	4042	29-Nov-89		4,5	5	5								4,5	
NAR	34	0501	14-Jun-93		6	5	5								5,6	
NAR	34	0501	14-Jun-93		6	6	6								5,6	
NAR	34	0559	25-Jan-92			2	2								2	
NAR	34	0859	21-Jun-95			1	1								4	1,2,3
NAR	34	0859	21-Jun-95			2	2								4	1,2,3
NAR	34	0859	21-Jun-95			3	3								4	1,2,3
NAR	34	0859	21-Jun-95			4	4								4	1,2,3
NAR	34	0860	21-Jun-95			4	4								4	
SR	35	1022	20-Nov-91			2	2									2
SR	35	1112	18-Apr-95			1	1								1	
SR	35	2006	20-Nov-91			3	3								3	3
SR	35	6035	19-Nov-91			1	1									1
NAR	36	1008	05-Jun-90		2	5	5								5	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NAR	36	1643	08-Jun-90			2	2									2,3,6
NAR	36	1643	08-Jun-90			3	3									2,3,6
NAR	36	1643	08-Jun-90			6	6									2,3,6
NAR	36	1643	19-Apr-91			2	2								2,8	
NAR	36	1643	19-Apr-91			8	8								2,8	
NAR	36	4017	01-Jun-94			5	5									5
NAR	36	4018	02-Nov-90		9	9	9								9	
NAR	36	4018	04-Aug-93			6	6								6	
NAR	36	0859	06-Sep-94			2	2									2
NAR	36	A310	08-Jun-90			4	4								4	
NAR	36	A320	08-Jul-92			5	5								5	
NAR	36	A321	05-Jul-95			5	5								5	5
NAR	36	A350	08-Jun-90			3	3								3	
NAR	36	B320	06-Jun-90			3	3									3,4,6
NAR	36	B320	06-Jun-90			4	4									3,4,6
NAR	36	B320	21-Nov-90			6	6								6	
NAR	36	B330	06-Jun-90			1	1								1	
NAR	36	B330	21-Nov-90			All	All									
NAR	36	B331	21-Nov-90			7	7								7	
NAR	36	B350	29-Jun-94			4	4								4	
NAR	36	B351	06-Jun-90			3	3								3	
NAR	36	B351	21-Nov-90			2	2								2	
NAR	36	B352	06-Jun-90			6	6								6	
NAR	36	B353	21-Nov-90			5	5								5	
NAR	36	B354	06-Jun-90			1	1								1	5
NAR	36	B354	06-Jun-90			5	5								1	5
NAR	36	B354	21-Nov-90			7	7								7	
NAR	36	B354	14-Sep-93			2	2								2,3	
NAR	36	B354	14-Sep-93			3	3								2,3	
NAR	37	1024	31-Oct-91			3	3								3	
NAR	37	1024	10-Apr-92			8	8								8	
NAR	37	1028	30-Jan-90		1	1	1								1	2
NAR	37	1028	30-Jan-90		1	2	2								1	2
NAR	37	1028	08-Mar-91			4	4								4	
NAR	37	1030	11-Dec-89		3,4	4	4								4	
NAR	37	1801	18-Mar-90			1	1								1,4	
NAR	37	1801	18-Mar-90			4	4								1,4	
NAR	37	1801	30-Oct-91			3	3								3	
NAR	37	1801	07-Dec-92			2	2								2,4	
NAR	37	1801	07-Dec-92			4	4								2,4	
NAR	37	1802	05-Feb-90		1,5	4	4								4,5	
NAR	37	1802	05-Feb-90		1,5	5	5								4,5	
NAR	37	1802	01-Dec-95			5	5								5	
NAR	37	1802	25-Apr-96			3	3								3	5
NAR	37	1802	25-Apr-96			5	5								3	5
NAR	37	2819	12-Apr-92			3	3								3	
NAR	37	2825	30-Apr-93			2	2								2	
NAR	37	2825	15-Nov-93			6	6								6	
NAR	37	3008	09-Dec-92			2	2								2,4,6	
NAR	37	3008	09-Dec-92			4	4								2,4,6	
NAR	37	3008	09-Dec-92			6	6								2,4,6	
NAR	37	3008	15-Nov-93			3	3								3	
NAR	37	3011	23-Apr-93			5	5								5	
NAR	37	3011	15-Dec-94			1	1								1	
NAR	37	3044	20-Dec-90			2	2								2	
NAR	37	3044	15-Mar-91		5	5	5								5	
NAR	37	3816	20-Dec-90			3	3								3	
NAR	37	3816	15-Mar-91			7	7								7	
NAR	37	3816	14-Dec-92			6	6								6,8	
NAR	37	3816	14-Dec-92			8	8								6,8	
NAR	37	5827	07-Feb-90			1	1								1	
NAR	37	0201	30-Mar-94			2	2								2,4	2,4
NAR	37	0201	30-Mar-94			4	4								2,4	2,4
NAR	37	0202	30-Mar-94		8,9	8	8								8,9	
NAR	37	0202	30-Mar-94		8,9	9	9								8,9	
NAR	37	0203	30-Mar-94			8	8								8	
NAR	37	0204	30-Mar-94			6	6								6,9	
NAR	37	0204	30-Mar-94			9	9								6,9	
NAR	37	0205	30-Mar-94			3	3								3,5,7	3,4,5
NAR	37	0205	30-Mar-94			4	4								3,5,7	3,4,5
NAR	37	0205	30-Mar-94			5	5								3,5,7	3,4,5
NAR	37	0205	30-Mar-94			7	7								3,5,7	3,4,5
NAR	37	0206	30-Mar-94			4	4									4
NAR	37	0210	30-Mar-94			4	4									4
NCR	38	3006	23-Oct-89		1,2,5	All	All									All

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NCR	38	3006	11-Jun-93			All	All								All	
NCR	38	5002	25-Oct-89		All	All	All								All	
NCR	39	4031	27-Sep-89		3,4,5	3	3								3,4,5	
NCR	39	4031	27-Sep-89		3,4,5	4	4								3,4,5	
NCR	39	4031	27-Sep-89		3,4,5	5	5								3,4,5	
NCR	39	5010	09-Nov-91		4,5	All	All									All
NCR	39	9006	01-Feb-93			All	All								All	
NCR	39	0265	14-Aug-96			3	3								5	3
NCR	39	0265	14-Aug-96			5	5								5	3
NCR	39	0804	15-Dec-94			2	2								2	
NCR	39	B410	22-Dec-92			5	5								5	
NCR	39	B412	22-Dec-92		3	3	3								3,5,6	
NCR	39	B412	22-Dec-92		3	5	5								3,5,6	
NCR	39	B412	22-Dec-92		3	6	6								3,5,6	
NCR	39	B430	22-Dec-92		2,4	2	2								2,4,7,8	
NCR	39	B430	22-Dec-92		2,4	4	4								2,4,7,8	
NCR	39	B430	22-Dec-92		2,4	7	7								2,4,7,8	
NCR	39	B430	22-Dec-92		2,4	8	8								2,4,7,8	
SR	40	4086	30-Jan-91			2	2									2
SR	40	4086	30-Mar-95			2	2								2	5
SR	40	4086	30-Mar-95			5	5								2	5
SR	40	4157	04-Apr-95			4	4								4	
SR	40	0602	14-Jan-92			8	8								8	
SR	40	0602	13-Jan-95			6	6								6	
SR	40	0603	13-Jan-95			5	5									5
SR	40	0605	16-Mar-93			5	5							27-Aug-92	5	
SR	40	0605	13-Jan-95			7	7								7	
SR	40	0607	15-Jan-92			8	8								8	
SR	40	0608	15-Jan-92			1	1									1
SR	40	A410	02-Sep-91			6	6									6
SR	40	B320	31-Mar-95			4	4								4	
SR	40	B330	23-Mar-93			3	3								3	
SR	40	B350	23-Mar-93			1	1								1	
SR	40	C320	28-Jan-91			2	2								2	
WR	41	5005	25-Apr-92			2	2								2	
WR	41	5022	18-Nov-89			3	3									3
NAR	42	1597	04-Nov-89		5	1	1								4	1,5
NAR	42	1597	04-Nov-89		5	4	4								4	1,5
NAR	42	1597	04-Nov-89		5	5	5								4	1,5
NAR	42	1597	15-May-91			9	9								9	
NAR	42	1598	21-Nov-89			1	1								1	
NAR	42	1598	08-Nov-95		5	5	5									5
NAR	42	1605	14-May-91			6	6									6
NAR	42	1605	28-Oct-92			6	6								6	
NAR	42	1606	12-Nov-89			1	1								1,3,4,5	
NAR	42	1606	12-Nov-89			3	3								1,3,4,5	
NAR	42	1606	12-Nov-89			4	4								1,3,4,5	
NAR	42	1606	12-Nov-89			5	5								1,3,4,5	
NAR	42	1606	21-May-90			1	1								1	
NAR	42	1606	17-Oct-91			4	4								4	
NAR	42	1608	06-Oct-93			All	All									All
NAR	42	1610	16-Dec-92			6	6								6	
NAR	42	1613	15-May-90		2,5,7	4	4								4,8	
NAR	42	1613	15-May-90		2,5,7	8	8								4,8	
NAR	42	1614	06-Nov-89			1	1								1	
NAR	42	1614	20-May-90			3	3								3	
NAR	42	1614	11-Oct-91			5	5								5	
NAR	42	1617	02-Dec-89		3,5	2	2								2,3,5	
NAR	42	1617	02-Dec-89		3,5	3	3								2,3,5	
NAR	42	1617	02-Dec-89		3,5	5	5								2,3,5	
NAR	42	1617	15-May-90			1	1								3,4,5	1
NAR	42	1617	15-May-90			3	3								3,4,5	1
NAR	42	1617	15-May-90			4	4								3,4,5	1
NAR	42	1617	15-May-90			5	5								3,4,5	1
NAR	42	1618	06-Oct-93			4	4								4,6	
NAR	42	1618	06-Oct-93			6	6								4,6	
NAR	42	1623	18-Oct-93			3	3									3
NAR	42	1690	02-Oct-91			5	5								5	
NAR	42	1691	10-Nov-89		1,4	1	1								1,4	1
NAR	42	1691	10-Nov-89		1,4	4	4								1,4	1
NAR	42	1691	22-Aug-90		All	6	6									6
NAR	42	3044	22-Nov-89			2	2								2	
NAR	42	3044	17-May-90			1	1								1	
NAR	42	5020	02-Dec-89		1	1	1									1,2
NAR	42	5020	02-Dec-89		1	2	2									1,2

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NAR	42	5020	03-Dec-89			5	5								5	
NAR	42	5020	16-May-90		5	1	1								1,2,3,5	
NAR	42	5020	16-May-90		5	2	2								1,2,3,5	
NAR	42	5020	16-May-90		5	3	3								1,2,3,5	
NAR	42	5020	16-May-90		5	5	5								1,2,3,5	
NAR	42	5020	15-Oct-93		5	5	5								5	
NAR	42	7025	13-Nov-89		1,2	1	1								1,2,3,5	
NAR	42	7025	13-Nov-89		1,2	2	2								1,2,3,5	
NAR	42	7025	13-Nov-89		1,2	3	3								1,2,3,5	
NAR	42	7025	13-Nov-89		1,2	5	5								1,2,3,5	
NAR	42	9027	14-Sep-94			2	2									2
NAR	42	0602	13-Aug-90			3	3								3	3
NAR	42	0602	11-Oct-91			3	3								3	
NAR	42	0603	04-Aug-92			3	3								3	
NAR	42	0603	18-Oct-95			All	All									All
NAR	42	0604	13-Aug-90			4	4								4	
NAR	42	0604	18-Oct-95			All	All									All
NAR	42	0605	13-Aug-90			3	3								3	
NAR	42	0606	13-Aug-90			3	3								5	3
NAR	42	0606	13-Aug-90			5	5								5	3
NAR	42	0606	18-Oct-95			All	All									All
NAR	42	0607	13-Aug-90			3	3								3	
NAR	42	0607	18-Oct-95			All	All								8	All
NAR	42	0608	18-Oct-95			All	All									All
NAR	42	0660	03-Oct-91			5	5								5	
NAR	42	0660	18-Oct-95			All	All									All
NAR	42	0661	18-Oct-95			All	All									All
NAR	42	0662	05-Aug-92			4	4								4,5	
NAR	42	0662	05-Aug-92			5	5								4,5	
NAR	42	0662	18-Oct-95			All	All									All
NAR	42	A310	18-May-90		1	1	1								1,5	
NAR	42	A310	18-May-90		1	5	5								1,5	
NAR	42	A310	19-Nov-90			1	1							05-Jun-90	1,4	
NAR	42	A310	19-Nov-90			4	4							05-Jun-90	1,4	
NAR	42	A330	18-May-90			1	1								1,5	
NAR	42	A330	18-May-90			5	5								1,5	
NAR	42	A330	19-Nov-90			2	2								2,5	
NAR	42	A330	19-Nov-90			5	5								2,5	
NAR	42	A330	14-May-91		4,7	2	2								2,4	4,7
NAR	42	A330	14-May-91		4,7	4	4								2,4	4,7
NAR	42	A330	14-May-91		4,7	7	7								2,4	4,7
NAR	42	A330	28-Oct-92			6	6								6	
NAR	42	A340	18-May-90			All	All									
NAR	42	A340	27-Oct-93			6	6								6	
NAR	42	A350	18-May-90		3	3	3								3,6	
NAR	42	A350	18-May-90		3	6	6								3,6	
NAR	42	A350	19-Nov-90			4	4								4	
NAR	42	A350	14-May-91		4,5	4	4								4,5	4,5
NAR	42	A350	14-May-91		4,5	5	5								4,5	4,5
NAR	42	A351	18-May-90		3	2	2								2,3	
NAR	42	A351	18-May-90		3	3	3								2,3	
NAR	42	A351	14-May-91			All	All								All	
NAR	42	A351	09-May-95			All	All								All	
NAR	42	A430	19-May-90			2	2								2,6	
NAR	42	A430	19-May-90			6	6								2,6	
NAR	42	A430	31-Aug-95			3	3								3	3
NAR	42	B310	24-May-90		All	All	All								All	
NAR	42	B310	20-Nov-90			4	4							01-Sep-90	4,5	
NAR	42	B310	20-Nov-90			5	5							01-Sep-90	4,5	
NAR	42	B310	27-Oct-92			2	2								2	
NAR	42	B330	24-May-90		1,2,4,5	All	All								All	
NAR	42	B330	20-Nov-90			6	6						01-Sep-90		6	
NAR	42	B330	27-Oct-92			3	3								3	
NAR	42	B340	24-May-90		3,4,5	All	All								3,4,5	
NAR	42	B340	27-Oct-92			5	5								5	
NAR	42	B340	03-Jun-94			3	3								3	
NAR	42	B350	24-May-90		6	All	All								1,4,6	
NAR	42	B351	24-May-90			All	All									
NAR	42	B351	20-Nov-90			5	5								5	
NAR	42	C411	17-Oct-91			2	2									2,3,4,5
NAR	42	C411	17-Oct-91			3	3									2,3,4,5
NAR	42	C411	17-Oct-91			4	4									2,3,4,5
NAR	42	C411	17-Oct-91			5	5									2,3,4,5
SR	45	7019	01-May-92			5	5									5
NCR	46	3009	13-Nov-89		All	All	All								All	All

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NCR	46	3010	13-Nov-89		1,2,3,4	All	All									All
NCR	46	3012	16-Jun-93			9	9								9	
NCR	46	3052	30-Jul-92			3	3								3	
NCR	46	3052	22-Oct-93		1	All	All								All	
NCR	46	5025	18-Nov-89			All	All									All
NCR	46	9106	15-Jun-93			2	2								2,9	
NCR	46	9106	15-Jun-93			9	9								2,9	
NCR	46	9187	16-Jun-93			All	All								All	
NCR	46	0601	20-Oct-93			2	2								2,5	
NCR	46	0601	20-Oct-93			5	5								2,5	
NCR	46	0803	23-Sep-96			1	1								1,2,4,5	
NCR	46	0803	23-Sep-96			2	2								1,2,4,5	
NCR	46	0803	23-Sep-96			4	4								1,2,4,5	
NCR	46	0803	23-Sep-96			5	5								1,2,4,5	
NCR	46	0804	25-Jan-95			3	3								3,6,8	
NCR	46	0804	25-Jan-95			6	6								3,6,8	
NCR	46	0804	25-Jan-95			8	8								3,6,8	
NCR	46	A410	03-Aug-92			All	All								All	
NCR	46	A411	29-Jul-94			4	4								4	
NCR	46	A420	03-Aug-92			3	3								3,4,7	
NCR	46	A420	03-Aug-92			4	4								3,4,7	
NCR	46	A420	03-Aug-92			7	7								3,4,7	
NCR	46	A421	20-Jun-91			3	3								3,4	
NCR	46	A421	20-Jun-91			4	4								3,4	
NCR	46	A421	03-Aug-92			2	2						01-Jun-92		2,3,5	
NCR	46	A421	03-Aug-92			3	3						01-Jun-92		2,3,5	
NCR	46	A421	03-Aug-92			5	5						01-Jun-92		2,3,5	
NCR	46	A422	03-Aug-92			2	2						01-Jun-92		2	
NCR	46	A422	23-Oct-93			7	7								7,8	
NCR	46	A422	23-Oct-93			8	8								7,8	
NCR	46	A423	20-Jun-91		4	4	4								4	
NCR	46	A430	03-Aug-92			All	All								All	
NCR	46	A430	23-Oct-93			5	5								7	5,7
NCR	46	A430	23-Oct-93			7	7								7	5,7
SR	47	1029	07-Dec-95			5	5								5	
SR	47	3109	24-Feb-94			1	1								1	
SR	47	0606	08-Oct-91			4	4								4	
SR	47	A310	27-Aug-92			8	8								8	
SR	47	A350	16-May-90			6	6								6	
SR	47	B330	30-Apr-96			1	1								1,3,6	
SR	47	B330	30-Apr-96			3	3								1,3,6	
SR	47	B330	30-Apr-96			6	6								1,3,6	
SR	47	B350	30-Apr-96			5	5									5
SR	47	C310	14-Jun-91			2	2									2
SR	48	1048	19-Oct-90			4	4									4
SR	48	1050	03-Nov-92			2	2								5	2
SR	48	1050	03-Nov-92			5	5								5	2
SR	48	1130	30-Jan-95			2	2								2,6	
SR	48	1130	30-Jan-95			6	6								2,6	
SR	48	1183	19-Nov-92			1	1									1
SR	48	2176	24-Oct-90			1	1								1	
SR	48	3679	17-Dec-91			7	7									7
SR	48	3689	03-Jun-93			7	7								7	7
SR	48	3699	10-Apr-90			4	4								4	
SR	48	3779	18-Feb-91			1	1								1	
SR	48	3845	22-Apr-93			1	1								1	
SR	48	3875	20-Jun-96			3	3								3	
SR	48	4143	08-Apr-91			3	3								3	
SR	48	4146	24-Apr-91			3	3									3
SR	48	5154	09-Jun-93			5	5								5	
SR	48	5287	18-Oct-91			5	5								5	
SR	48	A350	12-Apr-91			5	5								5	
SR	48	A350	21-Jul-94			4	4								4	
SR	48	A410	30-Jun-94			3	3								3	
SR	48	A502	12-Feb-93			5	5									5
SR	48	A507	19-Mar-91			5	5									5
SR	48	A507	21-Jan-92			3	3								3	
SR	48	B330	18-Mar-91			4	4									4
SR	48	C410	22-Mar-93			2	2								2	
SR	48	C430	13-Dec-94			4	4								4,7	7
SR	48	C430	13-Dec-94			7	7								4,7	7
SR	48	D330	26-Feb-91			1	1								1	
SR	48	D350	26-Feb-91			1	1								1	
SR	48	D430	08-Nov-90			6	6								6	
SR	48	D430	08-Apr-91			2	2								2	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
SR	48	E310	19-Nov-92			2	2								2,4	
SR	48	E310	19-Nov-92			4	4								2,4	
SR	48	E340	19-Nov-92			6	6								6	
SR	48	F330	21-Mar-91			5	5								5	5
SR	48	F340	17-Feb-93			1	1								1	
SR	48	F350	29-Aug-90			1	1								1	
SR	48	F350	21-Mar-91			5	5								5	5
SR	48	F350	17-Feb-93			3	3								3	
SR	48	G320	23-Apr-90			6	6								6	
SR	48	H330	03-Nov-94			3	3								3	3
SR	48	H340	03-Nov-92			3	3								3	
SR	48	H350	16-Mar-90			3	3								3,5	
SR	48	H350	16-Mar-90			5	5								3,5	
SR	48	K340	06-Apr-90			3	3								3	
SR	48	K350	06-Apr-90			5	5								5	
SR	48	L340	18-Feb-91			3	3									3
SR	48	L350	14-Sep-90			7	7									7
SR	48	M310	01-Dec-94			3	3								3	
SR	48	N310	18-Apr-91			6	6								6	
SR	48	Q340	17-Sep-90			6	6								6	
WR	49	1017	31-Oct-95			1	1								4	1,4
WR	49	1017	31-Oct-95			4	4								4	1,4
WR	49	A320	04-Sep-90			5	5								5	
WR	49	B310	31-Oct-95			1	1								1,5	1,5
WR	49	B310	31-Oct-95			5	5								1,5	1,5
WR	49	B340	25-Oct-91		5	5	5								5	
WR	49	B350	03-Sep-90			2	2								2	
WR	49	B351	25-Oct-91		5	5	5									5
WR	49	B352	31-Oct-95			7	7								7	
WR	49	B361	25-Oct-91		1,3,4	3	3									1,3,4
WR	49	B361	25-Oct-91		1,3,4	4	4									1,3,4
WR	49	B390	31-Oct-95			8	8								8	
WR	49	C320	31-Aug-90			4	4								4	
WR	49	C410	18-Sep-94			3	3									3
WR	49	E410	14-Nov-92			1	1								1	
WR	49	E430	31-Jul-95			3	3								3	
WR	49	E431	14-Nov-92			4	4								4	
WR	49	E450	14-Nov-92			2	2								2	
WR	49	E450	31-Jul-95			6	6									6
WR	49	E451	14-Nov-92			1	1								1,2,4,5	1
WR	49	E451	14-Nov-92			2	2								1,2,4,5	1
WR	49	E451	14-Nov-92			4	4								1,2,4,5	1
WR	49	E451	14-Nov-92			5	5								1,2,4,5	1
WR	49	E451	12-Nov-93			5	5									5,9
WR	49	E451	12-Nov-93			9	9									5,9
WR	49	E454	12-Nov-93			2	2									2
WR	49	E455	14-Nov-92			3	3									3
WR	49	E455	31-Jul-95			4	4								4	
WR	49	E458	31-Jul-95			2	2								2	
NAR	50	1002	18-Feb-94			All	All									
NAR	50	1004	08-May-91			1	1								1,6,9	
NAR	50	1004	08-May-91			6	6								1,6,9	
NAR	50	1004	08-May-91			9	9								1,6,9	
NAR	50	1682	07-Jun-90			5	5								5	
NAR	50	1682	22-Jul-92			4	4								4	
NAR	50	1683	23-Oct-89			3	3									3
NAR	50	1683	07-Jun-90		2	2	2								2	
NAR	50	1683	22-Jul-92			5	5								5	
NAR	51	1002	05-Dec-92		5	5	5									5
NAR	51	1023	31-Jan-90			2	2								2	5
NAR	51	1023	31-Jan-90			5	5								2	5
NAR	51	1023	07-Dec-90			7	7								7	
NAR	51	1417	07-Dec-89			1	1								1,4	
NAR	51	1417	07-Dec-89			4	4								1,4	
NAR	51	1417	22-Mar-90		3,4,5,6	1	1								1,3,4,5,6	
NAR	51	1417	22-Mar-90		3,4,5,6	3	3								1,3,4,5,6	
NAR	51	1417	22-Mar-90		3,4,5,6	4	4								1,3,4,5,6	
NAR	51	1417	22-Mar-90		3,4,5,6	5	5								1,3,4,5,6	
NAR	51	1417	22-Mar-90		3,4,5,6	6	6								1,3,4,5,6	
NAR	51	1417	13-Dec-95			4	4								4	4
NAR	51	1423	08-Nov-94			3	3								3	
NAR	51	1464	10-Dec-89			2	2								2	
NAR	51	1464	11-Dec-89		4	4	4								4	
NAR	51	2004	05-Feb-90			5	5								5	
NAR	51	2004	09-Nov-94			2	2								2	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NAR	51	2004	05-Jan-96			3	3								3	3
NAR	51	2021	21-Mar-90			6	6								6	
NAR	51	2021	18-Dec-90			3	3								3,4	
NAR	51	2021	18-Dec-90			4	4								3,4	
NAR	51	2021	08-Nov-94			6	6								6	
NAR	51	2564	11-Dec-89			All	All								All	
NAR	51	5008	15-Dec-92			6	6								6	
NAR	51	5008	19-Dec-94			1	1									1,4
NAR	51	5008	19-Dec-94			4	4									1,4
NAR	51	5009	07-Dec-89			1	1								1	
NAR	51	5010	07-Dec-89			All	All								All	
NAR	51	5010	13-Dec-95			5	5								5	
NAR	51	0115	24-Apr-96			3	3								3,6,7	
NAR	51	0115	24-Apr-96			6	6								3,6,7	
NAR	51	0115	24-Apr-96			7	7								3,6,7	
NAR	51	0123	24-Apr-96			All	All									All
NAR	51	A310	01-Feb-90			1	1								1,4	1
NAR	51	A310	01-Feb-90			4	4								1,4	1
NAR	51	A320	01-Feb-90		1	1	1								1,5	
NAR	51	A320	01-Feb-90		1	5	5								1,5	
NAR	51	A340	01-Feb-90			1	1								1,3	
NAR	51	A340	01-Feb-90			3	3								1,3	
WR	53	1006	01-Aug-91			5	5								5,6	
WR	53	1006	01-Aug-91			6	6								5,6	
WR	53	1006	04-May-93			4	4								4	
WR	53	3019	29-May-92			5	5								5	
WR	53	3019	01-Sep-94			5	5								5	
WR	53	0210	18-Nov-95			1	1									1,4
WR	53	0210	18-Nov-95			4	4									1,4
WR	53	A310	27-Jul-90			1	1								1	
WR	53	A320	27-Jul-90			5	5								5	
WR	53	B310	30-Jul-90			4	4								4	
WR	53	B330	30-Jul-90			5	5								5	
WR	53	B330	03-Sep-96			1	1								1	
NAR	54	1640	15-Nov-89		3,5	2	2								2	3,4,5
NAR	54	1640	15-Nov-89		3,5	3	3								2	3,4,5
NAR	54	1640	15-Nov-89		3,5	4	4								2	3,4,5
NAR	54	1640	15-Nov-89		3,5	5	5								2	3,4,5
NAR	54	5007	20-Sep-90		5,6,7,8	5	5								5	
NAR	54	5007	30-Apr-92			4	4									4
NAR	54	5007	04-Nov-92			5	5							01-Sep-92	5	
NAR	54	7008	15-Nov-89			1	1								1	
NAR	54	7008	29-Apr-92			2	2								2	
NCR	55	3009	18-Aug-93			All	All								All	
NCR	55	3010	18-Aug-93			2	2								2,3,4,5	
NCR	55	3010	18-Aug-93			3	3								2,3,4,5	
NCR	55	3010	18-Aug-93			4	4								2,3,4,5	
NCR	55	3010	18-Aug-93			5	5								2,3,4,5	
NCR	55	3015	20-Aug-93			4	4								4,5,8	
NCR	55	3015	20-Aug-93			5	5								4,5,8	
NCR	55	3015	20-Aug-93			8	8								4,5,8	
NCR	55	3016	20-Aug-93			2	2								2,9	9
NCR	55	3016	20-Aug-93			9	9								2,9	9
NCR	55	5040	19-Aug-93			1	1								1,4	
NCR	55	5040	19-Aug-93			4	4								1,4	
NCR	55	6352	20-Sep-95		All	All	All								All	
NCR	55	6353	15-Feb-94			5	5									5,6
NCR	55	6353	15-Feb-94			6	6									5,6
NCR	55	6353	02-Aug-94			3	3								3,7	
NCR	55	6353	02-Aug-94			7	7								3,7	
NCR	55	6353	15-Oct-94			5	5									5
NCR	55	6353	20-Sep-95			All	All								All	
NCR	55	6354	02-Aug-94			4	4								4	
NCR	55	6354	20-Sep-95			All	All								All	
NCR	55	6355	20-Sep-95			All	All								All	
NCR	55	0901	21-Aug-93			3	3								3,4,5	
NCR	55	0901	21-Aug-93			4	4								3,4,5	
NCR	55	0901	21-Aug-93			5	5								3,4,5	
NCR	55	0901	18-Sep-95		3	3	3								All	
NCR	55	0901	18-Sep-95		3	4	4								All	
NCR	55	0901	18-Sep-95		3	5	5								All	
NCR	55	0901	18-Sep-95		3	6	6								All	
NCR	55	0902	18-Sep-95		3	3	3								3	
NCR	55	0903	18-Sep-95		2,7	All	All								All	
NCR	55	0907	18-Sep-95			2	2								All	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NCR	55	0907	18-Sep-95			5	5								All	
NCR	55	0907	18-Sep-95			6	6								All	
NCR	55	0907	18-Sep-95			7	7								All	
NCR	55	0908	18-Sep-95		2	2	2								2,4,6	
NCR	55	0909	18-Sep-95			1	1								1,5	
NCR	55	0909	18-Sep-95			5	5								1,5	
WR	56	1007	22-Oct-90			5	5									5
WR	56	1007	15-May-95			2	2									2
WR	56	1007	13-Oct-95			5	5								5	
WR	56	7772	05-Oct-93			5	5								5	
WR	56	A310	13-Oct-95			5	5								5	
WR	56	A320	05-Oct-93			3	3								3	
WR	56	A362	23-Sep-91			1	1								1	
WR	56	B310	17-Oct-95			5	5								5	
WR	81	1804	19-Jun-91			2	2									2,4,5
WR	81	1804	19-Jun-91			4	4									2,4,5
WR	81	1804	19-Jun-91			5	5									2,4,5
WR	81	2812	09-May-90			All	All								1,2	All
WR	82	9017	18-May-91			2	2								2	
NCR	83	1801	21-Oct-89			3	3								3,4	
NCR	83	1801	21-Oct-89			4	4								3,4	
NCR	83	3802	18-Oct-89			All	All								All	
NCR	83	3802	24-Jan-95			1	1								1,3	
NCR	83	3802	24-Jan-95			3	3								1,3	
NCR	83	6450	18-Oct-89			3	3								3,4,5	
NCR	83	6450	18-Oct-89			4	4								3,4,5	
NCR	83	6450	18-Oct-89			5	5								3,4,5	
NCR	83	6454	20-Oct-89			1	1								1,2,3,5	
NCR	83	6454	20-Oct-89			2	2								1,2,3,5	
NCR	83	6454	20-Oct-89			3	3								1,2,3,5	
NCR	83	6454	20-Oct-89			5	5								1,2,3,5	
NCR	83	0502	19-Oct-89			2	2								2,3,4,5	
NCR	83	0502	19-Oct-89			3	3								2,3,4,5	
NCR	83	0502	19-Oct-89			4	4								2,3,4,5	
NCR	83	0502	19-Oct-89			5	5								2,3,4,5	
NCR	83	0502	26-Aug-92			2	2								2	
NCR	83	0502	18-Jul-94			2	2									2
NCR	83	0503	19-Oct-89			1	1								1,3,4,5	
NCR	83	0503	19-Oct-89			3	3								1,3,4,5	
NCR	83	0503	19-Oct-89			4	4								1,3,4,5	
NCR	83	0503	19-Oct-89			5	5								1,3,4,5	
NCR	83	0503	15-Jul-91			1	1								1	
NCR	83	0503	26-Aug-92			1	1								1,3,7	
NCR	83	0503	26-Aug-92			3	3								1,3,7	
NCR	83	0503	26-Aug-92			7	7								1,3,7	
NCR	83	0503	18-Jul-94			4	4								4,5	
NCR	83	0503	18-Jul-94			5	5								4,5	
NCR	83	0504	20-Oct-89			1	1								1,3,4,5	
NCR	83	0504	20-Oct-89			3	3								1,3,4,5	
NCR	83	0504	20-Oct-89			4	4								1,3,4,5	
NCR	83	0504	20-Oct-89			5	5								1,3,4,5	
NCR	83	0504	26-Aug-92			1	1								1	
NCR	83	0504	18-Jul-94			9	9								9	
NCR	83	0505	20-Oct-89			All	All								All	
NCR	83	0505	26-Aug-92			5	5								5,7	
NCR	83	0505	26-Aug-92			7	7								5,7	
NCR	83	0506	19-Oct-89			All	All								All	
NCR	83	0506	26-Aug-92			1	1								1,2,3,7	
NCR	83	0506	26-Aug-92			2	2								1,2,3,7	
NCR	83	0506	26-Aug-92			3	3								1,2,3,7	
NCR	83	0506	26-Aug-92			7	7								1,2,3,7	
NCR	83	0506	18-Jul-94			6	6								6,8	
NCR	83	0506	18-Jul-94			8	8								6,8	
NCR	83	0507	20-Oct-89		4	1	1								1,2,4,5	
NCR	83	0507	20-Oct-89		4	2	2								1,2,4,5	
NCR	83	0507	20-Oct-89		4	4	4								1,2,4,5	
NCR	83	0507	20-Oct-89		4	5	5								1,2,4,5	
NCR	83	0507	25-May-90			1	1								1	
NCR	83	0508	19-Oct-89			1	1								1,2,3,4	
NCR	83	0508	19-Oct-89			2	2								1,2,3,4	
NCR	83	0508	19-Oct-89			3	3								1,2,3,4	
NCR	83	0508	19-Oct-89			4	4								1,2,3,4	
NCR	83	0508	18-Jul-94			1	1								1,2,4	
NCR	83	0508	18-Jul-94			2	2								1,2,4	
NCR	83	0508	18-Jul-94			4	4								1,2,4	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NCR	83	0509	19-Oct-89			1	1								1,3,4,5	
NCR	83	0509	19-Oct-89			3	3								1,3,4,5	
NCR	83	0509	19-Oct-89			4	4								1,3,4,5	
NCR	83	0509	19-Oct-89			5	5								1,3,4,5	
NCR	83	0509	29-Apr-95			All	All								1,2,5	2,3,5,7
NCR	83	A320	16-Jul-91			All	All								8,9	All
NCR	83	A320	27-Aug-92			5	5								5,6	
NCR	83	A320	27-Aug-92			6	6								5,6	
NAR	84	1802	23-Jul-90		3	3	3								3	
NAR	84	1802	20-Aug-91			3	3								3	
NAR	84	3803	20-Aug-91		1,4,5	1	1									1,2,4,5
NAR	84	3803	20-Aug-91		1,4,5	2	2									1,2,4,5
NAR	84	3803	20-Aug-91		1,4,5	4	4									1,2,4,5
NAR	84	3803	20-Aug-91		1,4,5	5	5									1,2,4,5
NAR	84	6804	20-Aug-91		2	2	2								2	
NAR	84	6804	13-Aug-95			3	3									3,4,6
NAR	84	6804	13-Aug-95			4	4									3,4,6
NAR	84	6804	13-Aug-95			6	6									3,4,6
NAR	85	1801	05-Oct-89			3	3									3
NAR	85	1801	25-Aug-91			5	5								5	
NAR	85	1803	08-Oct-89			2	2								2,6	
NAR	85	1803	08-Oct-89			6	6								2,6	
NAR	86	6802	26-Jul-90			2	2								2,8	
NAR	86	6802	26-Jul-90			8	8								2,8	
NAR	86	6802	22-Aug-91		3,8	8	8								8,9	
NAR	86	6802	22-Aug-91		3,8	9	9								8,9	
NAR	86	6802	20-Sep-92		5	5	5									5
NAR	87	1620	06-Sep-89			4	4								4,5	
NAR	87	1620	06-Sep-89			5	5								4,5	
NAR	87	1622	20-Aug-92			3	3								3,5,6	
NAR	87	1622	20-Aug-92			5	5								3,5,6	
NAR	87	1622	20-Aug-92			6	6								3,5,6	
NAR	87	1622	16-Feb-94			1	1								1	
NAR	87	1622	06-Apr-94			1	1								1,3,4,5	
NAR	87	1622	06-Apr-94			3	3								1,3,4,5	
NAR	87	1622	06-Apr-94			4	4								1,3,4,5	
NAR	87	1622	06-Apr-94			5	5								1,3,4,5	
NAR	87	1680	19-Jun-90			2	2								2,4,5,6	
NAR	87	1680	19-Jun-90			4	4								2,4,5,6	
NAR	87	1680	19-Jun-90			5	5								2,4,5,6	
NAR	87	1680	19-Jun-90			6	6								2,4,5,6	
NAR	87	1680	10-Jul-91		2	2	2								2	
NAR	87	2811	15-Jun-90			4	4									4
NAR	87	2811	15-Aug-92			All	All								All	
NAR	87	A310	20-Oct-90			4	4									2,4,5,8
NAR	87	A310	20-Oct-90			5	5									2,4,5,8
NAR	87	A310	25-Apr-91			7	7								7	
NAR	87	A320	18-Jun-90			6	6								6	
NAR	87	A320	25-Apr-91			All	All								All	
NAR	87	A340	18-Jun-90			2	2								2	
NAR	87	B310	20-Aug-92			All	All								All	
NAR	87	B311	19-Oct-90			All	All								All	All
NAR	87	B320	19-Oct-90			2	2								2,5	
NAR	87	B320	19-Oct-90			5	5								2,5	
NAR	87	B320	20-Aug-92			2	2								2,3,5,6	
NAR	87	B320	20-Aug-92			3	3								2,3,5,6	
NAR	87	B320	20-Aug-92			5	5								2,3,5,6	
NAR	87	B320	20-Aug-92			6	6								2,3,5,6	
NAR	87	B330	20-Aug-92			3	3								3,6	
NAR	87	B330	20-Aug-92			6	6								3,6	
NAR	87	B340	19-Oct-90			3	3								3,5,7	
NAR	87	B340	19-Oct-90			5	5								3,5,7	
NAR	87	B340	19-Oct-90			7	7								3,5,7	
NAR	87	B360	08-Sep-93			4	4								4	
NAR	88	1646	21-Aug-91			6	6								6	
NAR	88	1646	22-Sep-92			4	4								4	
NAR	88	1647	29-Sep-89			3	3								3	
NAR	89	1021	23-Sep-89			1	1									1,3,5
NAR	89	1021	23-Sep-89			3	3									1,3,5
NAR	89	1021	23-Sep-89			5	5									1,3,5
NAR	89	1021	24-Jun-90			2	2								2	
NAR	89	1021	16-Jul-91			3	3								3,6	
NAR	89	1021	16-Jul-91			6	6								3,6	
NAR	89	1021	25-Aug-92			7	7								7	
NAR	89	1021	19-Jul-94			3	3								3	

Table 18. Profile runs with saturation spikes.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Wheelpath Spikes Run No.	Right Wheelpath Spikes Run No.
NAR	89	1125	25-Sep-89		2	2	2								2	
NAR	89	1125	22-Jun-90		5	1	1								1,4,5	
NAR	89	1125	22-Jun-90		5	4	4								1,4,5	
NAR	89	1125	22-Jun-90		5	5	5								1,4,5	
NAR	89	1125	27-Aug-92			All	All								All	
NAR	89	1127	25-Sep-89		1,2,4	2	2									2
NAR	89	1127	22-Jun-90		6	6	6								6	
NAR	89	1127	27-Apr-94			4	4								4	
NAR	89	1127	20-Jul-94			2	2								2	
NAR	89	2011	21-Sep-89			1	1								1,3,4,6	
NAR	89	2011	21-Sep-89			3	3								1,3,4,6	
NAR	89	2011	21-Sep-89			4	4								1,3,4,6	
NAR	89	2011	21-Sep-89			6	6								1,3,4,6	
NAR	89	2011	21-Jun-90			All	All								All	
NAR	89	2011	13-Jul-91		1	4	4									4
NAR	89	2011	27-Aug-92		5	5	5								5,6	
NAR	89	2011	27-Aug-92		5	6	6								5,6	
NAR	89	2011	11-Aug-93			All	All								All	All
NAR	89	2011	22-Jul-94			1	1									1,3,4,5
NAR	89	2011	22-Jul-94			3	3									1,3,4,5
NAR	89	2011	22-Jul-94			4	4									1,3,4,5
NAR	89	2011	22-Jul-94			5	5									1,3,4,5
NAR	89	3002	22-Sep-89		3,4	3	3									3,4
NAR	89	3002	22-Sep-89		3,4	4	4									3,4
NAR	89	3002	12-Jul-91			All	All								All	2,3,4,5
NAR	89	3015	19-Jul-94			8	8								8	
NAR	89	3016	23-Sep-89			2	2								2	
NAR	89	3016	22-Jun-90			1	1								1	
NAR	89	3016	04-Sep-91			5	5									5,7
NAR	89	3016	04-Sep-91			7	7									5,7
NAR	89	3016	26-Aug-92		1	1	1								1,2	
NAR	89	3016	26-Aug-92		1	2	2								1,2	
NAR	89	3016	07-May-96			All	All									All
NAR	89	9018	23-Sep-89			3	3								3,5	
NAR	89	9018	23-Sep-89			5	5								3,5	
NAR	89	9018	18-Jul-95			5	5								5	
NAR	89	A340	25-Aug-92			6	6								6	
NAR	89	A350	19-Jul-95			4	4								4	
NCR	90	6400	21-Oct-89			1	1								1,2,3,4	
NCR	90	6400	21-Oct-89			2	2								1,2,3,4	
NCR	90	6400	21-Oct-89			3	3								1,2,3,4	
NCR	90	6400	21-Oct-89			4	4								1,2,3,4	
NCR	90	6400	25-Jun-95			All	All								All	
NCR	90	6405	22-Oct-89			1	1								1,2,3,5	
NCR	90	6405	22-Oct-89			2	2								1,2,3,5	
NCR	90	6405	22-Oct-89			3	3								1,2,3,5	
NCR	90	6405	22-Oct-89			5	5								1,2,3,5	
NCR	90	6405	12-Jun-93			9	9								9	
NCR	90	6405	17-Apr-94			2	2								2,6,8	
NCR	90	6405	17-Apr-94			6	6								2,6,8	
NCR	90	6405	17-Apr-94			8	8								2,6,8	
NCR	90	6410	22-Oct-89			1	1								1	
NCR	90	6410	30-May-90			6	6								6	
NCR	90	6410	24-Jun-95			2	2								2,3,4,5	
NCR	90	6410	24-Jun-95			3	3								2,3,4,5	
NCR	90	6410	24-Jun-95			4	4								2,3,4,5	
NCR	90	6410	24-Jun-95			5	5								2,3,4,5	
NCR	90	6412	20-Jul-94			5	5									5,6,7,9
NCR	90	6412	20-Jul-94			6	6									5,6,7,9
NCR	90	6412	20-Jul-94			7	7									5,6,7,9
NCR	90	6412	20-Jul-94			9	9									5,6,7,9
NCR	90	6412	24-Jun-95			4	4								4,5	
NCR	90	6412	24-Jun-95			5	5								4,5	
NCR	90	A352	17-Jul-91			4	4								4,8	
NCR	90	A352	17-Jul-91			8	8								4,8	
NCR	90	B351	12-Jun-93			7	7								7	

APPENDIX F. SUMMARY OF ALL LOST LOCK PROFILE RUNS

Table 19. Profile runs with lost lock.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Whp Lost Lock Run No.	Right Whp Lost Lock Run No.
SR	1	1001	18-Feb-94				All							All	All
SR	1	6019	08-Aug-94				All								All
SR	1	0101	12-Aug-93				1								All
SR	1	0101	12-Aug-93				2								All
SR	1	0101	12-Aug-93				3								All
SR	1	0101	12-Aug-93		4		4								All
SR	1	0101	12-Aug-93				5								All
SR	1	0101	25-Aug-94				All								All
SR	1	0102	12-Aug-93				All								All
SR	1	0103	12-Aug-93				All								All
SR	1	0103	25-Aug-94				All								All
SR	1	0104	12-Aug-93				All								All
SR	1	0104	25-Aug-94				All								All
SR	1	0105	11-Aug-93				All								All
SR	1	0105	25-Aug-94				All								All
SR	1	0106	12-Aug-93				All								All
SR	1	0106	25-Aug-94				All								All
SR	1	0107	11-Aug-93				All								All
SR	1	0107	25-Aug-94				All								All
SR	1	0108	11-Aug-93				All								All
SR	1	0108	25-Aug-94				All								All
SR	1	0109	11-Aug-93				All								All
SR	1	0109	24-Aug-94				1								All
SR	1	0109	24-Aug-94				2								All
SR	1	0109	24-Aug-94				3								All
SR	1	0109	24-Aug-94				4								All
SR	1	0109	24-Aug-94				5								All
SR	1	0110	11-Aug-93				All								All
SR	1	0110	25-Aug-94				All								All
SR	1	0111	11-Aug-93				All								All
SR	1	0111	25-Aug-94				All								All
SR	1	0112	11-Aug-93				All								All
SR	1	0112	25-Aug-94				All								All
SR	1	0161	11-Aug-93				All								All
SR	1	0161	25-Aug-94				All								All
SR	1	0162	12-Aug-93				All								All
SR	1	0162	25-Aug-94				All								All
SR	1	0163	25-Aug-94				All								All
SR	1	0502	01-Apr-92				1							1	1
SR	1	A320	24-Aug-94				All								All
SR	1	A320	19-Dec-95				All							All	
SR	1	A340	24-Aug-94				All								All
SR	1	C320	09-Aug-94				All								All
WR	4	1002	09-Aug-96				All						13-May-96	All	
WR	4	1003	21-Jan-92				All							All	
WR	4	1024	10-Feb-93				All							All	
WR	4	1025	03-Apr-90				All							All	
WR	4	1065	02-Apr-90				All							All	
WR	4	0601	12-Feb-93				All			All					All
WR	4	A350	05-Feb-93				2							2,4,5,6	2,4,5,6
WR	4	A350	05-Feb-93				4							2,4,5,6	2,4,5,6
WR	4	A350	05-Feb-93				5							2,4,5,6	2,4,5,6
WR	4	A350	05-Feb-93				6							2,4,5,6	2,4,5,6
WR	4	A350	28-Jan-94				2							2	2
WR	4	B320	21-Mar-95				4							4,5	
WR	4	B320	21-Mar-95				5							4,5	
WR	4	B330	21-Mar-95				3							3,4,5	
WR	4	B330	21-Mar-95				4							3,4,5	
WR	4	B330	21-Mar-95				5					01-Aug-94		3,4,5	
SR	5	3058	27-Sep-94				1								All
SR	5	3058	27-Sep-94		2		2								All
SR	5	3058	27-Sep-94				3								All
SR	5	3058	27-Sep-94				4								All
SR	5	3058	27-Sep-94				5								All
SR	5	A320	28-Sep-94				All								All
SR	5	A330	28-Sep-94				All								All

Table 19. Profile runs with lost lock.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Whp Lost Lock Run No.	Right Whp Lost Lock Run No.
WR	6	2053	23-Mar-93				All							All	
WR	6	0509	11-Feb-92		5		5							5	5
WR	8	0506	28-May-91				1								1
NAR	10	1450	13-Nov-90				5								5
NAR	10	4002	27-Mar-90				1							1,3-5	
NAR	10	4002	27-Mar-90				3							1,3-5	
NAR	10	4002	27-Mar-90				4							1,3-5	
NAR	10	4002	27-Mar-90				5							1,3-5	
NAR	10	4002	04-Dec-90				All							All	
NAR	10	5004	15-Nov-90				All							All	
NAR	10	5005	16-Nov-95				All						01-May-95		All
SR	12	4097	30-Aug-94				All								All
SR	12	4100	26-Aug-94				All								All
SR	12	4108	29-Aug-94				All								All
SR	12	4135	02-Sep-94				All								All
SR	12	4137	02-Sep-94				All								All
SR	12	A310	02-Jul-91				All							All	
SR	12	A320	07-Sep-94				1								All
SR	12	A320	07-Sep-94				2								All
SR	12	A320	07-Sep-94				3								All
SR	12	A320	07-Sep-94		4		4								All
SR	12	A320	07-Sep-94				5								All
SR	12	A320	30-Jun-96				All							All	
SR	12	A321	02-Jul-91				All							All	
SR	12	A321	07-Sep-94				All								All
SR	12	B320	04-Apr-94				All								All
SR	12	C320	05-Sep-94				All								All
SR	13	1031	25-Jan-96		3		3								3
SR	13	1031	16-Oct-96				2								2,5
SR	13	1031	16-Oct-96		5		5								2,5
SR	13	3007	03-Aug-90				4							4	
SR	13	0501	13-Jun-94				All						07-Jun-93		All
SR	13	0501	07-May-96				All							All	All
SR	13	0502	13-Jun-94				All						16-Jun-93		All
SR	13	0503	13-Jun-94				All						08-Jun-93		All
SR	13	0504	13-Jun-94				All						16-Jun-93		All
SR	13	0505	13-Jun-94				All						16-Jun-93		All
SR	13	0506	13-Jun-94				All						07-Jun-93		All
SR	13	0507	13-Jun-94				All						16-Jun-93		All
SR	13	0508	13-Jun-94				All						16-Jun-93		All
SR	13	0509	13-Jun-94				All						16-Jun-93		All
SR	13	0560	14-Jun-94				All						15-Jun-93		All
SR	13	0561	14-Jun-94				All						15-Jun-93		All
SR	13	0562	14-Jun-94				All						17-Jun-93		All
SR	13	0563	14-Jun-94				All						17-Jun-93		All
SR	13	0564	14-Jun-94				All						17-Jun-93		All
SR	13	0565	14-Jun-94				All						18-Jun-93		All
SR	13	0566	14-Jun-94				All						18-Jun-93		All
SR	13	0567	14-Jun-94				All						18-Jun-93		All
SR	13	0567	08-May-96				4							4	
WR	16	1005	08-Aug-91				All								All
WR	16	9032	27-Oct-89				1							1,2	1,2
WR	16	9032	27-Oct-89				2							1,2	1,2
NCR	17	5217	08-Oct-92				All			9				All	
NCR	17	5423	08-Oct-92				All							All	1,5,7
NCR	17	0607	01-Oct-92				All							All	
NCR	17	A320	11-Dec-90				All								All
NCR	18	1028	15-Dec-90				5							5	
NCR	18	2009	03-Oct-89				2								2,4
NCR	18	2009	03-Oct-89				4								2,4
NCR	18	5528	09-Sep-91				All								All
NCR	18	5538	09-Sep-91				All								All
NCR	19	0110	01-Apr-96				All							All	
NCR	19	0111	01-Apr-96				All							All	
NCR	19	0112	16-Apr-96				All							All	
NCR	19	0159	16-Apr-96				All							All	
NCR	19	0214	16-Feb-95		5		5							5	
NCR	19	0703	01-Nov-93				1							1	
NCR	20	6026	19-Apr-92				All							All	All

Table 19. Profile runs with lost lock.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Whp Lost Lock Run No.	Right Whp Lost Lock Run No.
NCR	20	9037	11-Apr-90				2							2	
NCR	20	0162	01-Apr-96				1							1	1
NCR	20	0201	14-Aug-92				All							All	
NCR	20	0903	01-Apr-96				All							All	
NCR	20	B350	22-Apr-96				All							All	All
NCR	21	6043	12-Jan-91				1								1
NAR	23	1001	18-Sep-93				2								All
NAR	23	1001	18-Sep-93		5		5								All
NAR	23	1001	18-Sep-93				6								All
NAR	23	1001	18-Sep-93				7								All
NAR	23	1001	18-Sep-93		8		8								All
NAR	23	1001	14-Aug-95				All								All
NAR	23	1009	22-Aug-94				All								All
NAR	23	1012	01-Oct-90				All							All	
NAR	23	1012	19-Sep-93				All								All
NAR	23	1026	05-Oct-90				All							All	
NAR	23	0501	20-Aug-94				All								All
NAR	23	0502	20-Aug-94				All								All
NAR	23	0503	20-Aug-94				All								All
NAR	23	0504	20-Aug-94				All								All
NAR	23	0504	15-Aug-95				All						27-Jun-95		All
NAR	23	0505	20-Aug-94				All								All
NAR	23	0505	15-Aug-95				All						27-Jun-95		All
NAR	23	0506	20-Aug-94				All								All
NAR	23	0506	15-Aug-95				All						27-Jun-95		All
NAR	23	0507	20-Aug-94				All								All
NAR	23	0508	20-Aug-94				All							5	All
NAR	23	0508	15-Aug-95				4						27-Jun-95		All
NAR	23	0508	15-Aug-95				5						27-Jun-95		All
NAR	23	0508	15-Aug-95				7						27-Jun-95		All
NAR	23	0508	15-Aug-95				8						27-Jun-95		All
NAR	23	0508	15-Aug-95		9		9						27-Jun-95		All
NAR	23	0509	20-Aug-94				All								All
NAR	23	0509	15-Aug-95				All						27-Jun-95		All
NAR	23	0559	20-Aug-94				All								All
NAR	23	0559	15-Aug-95				All						27-Jun-95		All
NAR	24	1632	25-Mar-90				All							All	All
NAR	24	2401	10-Oct-90				All							All	
NAR	24	5807	12-Nov-90				All						01-Sep-90	All	
NAR	24	0502	25-Jun-94				All						01-Jun-92		All
NAR	24	0502	06-Dec-95				All								All
NAR	24	0505	25-Jun-94				All								All
NAR	24	0508	06-Dec-95				All								All
NAR	24	0509	06-Dec-95				All								All
NAR	24	0559	25-Jun-94				All								All
NAR	24	0560	25-Jun-94				All								All
NAR	24	0560	06-Dec-95				All								All
NAR	24	0561	25-Jun-93				All						13-May-92	All	
NAR	24	0561	24-Jun-94				All								All
NAR	24	0561	06-Dec-95				All								All
NAR	24	0562	25-Jun-94				All								All
NAR	24	0562	06-Dec-95				All								All
NAR	24	0563	06-Dec-95				All								All
NAR	24	0902	07-Dec-95				All								All
NAR	24	0960	26-Jun-94				All								All
NAR	24	0960	07-Dec-95				All								All
NAR	24	0961	07-Dec-95				All								All
NAR	24	0962	26-Jun-94				All								All
NAR	24	0962	07-Dec-95				All								All
NAR	24	A310	18-Jun-94				All								All
NAR	24	A311	18-Jun-94				All								All
NAR	24	A330	18-Jun-94				All								All
NAR	25	1002	22-Feb-94				6							6	
NAR	25	1002	15-Apr-94				1							1,4,5,9	
NAR	25	1002	15-Apr-94				4							1,4,5,9	
NAR	25	1002	15-Apr-94				5							1,4,5,9	
NAR	25	1002	15-Apr-94				9							1,4,5,9	
NAR	25	1004	27-Sep-90				All							All	
NAR	25	1004	10-Sep-94				All								All

Table 19. Profile runs with lost lock.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Whp Lost Lock Run No.	Right Whp Lost Lock Run No.
NCR	26	1004	09-Nov-94				All							All	
NCR	26	1012	15-Dec-93				5								5
NCR	26	6016	10-Oct-89				All								All
NCR	26	0115	28-Mar-96				All							All	
NCR	26	0116	28-Mar-96				All							All	
NCR	26	0117	28-Mar-96				All							All	
NCR	26	0118	28-Mar-96				All							All	
NCR	26	0120	28-Mar-96				All							All	
NCR	26	0123	28-Mar-96				All							All	
NCR	26	0124	28-Mar-96				All							All	
NCR	26	0603	09-Sep-94				8							8	
NCR	26	0608	09-Sep-94				8							8	
NCR	26	0659	09-Sep-94				8	All						8	
NCR	27	1018	17-Feb-94				All							All	
NCR	27	3003	03-Aug-92				1							1	
NCR	27	4040	09-Nov-94				All							All	
NCR	27	0704	31-Oct-92				All							All	
NCR	27	0903	23-Nov-93				All							All	All
SR	28	0506	03-Aug-95				5								5
SR	28	0507	03-Aug-95				1								1,4,6
SR	28	0507	03-Aug-95				4								1,4,6
SR	28	0507	03-Aug-95				6								1,4,6
SR	28	0902	07-Jun-95				All								All
SR	28	A310	13-May-91				All							All	
NCR	29	4069	12-Feb-92				All							All	4,5
NCR	29	5483	12-Feb-92				All							All	
NCR	29	5483	06-Mar-93				All							All	
NCR	29	0664	13-Mar-93				9							9	
NCR	29	B320	15-Feb-92				All							All	All
NCR	29	B351	15-Feb-92				All							All	All
NCR	31	6702	15-Aug-91				All								All
NCR	31	7040	17-Aug-91				All							All	All
NCR	31	A310	19-Sep-96				1							1	
WR	32	B310	26-Aug-91				All								All
NAR	33	1001	28-Sep-90				All							All	
NAR	33	1001	04-Aug-94				All								All
NAR	34	1003	28-Nov-90		All	All	All							All	
NAR	34	1003	07-Jun-94				4								4
NAR	34	1638	07-Sep-91				2							2,3	
NAR	34	1638	07-Sep-91				3							2,3	
NAR	34	1638	24-Jun-95				All								All
NAR	34	6057	28-Nov-89				All							All	
NAR	34	0503	09-Jun-94				All								All
NAR	34	0506	09-Jun-94				All								All
NAR	34	0506	23-Jun-95				All								All
NAR	34	0507	09-Jun-94				All								All
NAR	34	0559	09-Jun-94				All								All
NAR	34	0559	23-Jun-95				All								All
NAR	34	0560	09-Jun-94				All								All
NAR	34	0560	23-Jun-95				All								All
SR	35	2006	02-Dec-93				All							All	All
SR	35	6401	03-Dec-93				All								All
NAR	36	1008	30-Jul-91				5							5,6	
NAR	36	1008	30-Jul-91				6							5,6	
NAR	36	1644	07-May-91				All							All	
NAR	36	A310	21-Nov-90				5							5,7	
NAR	36	A310	21-Nov-90				7							5,7	
NAR	36	A321	21-Nov-90		All		All							All	
NAR	36	A321	15-Sep-93				All								All
NAR	36	A321	28-Jun-94				All								All
NAR	36	A331	08-Jun-90				3								3,4
NAR	36	A331	08-Jun-90		4		4								3,4
NAR	36	A331	08-Jul-92				2								2,4,7
NAR	36	A331	08-Jul-92				4								2,4,7
NAR	36	A331	08-Jul-92				7								2,4,7
NAR	36	A331	05-Jul-95				3								3
NAR	36	A340	15-Sep-93				4								All
NAR	36	A340	15-Sep-93				5								All
NAR	36	A340	15-Sep-93				6								All

Table 19. Profile runs with lost lock.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Whp Lost Lock Run No.	Right Whp Lost Lock Run No.
NAR	36	A340	15-Sep-93				7								All
NAR	36	A340	15-Sep-93		8		8								All
NAR	36	B320	06-Jun-90		6		6							6	
NAR	36	B330	07-May-91				4							4,5,9	
NAR	36	B330	07-May-91				5							4,5,9	
NAR	36	B330	07-May-91				9							4,5,9	
NAR	36	B331	06-Jun-90				All							All	5
NAR	36	B331	07-May-91				All							All	
NAR	36	B340	21-Nov-90				All							All	
NAR	36	B340	07-May-91				2							2,3,9	
NAR	36	B340	07-May-91				3							2,3,9	
NAR	36	B340	07-May-91				9							2,3,9	
NAR	36	B340	29-Jun-94				All								All
NAR	36	B350	06-Jun-90				2							2,4	
NAR	36	B350	06-Jun-90				4							2,4	
NAR	36	B350	21-Nov-90		2		2							All	
NAR	36	B350	21-Nov-90				4							All	
NAR	36	B350	21-Nov-90				5							All	
NAR	36	B350	21-Nov-90				6							All	
NAR	36	B350	21-Nov-90				7							All	
NAR	36	B350	07-May-91				2							All	
NAR	36	B350	07-May-91				3							All	
NAR	36	B350	07-May-91		7		7							All	
NAR	36	B350	07-May-91				8							All	
NAR	36	B350	07-May-91				9							All	
NAR	37	1006	21-Dec-90				All							All	
NAR	37	1006	14-Mar-91				All							All	
NAR	37	1006	15-Dec-94				All								All
NAR	37	1006	18-Dec-95				All								All
NAR	37	1024	10-Dec-90				All							All	
NAR	37	1028	11-Dec-89				All							All	All
NAR	37	1028	15-Dec-95				All								All
NAR	37	1645	12-Mar-91				1							1,4	
NAR	37	1645	12-Mar-91				4							1,4	
NAR	37	1645	04-Jun-92				1							1,3,4	
NAR	37	1645	04-Jun-92				3							1,3,4	
NAR	37	1645	04-Jun-92				4							1,3,4	
NAR	37	1802	14-Dec-94				All								All
NAR	37	1803	12-Sep-90				All							All	
NAR	37	1817	11-Sep-90				All							All	
NAR	37	2824	01-Nov-91				All							All	
NAR	37	3807	15-Dec-90				All							All	
NAR	37	3807	04-May-93				1							1,4,5	
NAR	37	3807	04-May-93				4							1,4,5	
NAR	37	3807	04-May-93				5							1,4,5	
NAR	37	3816	06-Jun-92				2							2	
NAR	37	5037	11-Dec-90				1							1,7,8,9	
NAR	37	5037	11-Dec-90				7							1,7,8,9	
NAR	37	5037	11-Dec-90				8							1,7,8,9	
NAR	37	5037	11-Dec-90				9							1,7,8,9	
NAR	37	5826	04-Jan-96				All								All
NAR	37	0208	30-Mar-94				1							All	
NAR	37	0208	30-Mar-94		2		2							All	
NAR	37	0208	30-Mar-94				3							All	
NAR	37	0208	30-Mar-94				5							All	
NAR	37	0208	30-Mar-94		6		6							All	
NCR	39	5010	28-Sep-89				5								5
NCR	39	5010	14-Aug-90				3							All	
NCR	39	5010	14-Aug-90				4							All	
NCR	39	5010	14-Aug-90		5		5							All	
NCR	39	5010	14-Aug-90				6							All	
NCR	39	5010	14-Aug-90				9							All	
SR	40	4163	21-Sep-93				All								All
SR	40	B320	11-Jan-91				1							All	
SR	40	B320	11-Jan-91				4							All	
SR	40	B320	11-Jan-91		5		5							All	
SR	40	B320	11-Jan-91				7							All	
SR	40	B320	11-Jan-91				9							All	
WR	41	6012	12-May-91				All							All	All

Table 19. Profile runs with lost lock.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Whp Lost Lock Run No.	Right Whp Lost Lock Run No.
NAR	42	1599	29-Sep-94				All								All
NAR	42	1605	05-Nov-89		1		1								1,4,5
NAR	42	1605	05-Nov-89				4								1,4,5
NAR	42	1605	05-Nov-89				5								1,4,5
NAR	42	1606	08-Oct-92				2							2	
NAR	42	1608	26-Sep-94				All								All
NAR	42	1613	02-Dec-89		All	All	All							All	
NAR	42	1613	09-Oct-91				All							All	
NAR	42	1613	13-Sep-94				6							6	
NAR	42	1617	13-Sep-94				6							6	
NAR	42	1623	27-Oct-92				1							1	
NAR	42	1627	20-Oct-92				All							All	
NAR	42	3044	08-Oct-91				4							4,5,6	
NAR	42	3044	08-Oct-91				5							4,5,6	
NAR	42	3044	08-Oct-91				6							4,5,6	
NAR	42	3044	14-Sep-94				All								All
NAR	42	5020	13-Sep-94				1								1
NAR	42	7037	18-Oct-91				5							5	
NAR	42	9027	13-Oct-92				1							1	
NAR	42	0603	26-Oct-93				All								All
NAR	42	0604	26-Oct-93				All								All
NAR	42	0606	26-Oct-93				All								All
NAR	42	0660	26-Oct-93				All								All
NAR	42	0661	26-Oct-93				All								All
NAR	42	0662	26-Oct-93				All								All
NAR	42	A320	19-Nov-90				1					10-Sep-90		All	
NAR	42	A320	19-Nov-90				2					10-Sep-90		All	
NAR	42	A320	19-Nov-90				3					10-Sep-90		All	
NAR	42	A320	19-Nov-90		4		4					10-Sep-90		All	
NAR	42	A320	19-Nov-90				5					10-Sep-90		All	
NAR	42	A351	27-Oct-93				All								All
NAR	42	B350	15-May-91				All							All	
NAR	42	B350	27-Oct-92				All							All	
NAR	44	7401	26-Sep-90				All							All	
NCR	46	3052	16-Aug-94		5		All								All
NCR	46	0603	20-Oct-93				7								7
NCR	46	0608	20-Oct-93				7								7
NCR	46	0662	20-Oct-93				7								7
NCR	46	A411	29-Jul-94				3			3				3	
NCR	46	A412	29-Jul-94				3			3				3	
NCR	46	A420	29-Jul-94				3			3				3	
NCR	46	A421	29-Jul-94				3			3				3	
NCR	46	A422	29-Jul-94				3			3				3	
NCR	46	A423	29-Jul-94				3			3				3	
NCR	46	A430	29-Jul-94				3			3				3	
SR	47	1029	15-Apr-92				All								All
SR	47	A310	10-Jun-94				All							All	
SR	47	A320	17-Jun-91		All		All							All	
SR	47	A320	10-Jun-94				All							All	
SR	47	A320	10-Apr-95				7								7
SR	47	A330	10-Jun-94				All							All	
SR	47	B330	10-Jun-94				All							All	
SR	47	C310	08-Jun-94				All							All	
SR	48	1060	03-Apr-90				2								2,3,4,5
SR	48	1060	03-Apr-90				3								2,3,4,5
SR	48	1060	03-Apr-90				4								2,3,4,5
SR	48	1060	03-Apr-90				5								2,3,4,5
SR	48	1068	20-Apr-94				2								2,5
SR	48	1068	20-Apr-94				5								2,5
SR	48	1077	14-Oct-94				All							All	All
SR	48	1087	05-Jan-94				All							All	All
SR	48	1111	17-Nov-94				All							5	All
SR	48	1123	17-Feb-95				All							All	All
SR	48	1169	31-Oct-94				All								All
SR	48	3559	02-Nov-94				3								3,4,5
SR	48	3559	02-Nov-94				4								3,4,5
SR	48	3559	02-Nov-94				5								3,4,5
SR	48	3729	30-Mar-90				1							1	
SR	48	3729	07-Mar-95				1								All

Table 19. Profile runs with lost lock.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Whp Lost Lock Run No.	Right Whp Lost Lock Run No.
SR	48	3729	07-Mar-95				2								All
SR	48	3729	07-Mar-95		3		3								All
SR	48	3729	07-Mar-95				4								All
SR	48	3729	07-Mar-95				5								All
SR	48	3739	21-Apr-95				1								1,2
SR	48	3739	21-Apr-95				2								1,2
SR	48	3769	12-Oct-94				All								All
SR	48	3779	11-Oct-90				2								2,3,4
SR	48	3779	11-Oct-90				3								2,3,4
SR	48	3779	11-Oct-90				4								2,3,4
SR	48	3865	24-Feb-95				All							All	
SR	48	3875	20-Jun-96				All							All	All
SR	48	5154	04-Apr-90				6							6	
SR	48	5154	09-Jun-93				5							5	
SR	48	A320	21-Jul-94				1								All
SR	48	A320	21-Jul-94				2								All
SR	48	A320	21-Jul-94		3		3								All
SR	48	A320	21-Jul-94				4								All
SR	48	A320	21-Jul-94				5								All
SR	48	A420	13-Mar-91				1							1	
SR	48	B320	15-Mar-91				All							All	All
SR	48	D320	15-Nov-94				All								All
SR	48	E320	17-Apr-94				All								All
SR	48	E352	18-Apr-94				All							All	All
SR	48	F350	17-Feb-93				1								1,4
SR	48	F350	17-Feb-93				4								1,4
SR	48	G330	31-Oct-94				All								All
SR	48	G350	31-Oct-94				All								All
SR	48	I330	02-Nov-94				All								All
SR	48	I340	02-Nov-94				All								All
SR	48	J320	01-Dec-95				All								All
SR	48	L310	12-Oct-94				All								All
SR	48	L320	12-Oct-94				All								All
SR	48	L340	12-Oct-94				All								All
SR	48	N320	18-Apr-91				4							4	
NAR	50	1002	09-Aug-93		1		1							All	
NAR	50	1002	09-Aug-93				2							All	
NAR	50	1002	09-Aug-93				3							All	
NAR	50	1002	09-Aug-93				4							All	
NAR	50	1002	09-Aug-93				6							All	
NAR	50	1004	25-Jul-92				1							1,3,5,6	3
NAR	50	1004	25-Jul-92				3							1,3,5,6	3
NAR	50	1004	25-Jul-92				5							1,3,5,6	3
NAR	50	1004	25-Jul-92				6							1,3,5,6	3
NAR	50	1681	06-Oct-90				All							All	
NAR	50	1681	09-Aug-93				All							All	All
NAR	50	1681	25-Jul-94				All								All
NAR	50	1682	09-Aug-93				All							All	
NAR	50	1682	25-Jul-94				All								All
NAR	50	1683	23-Oct-89				2							2	
NAR	50	1683	09-Aug-93				All							All	
NAR	50	1683	25-Jul-94				All								All
NAR	51	1423	15-Sep-90				All							All	
NAR	51	1464	22-Jun-91				All							All	
NAR	51	1464	14-Dec-95		8		All								All
NAR	51	5008	06-Dec-90				6							6,8	
NAR	51	5008	06-Dec-90				8							6,8	
NAR	51	5008	15-Dec-92				5							5	
NAR	51	5009	05-Nov-90				5							5	
NAR	51	5009	24-Jun-91				All							All	
NAR	51	5010	18-Jun-93				1							1,2,3	
NAR	51	5010	18-Jun-93				2							1,2,3	
NAR	51	5010	18-Jun-93				3							1,2,3	
NAR	51	A310	23-Jun-94				All								All
NAR	51	A320	23-Jun-91				1							All	
NAR	51	A320	23-Jun-91		2		2							All	
NAR	51	A320	23-Jun-91				3							All	
NAR	51	A320	23-Jun-91				4							All	
NAR	51	A320	23-Jun-91				5							All	

Table 19. Profile runs with lost lock.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported *Prior* Maint	Possibly Not Reported *Prior* Rehab	Left Whp Lost Lock Run No.	Right Whp Lost Lock Run No.
NAR	51	A320	23-Jun-94				All								All
NAR	51	A321	23-Jun-91				All							All	
NAR	51	A350	19-Jun-93				5							5,6	
NAR	51	A350	19-Jun-93				6							5,6	
WR	53	1002	26-Oct-89				2							2	
WR	53	1007	05-Aug-91				All								All
WR	53	1008	07-May-93				1							1,4	1,4
WR	53	1008	07-May-93				4							1,4	1,4
NAR	54	1640	17-Sep-90				1							1,4,5	
NAR	54	1640	17-Sep-90				4							1,4,5	
NAR	54	1640	17-Sep-90				5							1,4,5	
NAR	54	4003	04-Nov-93				All								All
NAR	54	7008	05-Nov-93				8								8
NCR	55	6351	18-Jun-92				4							4,8	
NCR	55	6351	18-Jun-92				8							4,8	
NCR	55	0901	27-Oct-92				All							All	
NCR	55	0902	27-Oct-92				All							All	
NCR	55	0903	27-Oct-92				All							All	All
NCR	55	0907	27-Oct-92				All							All	All
NCR	55	0908	27-Oct-92				All							All	All
NCR	55	0909	27-Oct-92				All							All	All
NCR	55	A901	27-Oct-92				All							All	
NCR	55	A902	27-Oct-92				All			1				All	
NCR	55	A903	27-Oct-92				All			1				All	All
NCR	55	A907	27-Oct-92				All			1				All	All
NCR	55	A908	27-Oct-92				All			1				All	All
NCR	55	A909	27-Oct-92				All			1				All	
NCR	55	B901	27-Oct-92				All							All	
NCR	55	B902	27-Oct-92				All							All	
NCR	55	B903	27-Oct-92				All							All	All
NCR	55	B907	27-Oct-92				All							All	All
NCR	55	B908	27-Oct-92				All							All	All
NCR	55	B909	27-Oct-92				All							8	All
WR	56	7775	21-Jul-94				All							All	All
WR	56	B330	21-Jul-94				All							All	All
WR	56	B360	21-Jul-94				1			1					1
NCR	83	1801	12-Nov-94				All							All	
NCR	83	3802	10-Nov-94				All							All	
NCR	83	A320	18-Nov-93				All							All	All
NCR	83	A330	18-Feb-94				All							All	All
NCR	83	A340	18-Feb-94				All							All	All
NCR	83	A350	18-Feb-94				All							All	All
NCR	83	A351	18-Feb-94				All							All	All
NAR	84	1684	06-Aug-94				All								All
NAR	84	6804	06-Aug-94				All								All
NAR	87	A310	20-Oct-90				1							1,2,8	
NAR	87	A310	20-Oct-90		2		2							1,2,8	
NAR	87	A310	20-Oct-90		8		8							1,2,8	
NAR	87	A320	20-Oct-90				1								All
NAR	87	A320	20-Oct-90		4		4								All
NAR	87	A320	20-Oct-90		7		7								All
NAR	87	A320	20-Oct-90		8		8								All
NAR	87	A320	20-Oct-90		9		9								All
NAR	87	A320	21-Aug-92		All		All		All					All	
NAR	87	A330	20-Oct-90				1							1,8,9	
NAR	87	A330	20-Oct-90				8							1,8,9	
NAR	87	A330	20-Oct-90				9							1,8,9	
NAR	87	A340	20-Oct-90				4							4,8	
NAR	87	A340	20-Oct-90				8							4,8	
NAR	87	A350	20-Oct-90				All							All	
NAR	87	B311	14-Jul-94				All								All
NAR	87	B330	19-Oct-90		2		2								All
NAR	87	B330	19-Oct-90		5		5								All
NAR	87	B330	19-Oct-90				7								All
NAR	87	B330	19-Oct-90				8								All
NAR	87	B330	19-Oct-90		9		9								All
NAR	87	B360	19-Oct-90				All							All	
NAR	87	B361	19-Oct-90				All							All	
NAR	87	B362	19-Oct-90		5		5							All	

Table 19. Profile runs with lost lock.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Whp Lost Lock Run No.	Right Whp Lost Lock Run No.
NAR	87	B362	19-Oct-90		6		6							All	
NAR	87	B362	19-Oct-90				7							All	
NAR	87	B362	19-Oct-90				8							All	
NAR	87	B362	19-Oct-90				9							All	
NAR	88	1645	21-Sep-92				3			3				3,5	
NAR	88	1645	21-Sep-92				5			5				3,5	
NAR	88	1645	09-Aug-94				All								All
NAR	89	1021	31-Oct-95				All								All
NAR	89	1125	16-Aug-93				All							All	
NAR	89	A310	12-Aug-93				All							All	
NAR	89	A310	19-Jul-94				All								All
NAR	89	A320	12-Aug-93				All							All	
NAR	89	A320	19-Jul-94				All								All
NAR	89	A330	12-Aug-93				All							All	
NAR	89	A330	19-Jul-94				All								All
NAR	89	A340	12-Aug-93				2							All	
NAR	89	A340	12-Aug-93				3							All	
NAR	89	A340	12-Aug-93				4							All	
NAR	89	A340	12-Aug-93				5							All	
NAR	89	A340	12-Aug-93		6		6							All	
NAR	89	A350	12-Aug-93				2							All	
NAR	89	A350	12-Aug-93				3							All	
NAR	89	A350	12-Aug-93		4		4							All	
NAR	89	A350	12-Aug-93				5							All	
NAR	89	A350	12-Aug-93				6							All	
NAR	89	A350	19-Jul-94				3								All
NAR	89	A350	19-Jul-94				4								All
NAR	89	A350	19-Jul-94				5								All
NAR	89	A350	19-Jul-94		6		6								All
NAR	89	A350	19-Jul-94				7								All
NCR	90	6405	11-Nov-94				All							All	
NCR	90	A310	28-Aug-92				All	All							All
NCR	90	A320	19-Jul-94				All								All
NCR	90	A330	31-May-90				5				5				5
NCR	90	A340	25-Jun-95				1				1			1	
NCR	90	A351	19-Jul-94				8								8
NCR	90	B310	19-Feb-94				All							All	All
NCR	90	B320	29-Aug-92				5							5	5
NCR	90	B320	12-Jun-93				3								3
NCR	90	B320	19-Feb-94				2							All	All
NCR	90	B320	19-Feb-94				3			3				All	All
NCR	90	B320	19-Feb-94				5							All	All
NCR	90	B320	19-Feb-94				7							All	All
NCR	90	B330	19-Feb-94				All							All	All
NCR	90	B331	19-Feb-94				All							All	All
NCR	90	B340	19-Feb-94				All							All	All
NCR	90	B351	19-Feb-94				All							All	All

APPENDIX G. SUMMARY OF ALL SHIFTED PROFILES

Table 20. Profile runs with shifted start locations.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Edit Run No.	Early Start OK Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Offset (m)
SR	1	1011	11-Feb-92							2						15
SR	1	1011	11-Feb-92							5						15
SR	1	4125	19-Dec-95							1						12
SR	1	4125	19-Dec-95							2						12
SR	1	4125	19-Dec-95							4						12
SR	1	B320	11-Jul-91									All				3
WR	4	0113	27-Feb-95									All				3
WR	4	0114	27-Jan-94									1				3
WR	4	0116	27-Jan-94									All				3
WR	4	0118	27-Jan-94									1				5
WR	4	0119	27-Jan-94									1				3
WR	4	0120	27-Jan-94									1				3
WR	4	0121	27-Jan-94									1				3
WR	4	0122	27-Jan-94									1				3
WR	4	0161	27-Jan-94									1				5
WR	4	0162	27-Jan-94									1				5
WR	4	0216	25-Jan-94									All				3
WR	4	0219	25-Jan-94									All				5
WR	4	0220	25-Jan-94									All				3
WR	4	0223	25-Jan-94									All				5
WR	4	0224	25-Jan-94									1				3
WR	4	0503	15-Jan-92									All				3
WR	4	0504	15-Jan-92									All				3
WR	4	0505	21-Sep-90									All				3
WR	4	0508	15-Jan-92									1				5
WR	4	0509	21-Sep-90									All				3
WR	4	0666	21-Jan-94									2,3,4,5				-3
WR	4	0667	21-Jan-94									2,3,4,5				-3
WR	4	0668	21-Jan-94									2,3,4,5				-3
WR	4	0669	21-Jan-94									2,3,4,5				-3
WR	4	1007	04-Mar-95							1	1				01-Feb-95	9
WR	4	1017	12-Jan-92							All	All					6
WR	4	1037	04-Feb-93							All	All					6
WR	4	0159	27-Feb-95							1						6
WR	4	0160	27-Jan-94							All						15
WR	4	0213	25-Jan-94							All						6
WR	4	0217	25-Jan-94							All	All					6
WR	4	0221	25-Jan-94							All	All					8
WR	4	0260	25-Jan-94							All						12
WR	4	0262	25-Jan-94							All	All					8
WR	4	0263	25-Jan-94							All	All					8
WR	4	0264	25-Jan-94							All	All					8
WR	4	0265	25-Jan-94							All	All					9
WR	4	0266	25-Jan-94							All	All					9
WR	4	0267	25-Jan-94							All	All					8
WR	4	0268	25-Jan-94							All	All					8
WR	4	0501	15-Jan-92							3	3					9
WR	4	0502	15-Jan-90							3	3					6
WR	4	0505	15-Jan-92							1	1					9
WR	4	0506	15-Jan-92							1	1					9
WR	4	0509	15-Jan-92							3	3					6
WR	4	0559	15-Jan-92							1	1					9
WR	4	0601	16-Sep-91							2						-15
WR	4	0601	27-Feb-92							All						-15
WR	4	0601	12-Feb-93				All			All						-15
WR	4	0603	12-Feb-93							All	All					6
WR	4	0604	16-Sep-91							1	1					9
WR	4	0606	16-Sep-91							1	1					6
WR	4	0607	16-Sep-91							1	1					6
WR	4	0607	16-Sep-91							3	3					6
WR	4	0607	16-Sep-91							4	4					6
WR	4	0664	12-Feb-93							All						11
WR	4	0666	12-Feb-93							All						12
WR	4	0667	12-Feb-93							All						11
WR	4	0668	12-Feb-93							All						15
WR	4	0669	12-Feb-93							All						15
WR	4	A310	19-Feb-92							1						-32
WR	4	A310	19-Feb-92							3						-32
WR	4	A310	28-Feb-95							All						-12
WR	4	A320	19-Feb-92							1						-26
WR	4	A320	19-Feb-92							3						-26
WR	4	A320	28-Feb-95									All				-3

Table 20. Profile runs with shifted start locations.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Edit Run No.	Early Start OK Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Offset (m)
WR	4	A330	19-Feb-92							1						-32
WR	4	A350	19-Feb-92							1						-43
WR	4	A350	19-Feb-92							3						-43
WR	4	A350	19-Feb-92							4						-43
WR	4	A350	28-Feb-95			1				1	1					-8
WR	4	A350	28-Feb-95							2	2					-8
WR	4	A350	28-Feb-95							3	3					-8
WR	4	A350	28-Feb-95							4	4					-8
WR	4	A350	28-Feb-95							5	5					-8
WR	4	A390	19-Feb-92							All						12
WR	4	B330	23-Feb-92									1				-3
WR	4	B350	23-Feb-92							1	1			01-Aug-94		6
WR	4	B350	09-Feb-93									All				-3
WR	4	B350	21-Mar-95									All				-3
WR	4	C340	17-Nov-94							All	All					-6
WR	4	D310	13-Jan-92							1	1					8
WR	4	D330	13-Jan-92							All	All					8
WR	4	D350	13-Jan-93							All						13
WR	4	D350	26-Feb-93									All				-3
WR	6	2002	08-Jun-94							All	All					6
WR	6	2038	25-Mar-93							All	All					8
WR	6	2038	20-Mar-97							All	All					6
WR	6	2647	14-Apr-97							All	All					6
WR	6	3024	26-Feb-97							All	All					6
WR	6	3042	01-May-91							3						15
WR	6	7452	14-Dec-89							1						18
WR	6	7456	22-Mar-93							1						12
WR	6	7493	25-Feb-97							All	All					6
WR	6	8149	28-Feb-97							All	All					6
WR	6	0601	06-Apr-93							1						15
WR	6	0602	14-Apr-92							All						12
WR	6	0602	06-Apr-93						All	1						6
WR	6	0602	11-Jun-96			6			All	1						6
WR	6	0603	14-Apr-92							All						14
WR	6	0603	06-Apr-93							1	1					6
WR	6	0604	06-Apr-93							1						37
WR	6	0605	14-Apr-92							All						11
WR	6	0605	06-Apr-93							1	1					6
WR	6	0606	14-Apr-92							All						12
WR	6	0606	14-Apr-92							All						14
WR	6	0606	06-Apr-93							1	1					6
WR	6	0606	06-Apr-93							1	1					6
WR	6	0608	11-May-91							1						15
WR	6	0608	11-Jun-96							All						14
WR	6	A310	09-May-91									1				-5
WR	6	A311	09-May-91									2				-5
WR	6	A330	10-Jun-94									1				3
WR	6	A340	09-May-91									1				-5
WR	6	A340	10-Jun-94									1				3
WR	6	A352	09-May-91									1				-5
WR	6	A352	10-Jun-94							1	1					8
WR	6	A353	09-May-91									1				-3
WR	6	A353	10-Jun-94									1				3
WR	6	A361	07-Aug-90							All						-23
WR	6	A362	07-Aug-90							All						-53
WR	6	A362	10-Jun-94									6				-3
WR	6	A363	09-May-91									1				-5
WR	6	A363	10-Jun-94							1	1					8
WR	8	0217	13-Apr-94									1				3
WR	8	0220	13-Apr-94									1				3
WR	8	0221	13-Apr-94									1				3
WR	8	0223	13-Apr-94									1				3
WR	8	0224	13-Apr-94									1				2
WR	8	0504	28-May-91									1				3
WR	8	1053	15-Apr-94							2	2					6
WR	8	1053	15-Apr-94							3	3					6
WR	8	1053	15-Apr-94							4	4					6
WR	8	7035	19-Nov-91							1	1					8
WR	8	7035	19-Nov-91							5	5					8
WR	8	7035	19-Nov-91							7	7					8
WR	8	7035	28-Oct-93							4	4					8
WR	8	9019	19-Nov-91							All	All					9
WR	8	9020	19-Nov-91							7	7					9
WR	8	0222	13-Apr-94							1	1					6
WR	8	0501	28-May-91							1	1					9

Table 20. Profile runs with shifted start locations.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Edit Run No.	Early Start OK Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Offset (m)
WR	8	0501	28-May-91							2	2					9
WR	8	0501	13-Nov-91							1						-11
WR	8	0504	13-Nov-91							1	1					-9
WR	8	0505	28-May-91							1	1					8
WR	8	0505	13-Nov-91							1						-11
WR	8	0506	13-Nov-91							1						-12
WR	8	0507	13-Nov-91							1	1					-8
WR	8	A350	08-Nov-92									All				-3
WR	8	A350	05-Nov-93									All				-5
WR	8	A350	27-Oct-95									All				-3
WR	8	B330	05-Nov-92							All	All					-6
WR	8	B330	02-Nov-93									All				-3
WR	8	B340	02-Nov-93									All				-3
WR	8	B350	14-Nov-91							1						14
SR	12	4057	03-Jul-90							3						15
SR	12	4101	20-May-91							1	1					6
SR	12	4101	20-May-91							5	5					6
SR	13	3019	27-Jul-92							1	1					9
WR	16	1007	14-Aug-91							3	3					9
WR	16	1010	11-Jul-94							4	4					8
WR	16	3023	17-Oct-89							All	All					8
WR	16	9032	21-Jun-91							3						15
WR	16	9034	17-Aug-94							2	2					9
WR	16	B310	26-Oct-92							All						-12
WR	16	B310	04-Dec-93									All				-3
WR	16	B310	14-Sep-94							All						-12
WR	16	B330	26-Oct-92									All				-3
WR	16	B330	04-Dec-93									All				-3
WR	16	B330	14-Sep-94									All				-3
WR	16	B330	18-Jul-95									All				-3
WR	16	B350	20-Sep-91									1				3
WR	16	B350	26-Oct-92							All	All					-6
WR	16	B350	04-Dec-93									All				-5
WR	16	B350	14-Sep-94							All	All					-9
WR	16	B350	18-Jul-95							All	All					-9
WR	16	C310	20-Sep-91									All				3
WR	16	C310	25-Oct-92							All	All					-8
WR	16	C310	04-Dec-93									All				-5
WR	16	C310	11-Jul-94							1	1					-8
WR	16	C310	11-Jul-94							2	2					-8
WR	16	C310	11-Jul-94							3	3					-8
WR	16	C310	11-Jul-94							5	5					-8
WR	16	C310	11-Jul-94							6	6					-8
WR	16	C310	11-Jul-94							7	7					-8
WR	16	C310	13-Sep-94							All	All					-6
WR	16	C310	17-Jul-95							All	All					-8
WR	16	C310	01-May-97							All	All					-6
WR	16	C320	20-Sep-91									All				3
WR	16	C320	25-Oct-92									All				-5
WR	16	C320	04-Dec-93									All				-3
WR	16	C320	11-Jul-94							4	4					8
WR	16	C320	13-Sep-94									All				-3
WR	16	C320	17-Jul-95									All				-3
WR	16	C330	25-Oct-92							All	All					-8
WR	16	C330	04-Dec-93									All				-5
WR	16	C330	11-Jul-94							All	All					-8
WR	16	C330	13-Sep-94									All				-5
WR	16	C330	17-Jul-95							All	All					-8
WR	16	C330	01-May-97									All				-5
WR	16	C350	20-Sep-91							All	All					8
WR	16	C350	25-Oct-92							All						-11
WR	16	C350	04-Dec-93							All	All					-9
WR	16	C350	11-Jul-94							1	1					-9
WR	16	C350	11-Jul-94							2	2					-9
WR	16	C350	11-Jul-94							3	3					-9
WR	16	C350	11-Jul-94							5	5					-9
WR	16	C350	11-Jul-94							6	6					-9
WR	16	C350	11-Jul-94							7	7					-9
WR	16	C350	13-Sep-94							All						-11
WR	16	C350	17-Jul-95							All						-11
WR	16	C350	01-May-97							All						-11
NCR	17	5217	08-Oct-92				All			9						6
NCR	17	9267	10-Oct-93							2						15
NCR	17	9267	10-Oct-93							3						15
NCR	17	0601	18-Apr-90									1				5

Table 20. Profile runs with shifted start locations.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Edit Run No.	Early Start OK Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Offset (m)
NCR	17	0603	01-Apr-90							3	3					6
NCR	17	0604	01-Apr-90							1	1					9
NCR	17	0605	17-Dec-91							1	1				01-Sep-90	6
NCR	17	0607	01-Apr-90							1	1					9
NCR	17	0607	01-Dec-91									5				3
NCR	17	0607	01-Mar-95									3				3
NCR	17	0608	01-Apr-90							1						15
NCR	17	0608	01-Mar-95									1				3
NCR	17	0659	01-Apr-90							1	1					9
NCR	17	0660	01-Apr-90							4	4					8
NCR	17	0661	01-Apr-90							1	1					8
NCR	17	0662	01-Apr-90							1	1					8
NCR	17	0663	01-Apr-90							1	1					8
NCR	17	0663	01-Dec-91									4				3
NCR	17	0663	01-Mar-94									1				3
NCR	17	0664	01-Apr-90							1	1					8
NCR	17	0664	01-Dec-91									5				2
NCR	17	A310	03-Mar-95							All						512
NCR	17	A320	03-Mar-95							All						444
NCR	17	A330	01-Jan-94							All						214
NCR	17	A330	01-Mar-95							All						674
NCR	17	A340	13-Jan-94							All						-214
NCR	17	A340	03-Mar-95							All						674
NCR	17	A350	13-Jan-94							All						429
NCR	17	B310	03-Mar-95							All						45
NCR	18	2009	31-May-91							All	All					8
NCR	18	3031	03-Dec-89							All	All					8
NCR	18	5022	03-Oct-92							All					16-May-92	12
NCR	18	5538	05-Apr-90							All	All					9
NCR	18	0601	01-Apr-90							All	All					8
NCR	18	0605	01-Oct-92							7	7					9
NCR	18	0607	01-Apr-90									All				5
NCR	18	0608	01-Oct-92							7	7					9
NCR	18	0659	14-Dec-90									All				3
NCR	18	0661	01-Oct-92							7	7					9
NCR	18	0664	01-Oct-92							7	7					9
NCR	18	0665	01-Mar-95									1 OR 3				2
NCR	18	0668	01-Apr-90									4,5				3
NCR	18	0669	01-Apr-90									4,5				3
NCR	18	0670	01-Apr-90									4,5				5
NCR	18	0671	01-Apr-90									4,5				5
NCR	18	0672	01-Oct-92							7	7					9
NCR	18	A310	19-Dec-91							All						33
NCR	18	A310	15-Jan-94							All						-31
NCR	18	A320	15-Jan-94							All						181
NCR	19	9116	08-Apr-90							All						14
NCR	19	0101	15-Feb-95							All						1200
NCR	19	0102	15-Feb-95							All						1764
NCR	19	0103	15-Feb-95							All						2709
NCR	19	0104	15-Feb-95							All						-8985
NCR	19	0105	15-Feb-95							All						2285
NCR	19	0106	01-Feb-95							All						2314
NCR	19	0107	01-Oct-93							All						23
NCR	19	0107	01-Feb-95							All						1158
NCR	19	0108	15-Feb-95							All						3519
NCR	19	0109	01-Feb-95							All						1794
NCR	19	0110	15-Feb-95							All						1147
NCR	19	0111	15-Feb-95							All						535
NCR	19	0112	15-Feb-95							All						506
NCR	19	0213	01-Feb-95									6				2
NCR	19	0216	01-Feb-95									6				2
NCR	19	0223	01-Apr-96									2				2
NCR	19	0608	01-Nov-93									All				3
NCR	19	0659	01-Nov-93							All	All					6
NCR	19	0708	01-May-92							1	1					8
NCR	19	0709	01-May-92							1	1					8
NCR	19	0709	01-Nov-93									1				2
NCR	19	0710	01-Nov-93									1				2
NCR	19	0759	01-Nov-93									1				2
NCR	19	A310	01-Jun-90							All						14
NCR	19	A310	01-May-92							8	8					6
NCR	19	A320	01-Jun-90									1				2
NCR	19	A350	01-Jun-91									1				2
NCR	20	1005	01-May-90							All	All					6
NCR	20	3013	07-Mar-93							2						12

Table 20. Profile runs with shifted start locations.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Edit Run No.	Early Start OK Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Offset (m)
NCR	20	4053	25-Apr-96							3						15-40
NCR	20	4053	25-Apr-96							4						15-40
NCR	20	4053	25-Apr-96							6						15-40
NCR	20	4053	25-Apr-96							7						15-40
NCR	20	0103	01-Apr-96									1				2
NCR	20	0104	01-Apr-96									7				3
NCR	20	0109	01-Sep-94									1				2
NCR	20	0111	01-Apr-96									1				2
NCR	20	0112	01-Apr-96									1				2
NCR	20	0162	01-Feb-95									All				2
NCR	20	0163	01-Feb-95									1				2
NCR	20	0164	01-Feb-95									1				2
NCR	20	0208	01-May-94									1				2
NCR	20	0209	01-Apr-96									1				2
NCR	20	0210	01-Apr-96									1				2
NCR	20	0212	01-Apr-96									1				2
NCR	20	0259	01-Apr-96									1				2
NCR	20	A310	31-Mar-91							All	All					6
NCR	20	A320	01-May-90							All	All					6
NCR	20	A330	01-May-90							All	All					9
NCR	20	A350	01-May-90							All	All					8
NCR	20	A350	31-Mar-91							All	All					8
NCR	20	A410	01-Apr-92									All				3
NCR	20	B310	01-May-90							All	All					-5
NCR	20	B310	01-Apr-91							All	All					8
NCR	20	B320	01-Apr-91							1						15
NCR	20	B330	02-May-90							All						18
NCR	20	B430	15-May-94							2	2					8
NCR	21	A310	28-Apr-90							All						245
NCR	21	A320	28-Apr-90							All						245
NCR	21	A330	28-Apr-90							All						237
NCR	21	A330	07-Nov-91									15				1
NCR	21	A340	28-Apr-90							All						239
NCR	21	A340	07-Nov-91									15				1
NCR	21	A350	28-Apr-90							All						244
NCR	21	B310	29-Apr-90							All						12
NCR	21	B320	29-Apr-90							All						18
NCR	21	B330	29-Apr-90							All						26
NCR	21	B340	29-Apr-90							All						37
NCR	21	B350	29-Apr-90							All						46
SR	22	0706	06-Feb-95									4				5
SR	22	0707	06-Feb-95									4				5
SR	22	0708	06-Feb-95									4				5
SR	22	0709	06-Feb-95									4				5
NAR	23	1026	17-Sep-93							4	4					6
NAR	24	0501	25-Jun-93									All				3
NAR	24	0502	24-Jan-92									6				2
NAR	24	0503	24-Jan-92							4						11
NAR	24	0503	24-Jan-92							5						11
NAR	24	0504	24-Jan-92							All						12
NAR	24	0505	24-Jan-92							3	3					8
NAR	24	0505	24-Jan-92							4	4					8
NAR	24	0505	24-Jan-92							5	5					8
NAR	24	0506	24-Jan-92							1						23
NAR	24	0506	24-Jan-92							3						23
NAR	24	0506	24-Jan-92			5				5						23
NAR	24	0508	24-Jan-92							All						21
NAR	24	0509	24-Jan-92							All						46
NAR	24	0559	24-Jan-92							All						50
NAR	24	0561	24-Jan-92							All						12
NAR	24	0563	11-Jun-92									All				2
NAR	24	A310	25-Jun-92							All	All					9
NAR	24	A311	25-Jun-92							All						15
NAR	24	A320	25-Jun-92			5				5						15
NAR	24	A320	25-Jun-92							6						15
NAR	24	A320	25-Jun-92							7						15
NAR	24	A320	25-Jun-92							8						15
NAR	24	A320	25-Jun-92							9						15
NAR	24	A330	25-Jun-92							All						15
NAR	24	A331	25-Jun-92							All						15
NAR	24	A340	25-Jun-92							4						15
NCR	26	1004	17-Sep-95							All						14
NCR	26	1010	04-Jan-91							6						12
NCR	26	1010	04-Jan-91							9						12
NCR	26	3068	25-Sep-92					1		1						9

Table 20. Profile runs with shifted start locations.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Edit Run No.	Early Start OK Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Offset (m)
NCR	26	6016	15-Sep-95			1				1	1					8
NCR	26	0213	06-Sep-94							All						-36
NCR	26	0213	08-Jan-96			1				All						-3330
NCR	26	0214	08-Jan-96							All						-1196
NCR	26	0216	06-Sep-94							All						-166
NCR	26	0216	08-Jan-96							All						-2040
NCR	26	0217	08-Jan-96							All						-3773
NCR	26	0218	08-Jan-96							All						-1196
NCR	26	0219	08-Jan-96							All						-3773
NCR	26	0220	08-Jan-96							All						-1641
NCR	26	0221	06-Sep-94							All						-46
NCR	26	0221	08-Jan-96							All						-2958
NCR	26	0222	08-Jan-96							All						-2040
NCR	26	0223	08-Jan-96							2						-1641
NCR	26	0223	08-Jan-96							3						-1641
NCR	26	0223	08-Jan-96			4				4						-1641
NCR	26	0223	08-Jan-96							5						-1641
NCR	26	0223	08-Jan-96							7						-1641
NCR	26	0224	06-Sep-94							All						-102
NCR	26	0224	08-Jan-96							All						-2496
NCR	26	0259	08-Jan-96							All						-2496
NCR	26	0601	02-Apr-90									All				2
NCR	26	0604	25-Sep-92							All						114
NCR	26	0605	02-Apr-90									All				3
NCR	26	A310	18-May-90							All						-13
NCR	26	A320	18-May-90							All						-15
NCR	26	A321	18-May-90							All						-49
NCR	26	A330	18-May-90							All						-24
NCR	26	A340	18-May-90							All						-34
NCR	26	A340	09-Jul-91							All						37
NCR	26	A350	18-May-90							All						-41
NCR	26	B310	07-Jan-91							1	1					6
NCR	26	B320	07-Jan-91							1	1					6
NCR	26	B330	07-Jan-91									All				2
NCR	26	B340	07-Jan-91									All				3
NCR	26	B350	07-Jan-91									All				2
NCR	26	D310	27-Jun-91							All						-215
NCR	26	D310	06-Jul-94							All	All					8
NCR	26	D340	04-Jan-91									6				5
NCR	26	D350	04-Jan-91									6				5
NCR	26	D351	04-Jan-91									6				5
NCR	27	1016	13-Jul-91					All		5						6
NCR	27	1087	26-Jul-94							2						37
NCR	27	0506	24-May-90							All	All					6
NCR	27	0559	24-May-90							All			All			147
NCR	27	A310	30-Oct-92							All						384
NCR	27	A320	13-Jul-91									5				5
NCR	27	A320	30-Oct-92							All						385
NCR	27	A330	30-Oct-92							All						387
NCR	27	A340	13-Jul-91									5				5
NCR	27	A340	30-Oct-92							All						391
NCR	27	A350	13-Jul-91									5				5
NCR	27	A350	30-Oct-92							All						393
NCR	27	C310	23-May-90									All				3
NCR	27	C320	23-May-90							1						15
NCR	27	C330	23-May-90							1						15
NCR	27	C340	23-May-90							1						15
NCR	27	D330	27-Jul-94			All				All	All			01-Aug-92		8
SR	28	0504	02-Aug-94									All				-3
SR	28	0504	03-Aug-95									All				-3
NCR	29	4031	07-Mar-91							2						84
NCR	29	4031	07-Mar-91							3						84
NCR	29	4031	07-Mar-91							4						84
NCR	29	4031	07-Mar-91			5				5						84
NCR	29	4031	07-Mar-91							7						84
NCR	29	0601	18-May-94							9	9					6
NCR	29	0602	13-Mar-93							All						564
NCR	29	0602	18-May-94									9				3
NCR	29	0605	13-Mar-93							All						-564
NCR	29	0661	11-Feb-92									All				2
NCR	29	0661	18-May-94									1				2
NCR	29	0663	18-May-94									9				5
NCR	29	0664	18-May-94									9				5
NCR	29	0665	13-Mar-93							All						-1223
NCR	29	0666	18-May-94									9				2

Table 20. Profile runs with shifted start locations.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Edit Run No.	Early Start OK Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Offset (m)
NCR	29	0702	31-Mar-91							4						15
NCR	29	0704	06-Apr-90							4						18
NCR	29	0705	31-Mar-91							4						18
NCR	29	0706	31-Mar-91							4						18
NCR	29	0706	16-Mar-94									2				3
NCR	29	0707	16-Mar-94									2				3
NCR	29	0709	16-Mar-94									All				2
NCR	29	0760	06-Apr-90									1,3				2
NCR	29	0760	18-Feb-92									All				2
NCR	29	A310	30-Apr-90							All						-148
NCR	29	A320	30-Apr-90							All						-151
NCR	29	A330	30-Apr-90							All						-208
NCR	29	A350	30-Apr-90							All						-237
NCR	29	A351	30-Apr-90							All						-205
NCR	29	B350	15-Feb-92							All						23
NCR	29	B350	15-Mar-93									4				2
WR	30	0502	09-Nov-91									All				3
WR	30	0503	12-Sep-96									All				3
WR	30	0506	25-Jul-94									1,2				5
WR	30	0507	25-Jul-94									1				5
WR	30	7088	16-Sep-89							All	All					8
WR	30	0502	25-May-91							All	All					8
WR	30	0502	25-Jul-94							1	1					8
WR	30	0502	25-Jul-94							2	2					8
WR	30	0503	25-May-91							All						14
WR	30	0503	25-Jul-94							1	1					6
WR	30	0503	25-Jul-94							2	2					6
WR	30	0504	25-May-91							All	All					9
WR	30	0504	25-Jul-94							1	1					6
WR	30	0504	25-Jul-94							2	2					6
WR	30	0506	25-May-91							1	1					8
WR	30	0506	25-May-91							3	3					8
WR	30	0507	25-May-91							All						12
WR	30	0508	25-May-91							All						12
WR	30	0508	25-Jul-94							1	1					9
WR	30	0508	25-Jul-94							2	2					9
WR	30	0509	25-Jul-94							1						11
WR	30	0509	25-Jul-94							2						11
WR	30	0560	29-Sep-93					1		1						6
WR	30	0560	25-Jul-94							1	1					9
WR	30	0560	25-Jul-94							2	2					9
WR	30	0561	25-May-91							All	All					8
WR	30	0561	25-Aug-94							1	1					9
WR	30	0561	25-Aug-94							2	2					9
WR	30	A330	26-Jul-94									All				-5
WR	30	A350	26-Jul-94									All				-5
NCR	31	1030	26-Nov-93							2	2					9
NCR	31	1030	29-Oct-95			4				4						15
NCR	31	4019	29-Nov-93					7		7						9
NCR	31	5052	28-Nov-93							All	All					8
NCR	31	0113	01-Nov-95									1				3
NCR	31	0120	01-Nov-95									3				2
NCR	31	A310	06-May-92							6	6					6
NCR	31	A310	26-Nov-93							2	2					6
NCR	31	A330	26-Nov-93							2	2					8
NCR	31	A330	29-Oct-95							4	4					8
NCR	31	A340	06-May-92							All						30
NCR	31	A350	05-Apr-91									3				2
NCR	31	A350	26-Nov-93							2	2					8
NCR	31	A350	29-Oct-95			4				4						12
NCR	31	A351	06-May-92							6	6					6
NCR	31	A351	26-Nov-93							All						30
NCR	31	A352	06-May-92							6	6					8
NCR	31	A353	05-Apr-91									3				2
NCR	31	A353	26-Nov-93									8				2
NCR	31	A353	29-Oct-95							4						14
NCR	31	B410	30-Oct-95							5						15
NCR	31	C410	29-Nov-93							7						14
NCR	31	C410	29-Nov-93							8						14
NCR	31	C410	29-Nov-93							9						14
NCR	31	C410	17-Sep-94							All						250
NCR	31	C430	29-Nov-93							All						-151
WR	32	0206	28-Jun-96									1				5
WR	32	1020	09-Aug-89							8						12
WR	32	7000	30-Sep-89							6	6					8

Table 20. Profile runs with shifted start locations.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Edit Run No.	Early Start OK Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Offset (m)
WR	32	7000	26-Aug-91							3						12
WR	32	0206	22-Apr-97							1	1					8
WR	32	0206	22-Apr-97							2	2					8
WR	32	0206	22-Apr-97							3	3					8
WR	32	0206	22-Apr-97							5	5					8
WR	32	0206	22-Apr-97							6	6					8
WR	32	A350	26-Apr-91									All				5
WR	32	A351	26-Apr-91							1	1					8
WR	32	A352	26-Apr-91									1				5
WR	32	B330	26-Aug-91							All						-15
WR	32	B330	16-Nov-92									All				-3
WR	32	B330	07-Dec-93									All				-5
WR	32	B330	14-Nov-95									All				-4
WR	32	B330	06-May-97									All				-3
WR	32	B340	03-Jul-90									All				3
WR	32	B340	26-Aug-91									1				-5
WR	32	B340	16-Nov-92									All				-5
WR	32	B340	07-Dec-93							All	All					-9
WR	32	B340	14-Nov-95							All	All					-9
WR	32	B340	06-May-97									All				-3
WR	32	B350	26-Aug-91							All						-14
WR	32	B350	07-Dec-93									All				-5
WR	32	B350	14-Nov-95									All				-3
WR	32	C340	28-Aug-91									All				-5
WR	32	C350	28-Aug-91									1				-5
NAR	34	0501	25-Jan-92									1				5
NAR	34	0505	25-Jan-92									All				3
NAR	34	0860	05-Aug-93							3	3					6
NAR	36	1008	22-Aug-89							All						12
NAR	36	1011	22-Aug-89							All						9-18
NAR	36	1643	23-Aug-89							1						12-18
NAR	36	1643	23-Aug-89							2						12-18
NAR	36	1643	23-Aug-89							3						12-18
NAR	36	1643	23-Aug-89							4						12-18
NAR	36	1643	23-Aug-89		5	5				5						12-18
NAR	36	1644	23-Aug-89							1						12-15
NAR	36	1644	23-Aug-89			2				2						12-15
NAR	36	1644	23-Aug-89							3						12-15
NAR	36	1644	23-Aug-89			4				4						12-15
NAR	36	1644	23-Aug-89							5						12-15
NAR	36	4017	25-Aug-89			1				1						15
NAR	36	4017	25-Aug-89							2						15
NAR	36	4017	25-Aug-89							3						15
NAR	36	4017	25-Aug-89			4				4						15
NAR	36	4017	25-Aug-89			5				5						15
NAR	36	4017	09-Aug-96							5						14
NAR	36	4017	09-Aug-96							6						14
NAR	36	4018	24-Aug-89							1						15
NAR	36	4018	24-Aug-89		2	2				2						15-23
NAR	36	4018	24-Aug-89							3						15-23
NAR	36	4018	24-Aug-89			4				4						15-23
NAR	36	4018	24-Aug-89							5						15-23
NAR	36	A331	09-May-96							All						12
NAR	37	3011	15-Dec-94							2						30
NAR	37	0211	30-Mar-94									1				2
NAR	37	0212	30-Mar-94									1				2
NAR	37	0260	30-Mar-94									1				2
NCR	39	0106	14-Aug-96									1				2
NCR	39	0111	14-Aug-96									1				2
NCR	39	0112	14-Aug-96									1				2
NCR	39	0203	14-Aug-96									All				2
NCR	39	0204	14-Aug-96									1				5
NCR	39	0205	14-Aug-96									All				2
NCR	39	0206	14-Aug-96									All				2
NCR	39	0207	14-Aug-96									All				2
NCR	39	0208	14-Aug-96									All				2
NCR	39	0209	14-Aug-96									All				2
NCR	39	0211	14-Aug-96									All				2
NCR	39	0260	14-Aug-96									All				2
NCR	39	0261	14-Aug-96									All				2
NCR	39	B411	05-Apr-94							All						-227
SR	40	C310	05-Sep-90									8				2
WR	41	2002	30-Mar-93							All	All					8
WR	41	5022	31-Mar-93							2						11
WR	41	6011	18-Nov-89							All	All					9

Table 20. Profile runs with shifted start locations.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Edit Run No.	Early Start OK Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Offset (m)
WR	41	7019	08-Jun-94							All	All					6
WR	41	7081	21-Oct-89							All						12
NAR	42	1623	05-Nov-89			1				1						18
SR	45	1024	24-Jul-92							1	1					6
SR	45	1024	24-Jul-92							2	2					6
SR	45	1024	24-Jul-92							3	3					6
NCR	46	9187	25-Apr-95							All	All					6
NCR	46	9187	22-Jun-95							All	All					6
NCR	46	9197	22-Oct-93							5						15
NCR	46	9197	22-Oct-93							6						15
NCR	46	9197	22-Oct-93							7						15
NCR	46	9197	22-Oct-93							8						15
NCR	46	9197	22-Oct-93							9						15
NCR	46	0601	14-Apr-92									All				2
NCR	46	0601	18-Aug-94									All				2
NCR	46	0608	18-Aug-94							All						-216
NCR	46	0660	18-Aug-94							All						-421
NCR	46	A410	24-Jul-94							3						38
NCR	46	A411	29-Jul-94				3			3						38
NCR	46	A412	29-Jul-94				3			3						38
NCR	46	A420	29-Jul-94				3			3						38
NCR	46	A421	29-Jul-94				3			3						38
NCR	46	A422	29-Jul-94				3			3						38
NCR	46	A423	29-Jul-94				3			3						38
NCR	46	A430	29-Jul-94				3			3						38
SR	48	3739	14-Dec-93							5	5					6
SR	48	4152	13-Apr-90							All						12
SR	48	H330	04-Apr-91			2				All					11-Oct-90	46
SR	48	H330	04-Apr-91							All					11-Oct-90	46
WR	49	1001	09-Nov-93							5	5					8
WR	49	1001	18-Nov-94							1	1					6
WR	49	1004	11-Nov-92							5						15
WR	49	1005	15-Nov-92							All						49
WR	49	1005	16-Nov-93							All						46
WR	49	3011	15-Nov-93							1	1					8
WR	49	3011	15-Nov-93							3	3					8
WR	49	3011	15-Nov-93							5	5					8
WR	49	A310	04-Sep-90									All				3
WR	49	A310	24-Oct-91							1	1					8
WR	49	A310	11-Nov-92									All				-3
WR	49	A320	11-Nov-92									All				-3
WR	49	A320	15-Nov-93									All				-3
WR	49	A320	01-Nov-95									All				-3
WR	49	A332	24-Oct-91							1	1					8
WR	49	A332	11-Nov-92							All						-20
WR	49	A332	15-Nov-93							All						-15
WR	49	A332	01-Nov-95							All						-14
WR	49	A340	24-Oct-91							1	1					6
WR	49	A340	11-Nov-92							All	All					-9
WR	49	A350	11-Nov-92									All				-3
WR	49	A350	15-Nov-93									All				-3
WR	49	A350	01-Nov-95									All				-3
WR	49	A351	24-Oct-91							1	1					6
WR	49	A351	11-Nov-92							All						-14
WR	49	A351	15-Nov-93							All	All					-8
WR	49	A351	01-Nov-95							All	All					-8
WR	49	A352	24-Oct-91							1	1					6
WR	49	A352	11-Nov-92							All						-15
WR	49	A352	15-Nov-93							All	All					-9
WR	49	A352	01-Nov-95							All	All					-8
WR	49	A361	04-Sep-90							1						17
WR	49	A361	24-Oct-91							1						17
WR	49	A361	15-Nov-93							All	All					6
WR	49	A361	01-Nov-95							All	All					8
WR	49	A390	24-Oct-91									1				5
WR	49	A390	11-Nov-92									All				-5
WR	49	A390	15-Nov-93									All				-3
WR	49	A390	01-Nov-95									All				-3
WR	49	B310	25-Oct-91		1	1				1						15
WR	49	B310	14-Nov-93							All						-15
WR	49	B320	30-Jun-90							1						12
WR	49	B320	03-Sep-90							1	1					8
WR	49	B320	25-Oct-91							1						18
WR	49	B320	11-Nov-92									All				5
WR	49	B330	25-Oct-91									1				2

Table 20. Profile runs with shifted start locations.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Edit Run No.	Early Start OK Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Offset (m)
WR	49	B330	11-Nov-92							1	1					6
WR	49	B330	14-Nov-93									All				-5
WR	49	B331	25-Oct-91							1						21
WR	49	B331	11-Nov-92									1				3
WR	49	B350	30-Jun-90							All	All					-6
WR	49	B350	03-Sep-90							1	1					-6
WR	49	B350	14-Nov-93							All	All					-9
WR	49	B350	31-Oct-95									All				-5
WR	49	B351	11-Nov-92							All	All					8
WR	49	B351	14-Nov-93									All				-3
WR	49	B352	03-Sep-90									1				-3
WR	49	B352	25-Oct-91									1				3
WR	49	B352	14-Nov-93							All	All					-8
WR	49	B361	03-Sep-90									1				3
WR	49	B361	25-Oct-91		1,3,4	1				1	1					8
WR	49	B361	11-Nov-92									1				3
WR	49	B361	14-Nov-93									All				-5
WR	49	B390	11-Nov-92							All						11
WR	49	C310	25-Oct-91							1	1					-8
WR	49	C310	10-Nov-93									All				-5
WR	49	C310	02-Aug-95									All				-5
WR	49	C320	25-Oct-91									1				-3
WR	49	C330	25-Oct-91							1	1					-6
WR	49	C330	10-Nov-93									All				-4
WR	49	C330	02-Aug-95									All				-4
WR	49	C331	31-Aug-90							All	All					-6
WR	49	C331	25-Oct-91							1						-18
WR	49	C331	10-Nov-92									All				-3
WR	49	C331	10-Nov-93							All	All					-8
WR	49	C331	02-Aug-95							All	All					-8
WR	49	C350	25-Oct-91							1	1					-10
WR	49	C350	10-Nov-92									All				-3
WR	49	C350	10-Nov-93							All	All					-5
WR	49	C350	02-Aug-95							All	All					-5
WR	49	C351	31-Aug-90									All				-3
WR	49	C351	25-Oct-91							1						-15
WR	49	C351	10-Nov-92									All				-5
WR	49	C351	10-Nov-93							All	All					-8
WR	49	C351	02-Aug-95							All	All					-8
WR	49	C352	31-Aug-90							All	All					-6
WR	49	C352	25-Oct-91							1						-15
WR	49	C352	10-Nov-92									All				-5
WR	49	C352	10-Nov-93							All	All					-8
WR	49	C352	02-Aug-95							All	All					-8
WR	49	C361	25-Oct-91							1	1					-6
WR	49	C361	10-Nov-92									All				-3
WR	49	C361	10-Nov-93							All	All					-6
WR	49	C361	02-Aug-95							All	All					-6
WR	49	C410	27-Jul-95									All				-3
WR	49	E431	12-Nov-93							2	2					8
WR	49	E448	12-Nov-93							1	1					6
WR	49	E450	12-Nov-93							2	2					8
WR	49	E451	12-Nov-93							1	1					7
WR	49	E454	12-Nov-93							1	1					7
WR	49	E455	12-Nov-93							1	1					6
WR	49	E459	12-Nov-93							1	1					7
WR	49	E460	12-Nov-93							1	1					6
WR	49	E462	12-Nov-93							1	1					8
WR	53	1801	29-Mar-93							4	4					6
WR	53	6049	10-Dec-90							All	All					6
WR	53	6056	28-Nov-90							All	All					6
WR	53	7322	11-May-93							5	5					9
WR	53	7409	23-Apr-93							4	4					6
WR	53	A310	07-May-93									All				3
WR	53	A330	19-May-92									All				-3
WR	53	A350	19-May-92							All	All					-5
WR	53	C310	06-Aug-90							All	All					6
WR	53	C320	28-Apr-92							All	All					-6
WR	53	C320	29-Mar-93							All	All					-6
WR	53	C320	28-Aug-96							All	All					-6
WR	53	C330	28-Apr-92									All				-5
WR	53	C330	28-Aug-96									All				-5
WR	53	C340	29-Mar-93									All				-5
WR	53	C350	28-Apr-92							All	All					-6
WR	53	C350	28-Aug-96									1				-5

Table 20. Profile runs with shifted start locations.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Edit Run No.	Early Start OK Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Offset (m)
NCR	55	3019	17-Sep-95							All	All					9
NCR	55	5037	17-Sep-95							All	All					8
NCR	55	5040	30-Sep-95							1	1					8
NCR	55	5040	30-Sep-95							2	2					8
NCR	55	5040	30-Sep-95							4	4					8
NCR	55	5040	30-Sep-95							5	5					8
NCR	55	5040	30-Sep-95			6				6	6					8
NCR	55	0901	18-Sep-95		3	1				1						17
NCR	55	0902	18-Jun-92							2	2					8
NCR	55	0902	18-Jun-92							4	4					8
NCR	55	0902	18-Jun-92							6	6					8
NCR	55	0902	18-Jun-92							7	7					8
NCR	55	0907	18-Jun-92							2						12
NCR	55	0907	18-Sep-95			1				1						12
NCR	55	A901	17-Jun-92							3	3					9
NCR	55	A902	17-Jun-92							3	3					9
NCR	55	A902	27-Oct-92				All			1						9
NCR	55	A903	27-Oct-92				All			1						9
NCR	55	A907	27-Oct-92				All			1						61
NCR	55	A908	27-Oct-92				All			1						9
NCR	55	A909	27-Oct-92				All			1						9
NCR	55	B901	17-Jun-92							All	All					6
NCR	55	B901	28-Sep-95					6		6						15
NCR	55	B902	17-Jun-92							All	All					6
NCR	55	B902	28-Sep-95		1	1				1						12
NCR	55	B902	28-Sep-95		3	3				3						12
NCR	55	B902	28-Sep-95		4	4				4						12
NCR	55	B902	28-Sep-95							5						12
NCR	55	B902	28-Sep-95							9						12
NCR	55	B903	17-Jun-92							All	All					6
NCR	55	B903	28-Sep-95							3						12
NCR	55	B903	28-Sep-95							4						12
NCR	55	B903	28-Sep-95			5				5						12
NCR	55	B903	28-Sep-95							6						12
NCR	55	B903	28-Sep-95							8						12
NCR	55	B907	17-Jun-92							All	All					6
NCR	55	B907	28-Sep-95							3						12
NCR	55	B907	28-Sep-95		4	4				4						12
NCR	55	B907	28-Sep-95							5						12
NCR	55	B907	28-Sep-95							7						12
NCR	55	B907	28-Sep-95							8						12
NCR	55	B908	17-Jun-92							All	All					6
NCR	55	B908	28-Sep-95							6						12
NCR	55	B908	28-Sep-95							7						12
NCR	55	B909	17-Jun-92							2	2					6
NCR	55	B909	28-Sep-95		4	4				4						12
NCR	55	B909	28-Sep-95							6						12
NCR	55	B909	28-Sep-95							7						12
NCR	55	B909	28-Sep-95							8						12
NCR	55	B909	28-Sep-95							9						12
WR	56	1007	01-Nov-94							2	2					9
WR	56	2017	06-Oct-93							2						15
WR	56	2017	06-Oct-93							5						15
WR	56	6032	15-Sep-94							2	2					8
WR	56	A310	22-Jul-90									1,2				5
WR	56	A310	23-Sep-91							1						32
WR	56	A310	28-Oct-92							All	All					-8
WR	56	A320	22-Jul-90							1						15
WR	56	A320	22-Jul-90							2						15
WR	56	A320	22-Oct-90							All						14
WR	56	A320	23-Sep-91							1						23
WR	56	A330	22-Jul-90							1						11
WR	56	A330	22-Jul-90							2						11
WR	56	A330	22-Oct-90							All	All					8
WR	56	A330	23-Sep-91							1						18
WR	56	A330	28-Oct-92							All	All					-6
WR	56	A350	22-Jul-90							1						15
WR	56	A350	22-Jul-90							2						15
WR	56	A350	22-Oct-90							1						11
WR	56	A350	23-Sep-91							1						25
WR	56	A350	28-Oct-92							All	All					-7
WR	56	A363	22-Jul-90							All	All					7
WR	56	A363	22-Oct-90							All	All					5
WR	56	A363	23-Sep-91							1						14
WR	56	B320	09-Nov-90									All				5

Table 20. Profile runs with shifted start locations.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Edit Run No.	Early Start OK Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Offset (m)
WR	56	B320	25-Sep-91							All	All					6
WR	56	B330	09-Nov-90							All	All					8
WR	56	B330	25-Sep-91							1						13
WR	56	B350	09-Nov-90							All	All					9
WR	56	B350	25-Sep-91							All						15
WR	56	B360	29-Oct-90							All	All					-6
WR	56	B360	09-Nov-90							All	All					8
WR	56	B360	21-Jul-94				1			1						-6
WR	56	B360	21-Jul-94							2	2					-6
WR	56	B360	21-Jul-94							3	3					-6
WR	56	B360	21-Jul-94							4	4					-6
WR	56	B360	21-Jul-94							5	5					-6
WR	81	0502	15-Sep-92									All				5
WR	81	0502	24-Sep-93									1				3
WR	81	0503	15-Sep-92									All				5
WR	81	0503	24-Sep-93									All				5
WR	81	0504	30-Jul-94									1				5
WR	81	0507	30-Jul-94									1				3
WR	81	0509	15-Sep-92									All				5
WR	81	0509	24-Sep-93									1				3
WR	81	1805	16-Jun-91							All						11
WR	81	0502	20-Jun-91							1						11
WR	81	0502	20-Jun-91							2						11
WR	81	0502	20-Jun-91							3						11
WR	81	0502	20-Jun-91			5				5						11
WR	81	0502	20-Jun-91			6				6						11
WR	81	0503	30-Jul-94							1						11
WR	81	0508	30-Jul-94							1	1					8
WR	81	0508	10-Jun-95							All						-12
WR	81	0509	30-Jul-94							1						11
NCR	83	A310	18-Feb-94							All	All					6
NCR	83	A331	27-Aug-92							1	1					6
NCR	83	A350	27-Aug-92							1	1					6
NAR	85	1808	28-Jul-90							All						15
NAR	87	A320	24-Apr-92									2,8				3
NAR	87	A330	24-Apr-92									2,8				3
NAR	87	A340	24-Apr-92									2,8				3
NAR	87	A350	24-Apr-92									2,8				3
NAR	87	B320	13-Jul-95							All						24
NAR	87	B361	05-Mar-97									All				2
NAR	87	B361	08-Aug-97									All				2
NAR	88	1645	21-Sep-92							1						12
NAR	88	1645	21-Sep-92							2						12
NAR	88	1645	21-Sep-92				3			3						12
NAR	88	1645	21-Sep-92							4						12
NAR	88	1645	21-Sep-92				5			5						12
NAR	89	3001	11-Aug-93							1	1					6
NAR	89	3001	11-Aug-93							4	4					6
NAR	89	3001	11-Aug-93							5	5					6
NCR	90	6405	19-Feb-94							3						15
NCR	90	A310	31-May-90							All			All			49
NCR	90	A351	17-Jul-91							All						43
NCR	90	B320	19-Feb-94				3			3						15
NCR	90	B350	19-Feb-94							3						15

APPENDIX H. SUMMARY OF WRONG TESTING LOCATION DATA

Table 21. Profile runs tested in the wrong location.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab
NCR	17	1002	12-Jun-90					All					
NCR	17	1003	03-Mar-95					All					
NCR	17	4082	13-Jan-94					All					
NCR	17	5151	11-Mar-95					All					
NCR	17	9267	11-Mar-95			4		All					
NCR	18	3003	24-Jun-91					All					
NCR	18	6012	15-Mar-95					2					
NCR	18	6012	15-Mar-95					3					
NCR	18	6012	15-Mar-95					4					
NCR	18	6012	15-Mar-95					5					
NCR	18	9020	04-Oct-89					All					
NCR	18	9020	06-Oct-94					All					
NCR	18	0901	27-Apr-92					All					
NCR	18	0901	02-Feb-94					All					
NCR	18	0902	27-Apr-92					All					
NCR	18	0902	02-Feb-94					All					
NCR	18	0904	27-Apr-92					All					
NCR	18	0904	02-Feb-94					All					
NCR	18	0905	27-Apr-92					All					
NCR	18	0905	02-Feb-94					All					
NCR	19	3009	16-Sep-94		5			All					
NCR	19	3055	15-Sep-94					All					
NCR	20	1009	23-Apr-96					All					
NCR	20	4054	10-Mar-93			1		1					
NCR	20	4054	10-Mar-93			8		8					
NCR	20	4054	18-Feb-95					All					
NCR	20	9037	09-Mar-93		5			2					
NCR	20	9037	09-Mar-93		5			3					
NCR	20	9037	09-Mar-93		5			4					
NCR	20	0259	10-Mar-93					All					
NCR	20	A340	24-Apr-96					All					
NCR	20	A350	24-Apr-96					All					
NCR	21	1010	28-Apr-90					All					
NAR	24	0501	24-Jan-92					2					
NAR	24	0501	24-Jan-92					4					
NAR	24	0501	24-Jan-92					5					
NAR	24	0560	24-Jan-92					All					
NAR	24	0560	25-Jun-93					All					13-May-92
NAR	24	0561	08-Aug-91					All					
NCR	26	3068	25-Sep-92					1		1			
NCR	26	3068	25-Sep-92					2					
NCR	26	3068	25-Sep-92					3					
NCR	26	3068	25-Sep-92					4					
NCR	26	3068	25-Sep-92					5					
NCR	26	7072	24-Sep-92					1					
NCR	26	7072	24-Sep-92					2					
NCR	26	9029	09-Oct-89					All					
NCR	26	9029	26-Sep-92					All					
NCR	26	0659	09-Sep-94				8	All					
NCR	26	C310	24-Jul-90					All					
NCR	26	C320	24-Jul-90					All					
NCR	26	C321	24-Jul-90					All					
NCR	26	C330	24-Jul-90					All					
NCR	26	C340	24-Jul-90					All					

Table 21. Profile runs tested in the wrong location.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab
NCR	26	C350	24-Jul-90					All					
NCR	26	C351	24-Jul-90					All					
NCR	27	1016	13-Jul-91					All		5			
NCR	27	1016	30-Oct-92					All					
SR	28	3085	04-Dec-90					6					
SR	28	3085	04-Dec-90					7					
SR	28	3085	04-Dec-90					8					
SR	28	3085	04-Dec-90					9					
NCR	29	1002	10-May-94					All					
NCR	29	1005	14-Mar-93	17:14:39				All					
NCR	29	5047	15-Mar-93		1,2,5,7			All					
NCR	29	5503	16-Feb-92					All					
WR	30	0502	03-May-90					All					
WR	30	0502	09-Nov-91					All					
WR	30	0502	26-Aug-92					All					
WR	30	0502	29-Sep-93					All					
WR	30	0504	03-May-90					All					
WR	30	0504	09-Nov-91					All					
WR	30	0504	26-Aug-92			4		All					
WR	30	0506	09-Nov-91					All					
WR	30	0507	09-Nov-91					All					
WR	30	0507	26-Aug-92					All					
WR	30	0509	03-May-90					All					
WR	30	0509	25-May-91					All					
WR	30	0509	09-Nov-91					All					
WR	30	0509	26-Aug-92					All					
WR	30	0560	29-Sep-93					1		1			
WR	30	0560	29-Sep-93					2					
WR	30	0560	29-Sep-93					3					
WR	30	0560	29-Sep-93					4					
WR	30	0560	29-Sep-93					5					
WR	30	0561	09-Nov-91					All					
WR	30	0561	26-Aug-92					All					
WR	30	0561	29-Sep-93					All					
WR	30	A310	29-Sep-93					All					
WR	30	A310	26-Jul-94					All					
WR	30	A310	12-Sep-96					All					
NCR	31	3018	17-Apr-96					All					
NCR	31	3028	19-Sep-94					All					
NCR	31	4019	29-Nov-93					2					
NCR	31	4019	29-Nov-93					3					
NCR	31	4019	29-Nov-93					4					
NCR	31	4019	29-Nov-93					5					
NCR	31	4019	29-Nov-93					7		7			
NCR	31	0114	19-Apr-96					All					
NCR	39	3801	05-Apr-94					All					
NAR	42	0603	13-Aug-90					All					
NAR	42	0604	13-Aug-90					All					
NAR	42	0606	13-Aug-90					All					
NAR	42	0607	13-Aug-90					All					
NAR	42	0608	13-Aug-90					All					
NAR	42	0662	13-Aug-90					All					
NCR	46	6600	20-Jun-91					All					
NCR	46	9106	23-Sep-96					All					
SR	47	9024	10-Apr-95					All					
WR	49	E430	14-Nov-92					All					
WR	49	E440	14-Nov-92					All					

Table 21. Profile runs tested in the wrong location.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab
WR	49	E441	14-Nov-92					All					
WR	49	E443	14-Nov-92					All					
WR	49	E444	14-Nov-92					All					
WR	49	E445	14-Nov-92					All					
WR	49	E456	14-Nov-92					All					
WR	49	E458	14-Nov-92					All					
WR	49	E461	14-Nov-92					All					
WR	53	3019	25-Oct-89					4					
WR	53	A310	29-Jul-91					All					01-Sep-90
NCR	55	6354	15-Feb-94					All					
NCR	55	0908	18-Sep-95		2	4		4					
NCR	55	0908	18-Sep-95		2	6		6					
NCR	55	A901	28-Sep-95					All					
NCR	55	A902	28-Sep-95					All					
NCR	55	A903	28-Sep-95					All					
NCR	55	A907	28-Sep-95			3		All					
NCR	55	A908	28-Sep-95					All					
NCR	55	A909	28-Sep-95					All					
NCR	55	B901	28-Sep-95					5					
NCR	55	B901	28-Sep-95					6		6			
NCR	55	B901	28-Sep-95					7					
NCR	55	B901	28-Sep-95					8					
NCR	55	B901	28-Sep-95					9					
NCR	55	B908	28-Sep-95					3					
NCR	55	B908	28-Sep-95					8					
NCR	55	B908	28-Sep-95					9					
NCR	83	0501	29-Apr-95					All					
NCR	83	0502	29-Apr-95					All					
NCR	83	0503	29-Apr-95					All					
NCR	83	0504	29-Apr-95			All		All					
NCR	83	0505	29-Apr-95					All					
NCR	83	0506	29-Apr-95					All					
NCR	83	0507	29-Apr-95					All					
NCR	83	0508	29-Apr-95					All					
NCR	90	6410	29-Aug-92					All					
NCR	90	6412	29-Aug-92					All					
NCR	90	A310	17-Jul-91					All					
NCR	90	A310	28-Aug-92				All	All					
NCR	90	A310	12-Jun-93					All					
NCR	90	A310	19-Nov-93					All					

APPENDIX I. SUMMARY OF OUT-OF-STUDY PROFILE DATA

Table 22. Profile runs for out-of-study sections.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Load Run No.	DMI Off Del Run No.	DMI Off Load Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab
WR	4	0601	02-May-95						All						
WR	6	0602	06-Apr-93						All	1	1				
WR	6	0602	11-Jun-96			6			All	1	1				
NCR	17	1002	01-Oct-94						All						
NCR	17	B310	14-Oct-94						All						
NCR	17	B320	14-Oct-94						All						
NCR	17	B330	14-Oct-94						All						
NCR	17	B340	14-Oct-94						All						
NCR	17	B350	14-Oct-94						All						
NCR	18	0601	01-Feb-94						All						27-Jul-93
NCR	29	0666	13-Feb-92						All						
WR	30	0501	09-Nov-91						All						
WR	30	0501	26-Aug-92			5			All						
WR	32	A351	27-Mar-92						All						
SR	35	6035	03-Dec-93						All						01-Oct-93
SR	47	6022	28-Feb-94						All						
NAR	87	A320	21-Aug-92			All	All		All						
NAR	87	A320	09-Sep-93			All			All						
NAR	87	A320	15-Jul-94						All						
NAR	87	A320	13-Jul-95			All			All						
NAR	87	A320	07-Aug-97						All						
NAR	87	A330	21-Aug-92						All						
NAR	87	A330	09-Sep-93						All						
NAR	87	A330	15-Jul-94						All						
NAR	87	A330	13-Jul-95						All						
NAR	87	A330	07-Aug-97						All						
NAR	87	A340	21-Aug-92						All						
NAR	87	A340	09-Sep-93						All						
NAR	87	A340	15-Jul-94						All						
NAR	87	A340	13-Jul-95						All						
NAR	87	A340	07-Aug-97						All						
NAR	87	A350	20-Aug-92						All						
NAR	87	A350	09-Sep-93						All						
NAR	87	A350	15-Jul-94						All						
NAR	87	A350	13-Jul-95						All						
NAR	87	A350	07-Aug-97						All						
NCR	90	1802	17-Jul-91						All						
NCR	90	1802	28-Aug-92						All						
NCR	90	1802	12-Jun-93						All						
NCR	90	1802	25-Jun-95						All						
NCR	90	A330	19-Nov-93						All						14-Jul-93
NCR	90	A330	19-Jul-94						All						14-Jul-93

APPENDIX J. SUMMARY OF MISCALIBRATED DMI PROFILE RUNS

Table 23. Profile runs with miscalibrated DMI.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	DMI Off Edit Run No.	DMI Off OK Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated DMI Offset (m)
NCR	20	1010	02-May-90								All	All				6
NCR	20	B340	02-May-90								All	All				6
NCR	20	B350	02-May-90								All	All				6
NCR	21	4025	31-May-95								All	All				6
NCR	21	A310	01-Jun-95								All	All				6
NCR	21	A320	01-Jun-95										All			5
NCR	21	A330	01-Jun-95										All			5
NCR	21	A340	01-Jun-95								All	All				6
NCR	21	A350	01-Jun-95								All	All				6
NCR	26	9030	17-May-90								All	All				6
NCR	27	1016	24-May-90								All	All				6
NCR	27	4040	22-Apr-95	9:32:05		1					All	All				8
NCR	27	4040	22-Apr-95	12:38:31							All	All				8
NCR	27	4040	22-Apr-95	15:49:06		7					All	All				8
NCR	27	4040	27-Jun-95								All	All				8
NCR	27	6251	23-May-90								All	All				6
NCR	27	6251	27-Jun-95								All	All				6
NCR	27	0501	24-May-90								All	All				6
NCR	27	0502	24-May-90								All	All				6
NCR	27	0503	24-May-90								All	All				6
NCR	27	0505	24-May-90			All					All	All				6
NCR	27	0507	24-May-90			All					All	All				6
NCR	27	0508	24-May-90			All					All	All				6
NCR	27	0509	24-May-90								All	All				6
NCR	27	0559	24-May-90							All	All	All				6
NCR	27	0560	24-May-90								All	All				6
NCR	27	0561	24-May-90								All	All				6
NCR	27	B310	23-May-90								All	All				8
NCR	27	B320	23-May-90								All	All				8
NCR	27	B330	23-May-90								All	All				8
NCR	27	B340	23-May-90								All	All				8
NCR	27	B350	23-May-90								All	All				8
NCR	27	C340	23-May-90								All	All				6
NCR	27	C350	23-May-90								All	All				8
NCR	27	D310	22-May-90										All			5
NCR	27	D320	22-May-90										All			5
NCR	27	D330	22-May-90										All			5
NCR	27	D340	22-May-90										All			5
NCR	27	D350	22-May-90										All			5
NCR	29	A340	30-Apr-90										All			3
NCR	29	B310	30-Apr-90										All			3
NCR	29	B320	30-Apr-90										All			3
NCR	29	B330	30-Apr-90										All			3
NCR	29	B340	30-Apr-90										All			3
NCR	31	3024	03-May-90								All	All				6
NCR	31	3028	03-May-90								All	All				6
NCR	31	A320	02-May-90										All			3
NCR	31	A330	02-May-90										All			3
NCR	31	A340	02-May-90										All			3
NCR	31	A350	02-May-90										All			3
NCR	31	A351	02-May-90										All			3
NCR	31	A352	02-May-90										All			3
NCR	31	A353	02-May-90										All			3
NCR	46	0803	22-Jun-95								All	All				6
NCR	46	0804	22-Jun-95								All	All				6
NCR	46	0859	22-Jun-95								All	All				6
NCR	83	0501	25-May-90										All			5
NCR	83	0502	25-May-90										All			5
NCR	83	0503	25-May-90										All			5
NCR	83	0504	25-May-90										All			5
NCR	83	0505	25-May-90										All			5
NCR	83	0506	25-May-90										All			5
NCR	83	0508	25-May-90										All			5
NCR	83	0509	25-May-90										All			5
NCR	83	A320	27-Apr-95			All					All	All				6
NCR	83	A330	27-May-90								All	All				6
NCR	83	A330	27-Apr-95			1					1	1				6
NCR	83	A330	27-Apr-95			2					2	2				6
NCR	83	A330	27-Apr-95								3	3				6
NCR	83	A330	27-Apr-95								6	6				6
NCR	83	A330	27-Apr-95								9	9				6

Table 23. Profile runs with miscalibrated DMI.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	DMI Off Edit Run No.	DMI Off OK Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated DMI Offset (m)
NCR	83	A331	27-Apr-95								All	All				6
NCR	83	A340	27-May-90								All	All				6
NCR	83	A340	27-Apr-95								All	All				6
NCR	83	A350	27-May-90								All	All				6
NCR	83	A351	27-May-90								All	All				6
NCR	90	A310	31-May-90							All	All	All				6
NCR	90	A310	25-Jun-95								All	All				6
NCR	90	A320	31-May-90								All	All				6
NCR	90	A320	25-Jun-95								1	1				6
NCR	90	A320	25-Jun-95			2					2	2				6
NCR	90	A320	25-Jun-95								5	5				6
NCR	90	A320	25-Jun-95			6					6	6				6
NCR	90	A320	25-Jun-95								7	7				6
NCR	90	A330	31-May-90								1	1				6
NCR	90	A330	31-May-90								2	2				6
NCR	90	A330	31-May-90								3	3				6
NCR	90	A330	31-May-90								4	4				6
NCR	90	A330	31-May-90				5				5	5				6
NCR	90	A340	31-May-90								All	All				6
NCR	90	A340	25-Jun-95				1				1	1				6
NCR	90	A340	25-Jun-95								2	2				6
NCR	90	A340	25-Jun-95								4	4				6
NCR	90	A340	25-Jun-95								5	5				6
NCR	90	A340	25-Jun-95								6	6				6
NCR	90	A350	31-May-90								All	All				6
NCR	90	A350	25-Jun-95			1					1	1				6
NCR	90	A350	25-Jun-95			2					2	2				6
NCR	90	A350	25-Jun-95								4	4				6
NCR	90	A350	25-Jun-95			5					5	5				6
NCR	90	A350	25-Jun-95								7	7				6
NCR	90	A351	31-May-90								All	All				6
NCR	90	A351	25-Jun-95			All					All	All				6
NCR	90	A352	31-May-90								All	All				6
NCR	90	A352	25-Jun-95			2					2	2				6
NCR	90	A352	25-Jun-95								4	4				6
NCR	90	A352	25-Jun-95			7					7	7				6
NCR	90	A352	25-Jun-95								8	8				6
NCR	90	A352	25-Jun-95								9	9				6
NCR	90	B310	31-May-90								All	All				6
NCR	90	B310	26-Apr-95			1					1	1				6
NCR	90	B310	26-Apr-95			2					2	2				6
NCR	90	B310	26-Apr-95			3					3	3				6
NCR	90	B310	26-Apr-95								4	4				6
NCR	90	B310	26-Apr-95			5					5	5				6
NCR	90	B310	24-Jun-95								All	All				6
NCR	90	B320	31-May-90								All	All				6
NCR	90	B320	26-Apr-95		A	All					All	All				6
NCR	90	B320	24-Jun-95								All	All				6
NCR	90	B330	31-May-90								All	All				6
NCR	90	B330	26-Apr-95			1					1	1				6
NCR	90	B330	26-Apr-95								2	2				6
NCR	90	B330	26-Apr-95			3					3	3				6
NCR	90	B330	26-Apr-95			4					4	4				6
NCR	90	B330	26-Apr-95			5					5	5				6
NCR	90	B330	24-Jun-95			1					1	1				6
NCR	90	B330	24-Jun-95			2					2	2				6
NCR	90	B330	24-Jun-95			3					3	3				6
NCR	90	B330	24-Jun-95								6	6				6
NCR	90	B330	24-Jun-95			7					7	7				6
NCR	90	B331	31-May-90								All	All				6
NCR	90	B331	26-Apr-95		A	All					All	All				6
NCR	90	B331	24-Jun-95			All					All	All				6
NCR	90	B340	31-May-90								All	All				6
NCR	90	B340	26-Apr-95		A	1					1	1				6
NCR	90	B340	26-Apr-95		A						2	2				6
NCR	90	B340	26-Apr-95		A	3					3	3				6
NCR	90	B340	26-Apr-95		A	4					4	4				6
NCR	90	B340	26-Apr-95		A	5					5	5				6
NCR	90	B340	24-Jun-95			3					3	3				6
NCR	90	B340	24-Jun-95								4	4				6
NCR	90	B340	24-Jun-95								5	5				6
NCR	90	B340	24-Jun-95			6					6	6				6
NCR	90	B340	24-Jun-95			7					7	7				6
NCR	90	B350	31-May-90								All	All				6

Table 23. Profile runs with miscalibrated DMI.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	DMI Off Edit Run No.	DMI Off OK Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated DMI Offset (m)
NCR	90	B350	26-Apr-95			1					1	1				6
NCR	90	B350	26-Apr-95								2	2				6
NCR	90	B350	26-Apr-95								3	3				6
NCR	90	B350	26-Apr-95								4	4				6
NCR	90	B350	26-Apr-95			5					5	5				6
NCR	90	B350	24-Jun-95			2					2	2				6
NCR	90	B350	24-Jun-95								3	3				6
NCR	90	B350	24-Jun-95			5					5	5				6
NCR	90	B350	24-Jun-95			6					6	6				6
NCR	90	B350	24-Jun-95			7					7	7				6
NCR	90	B351	31-May-90								All	All				6
NCR	90	B351	26-Apr-95			All					All	All				6
NCR	90	B351	24-Jun-95								1	1				6
NCR	90	B351	24-Jun-95			4					4	4				6
NCR	90	B351	24-Jun-95			5					5	5				6
NCR	90	B351	24-Jun-95								6	6				6
NCR	90	B351	24-Jun-95			7					7	7				6

APPENDIX K. SUMMARY: POSSIBLY UNREPORTED MAINTENANCE

Table 24. Profile runs with possibly unreported maintenance.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Del Run No.	Out Study Del Run No.	Early Start Del Run No.	DMI Off Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab
WR	4	B330	21-Mar-95					5					01-Aug-94	
WR	4	B350	23-Feb-92								1		01-Aug-94	
WR	16	1009	24-Oct-92										24-Oct-92	
NCR	18	0602	04-Apr-96										01-Jan-96	
NCR	18	0605	04-Apr-96										01-Jan-96	
NCR	19	A340	01-Sep-94										23-Mar-94	
NCR	19	A350	01-Sep-94										23-Mar-94	
NCR	20	B320	22-Apr-96										01-Jan-96	
NCR	27	D330	27-Jul-94			All					All		01-Aug-92	
NCR	31	1030	19-Sep-96										07-Aug-96	
NCR	38	2001	24-Oct-89										17-Aug-90	
NAR	42	0605	24-Nov-92										30-Sep-92	
NAR	42	A320	19-Nov-90			4		4					10-Sep-90	
NAR	42	A320	19-Nov-90					1					10-Sep-90	
NAR	42	A320	19-Nov-90					2					10-Sep-90	
NAR	42	A320	19-Nov-90					3					10-Sep-90	
NAR	42	A320	19-Nov-90					5					10-Sep-90	
NAR	42	B330	20-Nov-90			6	6						01-Sep-90	
NAR	42	B350	20-Nov-90										01-Sep-90	
NCR	46	0602	20-Oct-93										01-Jun-93	
NCR	46	0605	20-Oct-93										01-Jun-93	
NCR	46	A411	03-Aug-92										01-Jun-92	
NCR	46	A412	03-Aug-92										01-Jun-92	
NCR	46	A421	03-Aug-92			2	2						01-Jun-92	
NCR	46	A421	03-Aug-92			3	3						01-Jun-92	
NCR	46	A421	03-Aug-92			5	5						01-Jun-92	
NCR	46	A422	03-Aug-92			2	2						01-Jun-92	
NCR	46	A423	03-Aug-92										01-Jun-92	
SR	48	C420	13-Dec-94										10-May-94	
NAR	51	A321	07-Dec-90										06-Sep-90	

APPENDIX L. SUMMARY OF UNREPORTED REHABILITATION

Table 25. Profile runs with unreported rehabilitation.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Load Run No.	DMI Off Del Run No.	DMI Off Load Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab
SR	1	0504	01-Apr-92													11-Dec-91
SR	1	0505	01-Apr-92													11-Dec-91
SR	1	0506	01-Apr-92													11-Dec-91
SR	1	0507	01-Apr-92													11-Dec-91
SR	1	0508	01-Apr-92													11-Dec-91
SR	1	0509	01-Apr-92													11-Dec-91
WR	4	1002	09-Aug-96					All								13-May-96
WR	4	1003	27-Jan-97													25-May-93
WR	4	1007	04-Mar-95								1	1				01-Feb-95
WR	4	1015	04-Feb-97													01-Jan-97
WR	4	1021	21-Feb-97													13-Jun-96
WR	4	0559	21-Sep-90													01-Sep-90
WR	6	2004	25-Feb-97													31-Mar-95
WR	6	2051	16-Apr-97													01-Jan-97
WR	8	1047	07-Nov-92													01-Oct-92
NAR	10	4002	14-Jun-94													01-May-94
NAR	10	5005	16-Nov-95					All								01-May-95
NAR	10	0101	10-Jun-97													01-Sep-96
NAR	10	0102	10-Jun-97													01-Sep-96
NAR	10	0103	10-Jun-97													01-Sep-96
NAR	10	0104	10-Jun-97													01-Sep-96
NAR	10	0105	10-Jun-97													01-Sep-96
NAR	10	0106	10-Jun-97													01-Sep-96
NAR	10	0109	10-Jun-97													01-Sep-96
NAR	10	0111	10-Jun-97													01-Sep-96
NAR	10	0112	10-Jun-97													01-Sep-96
NAR	10	0159	10-Jun-97													01-Sep-96
NAR	10	0160	10-Jun-97													01-Sep-96
NAR	10	0201	10-Jun-97													01-Oct-96
NAR	10	0205	10-Jun-97													01-Oct-96
NAR	10	0209	10-Jun-97													01-Oct-96
NAR	10	0212	10-Jun-97													01-Oct-96
NAR	10	0259	30-Jul-96													01-Oct-96
SR	12	0502	02-Nov-95													18-Apr-95
SR	12	0503	02-Nov-95													17-Apr-95
SR	12	0504	02-Nov-95													18-Apr-95
SR	12	0505	02-Nov-95													18-Apr-95
SR	12	0506	02-Nov-95													18-Apr-95
SR	12	0507	02-Nov-95													14-Apr-95
SR	12	0508	02-Nov-95													12-Apr-95
SR	12	0509	02-Nov-95													18-Apr-95
SR	12	0561	02-Nov-95													18-Apr-95
SR	12	0563	02-Nov-95													18-Apr-95
SR	12	0564	02-Nov-95													18-Apr-95
SR	12	0565	02-Nov-95													17-Apr-95
SR	12	0566	02-Nov-95													18-Apr-95
SR	12	B310	03-Jul-91													19-Feb-91
SR	12	C310	01-Jul-91													19-Nov-90
SR	13	0501	13-Jun-94					All								07-Jun-93
SR	13	0502	13-Jun-94					All								16-Jun-93
SR	13	0503	13-Jun-94					All								08-Jun-93
SR	13	0504	13-Jun-94					All								16-Jun-93
SR	13	0505	13-Jun-94					All								16-Jun-93
SR	13	0506	13-Jun-94					All								07-Jun-93
SR	13	0507	13-Jun-94					All								16-Jun-93
SR	13	0508	13-Jun-94					All								16-Jun-93
SR	13	0509	13-Jun-94					All								16-Jun-93
SR	13	0560	14-Jun-94					All								15-Jun-93
SR	13	0561	14-Jun-94					All								15-Jun-93
SR	13	0562	14-Jun-94					All								17-Jun-93
SR	13	0563	14-Jun-94					All								17-Jun-93
SR	13	0564	14-Jun-94					All								17-Jun-93
SR	13	0565	14-Jun-94					All								18-Jun-93
SR	13	0566	14-Jun-94					All								18-Jun-93
SR	13	0567	14-Jun-94					All								18-Jun-93
NCR	17	0605	17-Dec-91								1	1				01-Sep-90
NCR	17	0660	17-Dec-91			All	All									01-Sep-90

Table 25. Profile runs with unreported rehabilitation.

LTPP Region	State Code	SHRP ID	Profile Date	Time	IMS Spike Run No.	Equip Spike Del Run No.	Equip Spike Load Run No.	Lost Lock Del Run No.	Wrong Location Delete Run No.	Out Study Del Run No.	Early Start Del Run No.	Early Start Load Run No.	DMI Off Del Run No.	DMI Off Load Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab
NCR	17	0661	17-Dec-91			3	3									01-Sep-90
NCR	17	0661	17-Dec-91			4	4									01-Sep-90
NCR	18	2008	25-Mar-95													01-Jan-95
NCR	18	5022	03-Oct-92								All					16-May-92
NCR	18	0601	01-Feb-94							All						27-Jul-93
NCR	18	0605	14-Dec-90													30-Aug-90
NAR	23	1028	04-Aug-94													01-Jun-94
NAR	23	0502	15-Aug-95													27-Jun-95
NAR	23	0503	15-Aug-95													27-Jun-95
NAR	23	0504	15-Aug-95					All								27-Jun-95
NAR	23	0505	15-Aug-95					All								27-Jun-95
NAR	23	0506	15-Aug-95					All								27-Jun-95
NAR	23	0507	15-Aug-95													27-Jun-95
NAR	23	0508	15-Aug-95			9		9								27-Jun-95
NAR	23	0508	15-Aug-95					4								27-Jun-95
NAR	23	0508	15-Aug-95					5								27-Jun-95
NAR	23	0508	15-Aug-95					7								27-Jun-95
NAR	23	0508	15-Aug-95					8								27-Jun-95
NAR	23	0509	15-Aug-95					All								27-Jun-95
NAR	23	0559	15-Aug-95					All								27-Jun-95
NAR	24	5807	12-Nov-90					All								01-Sep-90
NAR	24	0502	25-Jun-94					All								01-Jun-92
NAR	24	0560	25-Jun-93						All							13-May-92
NAR	24	0561	25-Jun-93					All								13-May-92
NCR	27	D310	05-Aug-92													01-Aug-92
SR	28	7012	19-Jan-94			3	3									01-Sep-92
SR	28	0501	14-Nov-90													25-Sep-90
SR	28	0502	14-Nov-90													25-Sep-90
SR	28	0504	14-Nov-90													24-Sep-90
SR	28	0505	14-Nov-90													24-Sep-90
SR	28	0506	14-Nov-90													24-Sep-90
SR	28	0507	14-Nov-90													24-Sep-90
SR	28	0508	14-Nov-90													25-Sep-90
SR	28	0509	14-Nov-90			6	6									25-Sep-90
SR	28	0560	14-Nov-90													25-Sep-90
SR	28	A320	12-Jul-91													23-Aug-90
SR	28	A330	12-Jul-91													23-Aug-90
NCR	29	5473	11-Mar-91													01-May-90
WR	32	7000	16-Nov-92													01-Sep-97
WR	32	B310	27-Sep-90													27-Sep-90
NAR	34	1031	31-Jul-96													01-May-96
SR	35	6035	03-Dec-93							All						01-Oct-93
NAR	36	A331	15-Sep-93													01-Jul-93
SR	40	0605	16-Mar-93			5	5									27-Aug-92
WR	41	2002	15-Jun-96													27-Aug-93
WR	41	7018	26-Apr-92													26-Jun-91
NAR	42	1605	31-Aug-95													01-May-95
NAR	42	A310	19-Nov-90			1	1									05-Jun-90
NAR	42	A310	19-Nov-90			4	4									05-Jun-90
NAR	42	B310	20-Nov-90			4	4									01-Sep-90
NAR	42	B310	20-Nov-90			5	5									01-Sep-90
SR	47	2008	24-May-90													01-Jul-91
SR	48	H330	04-Apr-91			2					All					11-Oct-90
SR	48	H330	04-Apr-91								All					11-Oct-90
SR	48	H330	04-Apr-91								All					11-Oct-90
SR	48	H330	04-Apr-91								All					11-Oct-90
SR	48	H330	04-Apr-91								All					11-Oct-90
NAR	50	1681	22-Jul-92													01-Jun-91
NAR	51	A310	07-Dec-90													23-Oct-90
WR	53	6048	21-Sep-92													19-Aug-92
WR	53	A310	29-Jul-91						All							01-Sep-90
NAR	54	1640	13-Nov-91													01-May-91
NAR	54	5007	04-Nov-92			5	5									01-Sep-92
NCR	55	3014	12-Jul-94													01-Jul-94
WR	56	2019	17-Jul-97													01-Jan-97
WR	56	6031	21-Jul-97													01-Jan-97
NAR	84	6804	24-Sep-92													01-Sep-91
NCR	90	6412	30-May-90													01-May-90
NCR	90	A330	19-Nov-93							All						14-Jul-93
NCR	90	A330	19-Jul-94							All						14-Jul-93

GLOSSARY

Acceleration Transducer (Accelerometer)	Sensor that measures the rate of change in vertical movement of a profile-measuring vehicle.
Accelerometer-Established Inertial Profiling Reference (AEIPR)	System of accelerometers, vertical displacement transducers, and distance-measuring instrument used to collect longitudinal profiles on pavement surfaces.
Analysis of Variance (ANOVA)	A procedure for dividing the total variation of a set of data into various components, including variation due to the error in selecting and testing specimens, within-sample variation, and inter-sample variation. Estimates of the different components of variation are then used to judge whether differences in sample means are statistically significant by comparing within- and between-sample variation.
Coefficient of Determination (r^2 or R^2)	The proportion of variability in the dependent variable that is accounted for or can be explained by the independent variables of a model. R^2 is used for models with multiple independent variables, while r^2 is for models with a single independent variable. For this analysis, poor, fair, good, and excellent ranges were set at < 50, 51-75, 76-95, and 96-100.
Coefficient of Variation (COV)	A measure of the dispersion of observed values equal to the standard deviation for the values divided by the average of the values. It may be expressed as a percentage of the average.
Construction Number	Incremented number (beginning with 1) assigned to each test section in the IMS database that is increased for each pavement rehabilitation event.
DataPave	Interactive software developed by the FHWA LTPP program to allow users to view, select, and extract data from the IMS database.
Degrees of Freedom (DF)	Degrees of freedom is generally defined as the number of values from a given set of data that can be assigned arbitrarily and still get the same value for each of one or more statistics calculated from the set of data.

Distance-Measuring Instrument (DMI)	Sensor mounted to a profile-measuring vehicle wheel that accurately measures the distance traveled by the vehicle.
Duncan's Multiple-Range Test	A multiple-comparison procedure developed in 1955 by D.B. Duncan for obtaining all pairwise comparisons among a given number of sample means.
F-test	A statistical test used to verify a given research hypothesis (H_A) by trying to contradict another hypothesis, called the null hypothesis (H_0). The null hypothesis usually concerns whether the variance of a given data set is inconsistent relative to the variances of other data sets. The decision to accept or reject the null hypothesis or reject it in favor of the research hypothesis is based on a test statistic (i.e., F-test statistic). The F-test utilizes the F-test statistic (F-value), which is estimated as the ratio of the variance of the given dataset to the pooled variance of all other data sets (excluding the variance of the test data set). The calculated F-statistic is compared to a predetermined value. If the calculated F-statistic is greater than the predetermined values (lies in the upper tail of the F-distribution), the null hypothesis is rejected.
General Pavement Studies (GPS)	LTPP test sections established using existing pavements intended for early evaluation of available pavement designs and practices.
Information Management System (IMS)	An Oracle database established in 1989 for storage and retrieval of all critical information collected in the SHRP-LTPP program.
International Roughness Index (IRI)	A profile-based filter that simulates the response to pavement roughness of a "Golden Car" traveling at 80 km/h, measured in units of length/length (m/km).
Least-Square Means	The least-square means, or the population marginal means, are the value of class or subclass means that would be expected for a balanced experimental design involving the class variable with all covariates (continuous variables) at their mean value.

Level of Significance (p-value)	The upper limit for the probability of a decision being made that a hypothesis about the value of a parameter is false when, in fact, it is true. It may also be defined as the weight of the evidence for rejecting a given null hypothesis, given in terms of probability for a given statistical test.
Long Term Pavement Performance (LTPP)	A 20-year program, sponsored by the FHWA, intended to collect data on pavement performance, evaluate pavement design, and identify factors affecting pavement performance.
Mays Output (MO)	An estimate, based on AEIPR-measured profiles, of the mechanical filter-based pavement roughness index — Mays Ride Number.
Probability > F (Pr > F)	The significance probability value (calculated F-statistic) associated with the F-test and obtained from a given data set.
Profilometer	AEIPR manufactured by K.J. Law.
ProQual Software	Software used to provide quality control and data processing for LTPP profile data.
Regional Coordination Office Contractor (RCOC)	Contractor charged with collecting pavement performance data for the LTPP program. There are four contractors collecting data in the North Atlantic, North Central, Western, and Southern regions of the United States and Canada.
Root Mean Square Vertical Acceleration (RMSVA)	A profile-based measure of pavement roughness based on the rate of change in pavement surface elevation using data from selected intervals.
Slope Variance (SV)	A profile-based estimate of a mechanical-type pavement roughness statistic measured using a CHLOE Profilometer.
Special Pavement Studies (SPS)	LTPP test sections designed and constructed to evaluate specific pavement designs and materials in different climatic regions under varying traffic conditions.
Standard Deviation (SD)	The positive square root of variance.

Tukey Studentized Range Test	A multiple comparison procedure developed in 1953 by Tukey that makes use of the studentized range distribution when more than two sample means are being compared by comparing the largest and smallest sample means.
Variance	A measure of dispersion of a series of results around their own mean.
Vertical Displacement Transducer (VDT)	Optical, infrared, laser, ultrasonic, or mechanical sensor that measures the vertical distance from the accelerometer to the pavement surface.

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ADDENDUM — QUALITY REVIEW OF 1997-1999 PROFILE DATA

Introduction

An analysis of the variability of the 1989 through 1997 longitudinal profiles and IRI data in the LTPP database was completed in June 1999. Several problems related to the profile data collected prior to October 1997 were noted in the final report for this analysis. In January 1999, the LTPP program issued a revised *LTPP Manual for Profile Measurement* [3] that called for changes to profile data collection and processing procedures that should significantly reduce the possibility of repeating the problems noted in the June 1999 report. To ensure that data collected between October 1997 and January 1999 are of good quality, LTPP commissioned a follow-up review of the interim data. The results of this review are discussed in this addendum.

Methods for Review

Previous analysis has concluded that reviewing overlaid profiles from LTPP test sections reveals problem data much better than reviewing IRI data. Therefore, the LTPP longitudinal profile data was reviewed, in addition to a review of the IRI data. The primary method for profile review was a close visual evaluation of all newly collected profile data. A secondary method included the review of the IRI trends for each section, and the subsequent review of profiles from sections with any questionable trends.

Profile Data Review

To complete the profile data review, the Profile Viewer software was updated. This update included displaying both the left and right wheelpath profiles on one page, displaying the construction number and testing time for each run, and providing the capability of displaying an unlimited number of profile runs.

Profiles from the repeated runs of all test sections measured between 1997 and 1999 were plotted for evaluation of saturation spikes, lost lock, and shifted starts. The third runs from each date for all test sections were also overlaid and plotted to provide a review of shifted starts, miscalibrated DMI, and unreported rehabilitation. Each of the profile problems identified from the profiles is described in Appendix A of the June 1999 report.

In addition, jpg files of each of these profiles were generated, and the PV-2 interactive Web-based profile viewing software was developed for LTPP distribution. This software can be incorporated into a Web page, allowing the user to view all profiles in the LTPP database prior to September 1999.

IRI Review

Rapid changes in IRI over time are sometimes an indication of equipment problems, differences in testing location, and rehabilitation events. To identify these changes, the DataPave 2.0 (September 1999) software was modified to display and scroll through the average IRI values for

each test section in the LTPP program. Sections that displayed rapid IRI reductions greater than about 10 percent were identified, and the profiles from those test sections were printed out and reviewed closely.

Profile Review Results

As expected, several of the problems noted in the previous review were also found in the interim data. These included shifted starts and testing in an unknown location. Surprisingly, the T-6600 equipment in several regions continued to generate saturation spikes at event markers. Lost lock was not a problem with the T-6600 data. DMI miscalibration was not a major problem either. This is probably the result of the requirement in the *1997 Manual for Profile Measurement*[2] that an accurately measured 300-m section must be used to calibrate the DMI monthly. Results of the secondary review are listed in table 26 and summarized in Appendix M of this report.

Table 26. Results of the supplemental profile review.

Noted Items	North Atlantic		North Central		Southern		Western	
	690 DNC	T-6600	690 DNC	T-6600	690 DNC	T-6600	690 DNC	T-6600
Total Runs Reviewed	8,600	4,442	14,705	9,477	10,389	3,756	14,255	7,310
Spikes (2-5 mm), # runs	-	-	1	45	-	199	-	200
Spikes (> 5 mm), # runs	8	-	5	65	6	279	8	62
Lost Lock, # runs	80		-		17		6	
Wrong Location, # runs	10	5	50	18	10	30	5	-
Zero IRI, # runs	-	1	-	-	-	-	-	15
GPS Start > 1 m		-		2		54		22
SPS Start > 2 m		5		2		175		952
Start 5-10 m	5		30		-		608	
Start > 10 m	12		2		-		316	
Maintenance, # visits		-		9		15		1
Rehabilitation, # visits		15		55		15		24
Variable 5-10 mm		96		11		115		11
Variable > 10 mm		157		31		273		34

Saturation Spikes

Several saturation spikes are still evident in the T-6600 profile data, particularly in data collected using the Southern and Western Region Profilometers. All of these spikes were noted at the beginning or ending stripe of a test section. New asphalt sections marked with reflective tape or fresh paint generated the greatest frequency of saturation spikes.

Saturation spikes noted in the Southern Region data most commonly occurred in January, February, and November 1997 and January 1998. The average spike amplitude was 9 mm, and the maximum was 27 mm. Spikes in the Western Region typically occurred in April and November 1998. They averaged 17 mm in height, with a maximum amplitude of 135 mm.

Saturation spikes in the North Central Region occurred in the right wheelpath in late 1997 and early 1998 on new AC pavements with fresh paint markings. Repair of the right sensor for this profiler reduced the presence and amplitude of the spikes dramatically.

Previous analysis (see figure 33) indicated that saturation spikes of 5 mm or less in amplitude have little effect. A 5-mm spike changes the IRI, RMSVA 4, RMSVA 16, Mays Output, and slope variance about 1.3, 0.3, 2.0, 0.5, and 2.0 percent, respectively. Therefore, only saturation spikes that were greater than 5 mm in amplitude were reprocessed and provided to RCOC's for replacement of profile data in the IMS database. This resulted in reprocessing and replacement of 433 profile runs for all regions (1.7 percent of the T-6600 data).

Lost Lock

Lost lock was evident on only 103 690DNC profile runs. No lost lock was noted in the T-6600 profiles. In a few cases, the affected profiles were runs that were identified in the initial review and had not been eliminated from the database. Other runs became more evident as being lost lock with the inclusion of profiles from subsequent years. Lists of these runs have been provided to RCOC's for deletion or replacement.

Wrong Location

About 0.2 percent of the database (128 runs) were shifted by such a large magnitude that they could not be identified as the section in question. These profiles were listed as having been collected in the wrong location. Regional contractors have been asked to review, delete, or replace these profiles.

Zero IRI

For any pavement other than a smooth glass-like surface, the IRI value should be greater than zero. However, 16 LTPP profile runs contain an IRI value of zero. This is probably because the IRI values were computed using a field computer and were not recomputed using an office computer during the final review. Without the second computation, the IRI values are not included in the final RIMS upload file, resulting in zero values in the database. These runs will be extracted and reprocessed by the RCOC's for replacement into the IMS before September 2000.

Shifted Start

Different regions showed markedly different amounts of shifted profiles. As noted in the previous review of the 690DNC profiles, there are a large number of Western Region profiles that did not begin collection at the same location. This was attributed to the problems experienced with the DMI for that region's Profilometer. A different type of problem is generally noted in the supplemental review of the Western Region's T-6600 profile start locations. Typically, the five runs collected on the same date were initiated at the same location. However, there were also many shifted starts for the Western Region T-6600 profiles from

October 1996 through December 1998. The average shift was about 9 m, and the maximum was 37 m.

The Southern Region also had several shifted starts in the T-6600 profile data, with an average shift of 8 m. The number of shifted starts in the Southern Region profiles decreased after October 1997, possibly due to a change in quality control procedures.

The RCOC's were asked during the previous profile data review to delete and replace all 690DNC profiles that were shifted more than 10 m. When the runs were shifted from 5 to 10 m, the RCOC's were asked to replace the profiles with data from the correct location. If replacement data were not available, the DATS contractor extracted these profiles and inserted a comment listing the approximate start offset. For this supplemental review, the RCOC's were asked to replace or delete any remaining 690DNC profiles that were shifted more than 10 m. This amounts to about 330 profile runs, or 0.7 percent of the 690DNC profiles.

For the supplemental review, tighter requirements were used for the allowable shifted start distance. These requirements were based on the limits currently used by the North Central Region Profilometer operators that require that GPS profiles shifted more than 1 m from the correct start location be resubsectioned or replaced. They require that SPS profiles that were shifted more than 2 m from the correct start location be resubsectioned or replaced. Based on these supplemental review limits, the RCOC's were asked to resection and replace all SPS profiles collected using the T-6600 that were shifted more than 2 m from the true start location. They were asked to reprocess, replace, or insert comments for GPS profiles that were shifted more than 1 m from the true start location. About 1,212 profile runs (4.9 percent of the T-6600 profile data) will be reviewed and replaced, if possible.

Variable Profiles

Variable T-6600 profiles of any magnitude were only noted in the Southern and North Atlantic Region profiles. This variation was measured as the maximum difference between the elevations of the five repeat runs on a section. Instances of variability of more than 5 mm were identified. Variable profiles are most commonly found in the North Atlantic data prior to August 1998, while the variability of profiles in the Southern Region is consistent from August 1996 through June 1999. The average variations for the North Atlantic and Southern Region variable profiles were 16 and 21 mm, up to 60 and 170 mm, respectively. About 1.5 percent (145 visits) of the T-6600 profile data displayed variability greater than 5 mm.

Typically, this problem appeared to be associated with accelerometer limits being exceeded as a result of a sudden jolt or insufficient time for the sensors to settle prior to collection. However, the Southern Region may have sensor problems that require repair prior to further data collection. No action will be required to modify the data, but repairs to these profilers are scheduled for April 2000.

Unreported Maintenance

Although unrelated to profile data quality, there are several profiles that indicate the occurrence of maintenance activities. RCOC's have been asked to confirm that the information is either in IMS or that the data have been requested from the State agencies.

Unreported Rehabilitation

Rehabilitation is also unrelated to profile data quality. However, profile review provides the opportunity to document the possible occurrence of rehabilitation and the lack of construction event information. RCOC's were asked to review the profiles and search their records to ensure that rehabilitation had indeed occurred and that data had been requested from the State agencies.

Summary

A supplemental review of LTPP profile data loaded in the database between October 7, 1997, and September 15, 1999, has been completed. This review identified reparable, irreparable, and potentially reparable problems. Reparable problems included:

- Saturation spikes: Noted in 1.6 percent (406 runs) of the T-6600 profiles and 0.06 percent (27 runs) of the 690DNC profiles.

- Incomplete IRI computation: Noted in 0.06 percent (16 runs) of the T-6600 profiles.

Saturation spikes have been reprocessed and distributed to regional contractors for replacement of data in the IMS. Profiles with incomplete IRI computations have been listed and forwarded to RCOC's for reprocessing and reloading of the data.

Irreparable problems included:

- Lost lock: Noted in 0.2 percent (103 runs) of the 690DNC data.

Lists of profiles exhibiting lost lock problems have been provided to RCOC's for deletion and possible replacement.

Potentially reparable problems included:

- Shifted starts: Found in 4.9 percent (1,212 runs) of T-6600 profiles and 0.7 percent (330 runs) of 690DNC data.

- Testing in an unknown location: Identified in 0.2 percent (130 runs) of the profile data.

Regional contractors have been notified of all profiles with shifted starts and testing in an unknown location and have been asked to reprocess and replace these profiles by August 18, 2000.

Recommendations

The interim profile data exhibited problems that were very similar to those found in the previous profile data, which indicates the importance of quality control for LTPP profile data collection. During the interim, a total of 1,689 runs (6.8 percent) collected using the T-6600 exhibited problems. In addition to the recommendations listed in the June 1999 report, this study reinforces the need for new quality control methods and tools that will improve LTPP profile data collection and processing:

- Immediate implementation of quality control (QC) processes and software for field collection and office review is critical.

- Regional contractors must have the tools to conduct a complete QC review similar to the work completed in this study. This requires a significant upgrade to the ProQual software and possibly supplemental software tools (Web version of Profile Viewer, IMS data extraction, RIMS upload file checking tools). These tools must be fast and easy to use. If these tools could be modified to meet the needs of individual RCO profile operations, they would be even more effective and useful.

- More immediate and effective maintenance and repair by the Profilometer manufacturer is needed to reduce the variability between profiles from repeated runs. This may include remounting the sensor bar or reorienting the vertical height sensors.

APPENDIX M. RESULTS OF SUBSEQUENT DATA REVIEW

Table 27. Profile runs with saturation spikes (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Locn. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Whp. Spikes Run No.	Right Whp. Spikes Run No.	Equip. Spike Elev. (mm)
SR	1	0101	27-Jan-98		All				All				All	5
SR	1	0102	27-Jan-98		All				All				All	6
SR	1	0103	27-Jan-98		All				All				All	5
SR	1	0104	27-Jan-98		All								All	6
SR	1	0104	07-Dec-98		All								All	7
SR	1	0105	27-Jan-98		All								All	5
SR	1	0106	27-Jan-98		All								All	6
SR	1	0107	27-Jan-98		All								All	6
SR	1	0108	27-Jan-98		All								All	5
SR	1	0109	27-Jan-98		All								All	5
SR	1	0110	27-Jan-98		All								All	6
SR	1	0111	27-Jan-98		All								All	5
SR	1	0161	27-Jan-98		All				All				All	5
SR	1	0162	27-Jan-98		All								All	5
SR	1	0163	27-Jan-98		All								All	5
SR	1	1001	27-Jan-98		All								All	6
WR	4	0114	14-Jan-98		All								All	5
WR	4	0114	07-Apr-98		All								All	5
WR	4	0114	08-Apr-98		All				All				All	5
WR	4	0114	08-Jul-98		All								All	5
WR	4	0121	08-Apr-98		All				All				All	5
WR	4	0121	04-Dec-98		All				All				All	4
WR	4	0124	08-Apr-98		All								All	5
WR	4	0161	08-Apr-98		All				All				All	5
WR	4	0161	04-Dec-98		All				All				All	3
WR	4	0665	17-Apr-98		All				All				All	4
WR	4	0668	17-Apr-98		All				All				All	4
WR	4	0669	17-Apr-98		All				All				All	3
WR	4	0902	08-Apr-98		All								All	5
WR	4	1003	04-Dec-97		All								All	7
WR	4	1003	08-Dec-98		All								All	5
WR	4	1024	14-Jan-98		All								All	5
WR	4	1024	14-Apr-98		All								All	6
WR	4	1024	08-Jul-98		All								All	7
WR	4	1037	15-Apr-98		All								All	8
WR	4	6060	17-Dec-97		All								All	7
SR	5	0901	05-Feb-97		All							All	All	12
SR	5	0902	05-Feb-97		All							All	All	10
SR	5	0903	05-Feb-97		All							All		13
SR	5	0960	05-Feb-97		All							All	All	12
SR	5	A430	09-Feb-97		All				2			All	All	7
SR	5	A603	05-Feb-97		All							All	All	17
SR	5	A604	05-Feb-97		All							All	All	12
SR	5	A606	05-Feb-97		All							All	All	15
SR	5	A607	05-Feb-97		All							All	All	10
SR	5	A608	05-Feb-97		All							All	All	13
WR	8	A320	18-Sep-97		All								All	7
SR	12	0101	27-Jan-97		All							All		6
SR	12	0102	27-Jan-97		All							All		7
SR	12	0103	27-Jan-97		All							All		7
SR	12	0104	27-Jan-97		All							All		7
SR	12	0105	27-Jan-97		All							All		5
SR	12	0106	27-Jan-97		All							All		6
SR	12	0107	27-Jan-97		All							All		6
SR	12	0108	27-Jan-97		All							All		8
SR	12	0109	27-Jan-97		All							All		7
SR	12	0110	27-Jan-97		All							All		6
SR	12	0111	27-Jan-97		All							All		6

Table 27. Profile runs with saturation spikes (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Locn. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Whp. Spikes Run No.	Right Whp. Spikes Run No.	Equip. Spike Elev. (mm)
SR	12	0112	27-Jan-97		All							All		6
SR	12	0161	27-Jan-97		All							All		6
SR	12	0902	23-Jan-97		All							All		7
SR	12	1030	14-Sep-97		All								All	7
SR	12	4107	23-Jun-92		3							3		23
SR	13	1005	29-Jan-98		All								All	13
SR	13	1031	16-Oct-97		All							1	All	8
SR	13	1031	28-Jan-98		All								All	5
SR	13	1031	05-Aug-98		All								All	5
WR	16	6027	19-Jul-95		All							All		8
NCR	17	A340	17-May-97		All							All		20
NCR	20	6026	11-Mar-93		6							6		9
NCR	20	A410	10-Mar-93		2							2		6
SR	22	0113	17-Nov-97		All							All	All	15
SR	22	0114	17-Nov-97		All								All	9
SR	22	0117	17-Nov-97		All								All	8
NAR	24	A340	05-Dec-90		1							1		10
NCR	26	0218	11-Aug-95		1							1		5
NCR	26	A350	14-Sep-95		7							7		8
SR	28	3099	30-Jul-98		All								All	5
SR	28	3099	12-Apr-99		All								All	5
NCR	29	B430	05-Mar-93		9								9	18
WR	30	0114	19-Nov-98		All				1				All	12
WR	30	0115	19-Nov-98		All								All	13
WR	30	0116	19-Nov-98		All								All	15
WR	30	0122	19-Nov-98		All				1				All	15
NCR	31	0904	18-Feb-97		1				1			1		20
WR	32	A330	24-Apr-97		2							2		90
WR	32	A330	24-Apr-97		2							2		135
SR	35	0502	09-Mar-97		1				1			1		5
SR	35	0502	09-Mar-97		3							3		7
SR	35	0503	09-Mar-97		All							All	7	5
SR	35	0506	09-Mar-97		All							All		5
SR	35	0507	09-Mar-97		8				8			8		5
SR	35	0508	09-Mar-97		1				1			1		5
SR	35	0508	09-Mar-97		2							2		5
SR	35	0901	09-Mar-97		All							All		5
SR	35	0902	09-Mar-97		7							7		7
SR	35	1005	21-May-97		All							All		12
SR	35	1022	21-May-97		All							All	All	8
SR	35	1022	09-Mar-99		All							All	2	5
SR	35	1112	15-Jan-97		All							All		5
SR	35	2007	21-May-97		All							All		14
SR	35	6035	20-May-97		All							All	All	18
NAR	37	1802	05-Feb-90		2							2		6
SR	40	0113	19-Nov-97		All								All	5
SR	40	0116	19-Nov-97		All								All	5
SR	40	0117	19-Nov-97		All								All	7
SR	40	0118	19-Nov-97		All								All	5
SR	40	0119	19-Nov-97		All								All	9
SR	40	0120	19-Nov-97		All								All	10
SR	40	0122	19-Nov-97		All								All	8
SR	40	0124	19-Nov-97		1								1	15
SR	40	0124	19-Nov-97		2								2	14
SR	40	0502	14-Jan-98		All								All	5
SR	40	0509	14-Jan-98		All								All	5
SR	40	0560	14-Jan-98		All								All	18
WR	41	6011	07-May-98		All								All	7
NAR	42	5020	02-Dec-89		3							3		7
NAR	42	1597	24-May-90		All							All		60
SR	47	0604	30-Jan-97		6							6	6	10

Table 27. Profile runs with saturation spikes (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Locn. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Whp. Spikes Run No.	Right Whp. Spikes Run No.	Equip. Spike Elev. (mm)
SR	47	0606	30-Jan-97		All							All	All	11
SR	47	0607	30-Jan-97		1							1		11
SR	47	0608	30-Jan-97		All							All		9
SR	47	0661	30-Jan-97		All							All	All	11
SR	48	1130	30-Jan-95		All							All		20
SR	48	0801	17-Jan-97		All							All	All	7
SR	48	0901	30-Dec-96		All							All	All	5
SR	48	A504	03-Jun-97		All							All		17
SR	48	A505	03-Jun-97		2							2		19
SR	48	A506	03-Jun-97		All							All		17
SR	48	A507	03-Jun-97		All							All		27
SR	48	A508	03-Jun-97		2							2		7
SR	48	A509	03-Jun-97		2							2		14
SR	48	M330	20-Mar-97		All							All	All	9
SR	48	M340	20-Mar-97		All							All	All	5
SR	48	M350	20-Mar-97		All							All	All	20
WR	53	7322	07-Oct-97		All								All	5
WR	53	0801	07-Oct-97		All								All	10
NCR	55	0113	01-Dec-97		All								All	11
NCR	55	0114	01-Dec-97		All								All	12
NCR	55	0115	01-Dec-97		All								All	12
NCR	55	0116	01-Dec-97		All								All	10
NCR	55	0117	01-Dec-97		All								All	13
NCR	55	0118	01-Dec-97		All								All	9
NCR	55	0119	01-Dec-97		All								All	11
NCR	55	0120	01-Dec-97		All								All	6
NCR	55	0121	01-Dec-97		All								All	12
NCR	55	0122	01-Dec-97		All								All	12
NCR	55	0123	01-Dec-97		All								All	13
NCR	55	0124	01-Dec-97		2								2	5
NCR	55	0806	01-Dec-97		All								All	11
WR	56	2037	24-Jun-89		1								1	45
WR	56	2037	24-Jun-89		4								4	45
WR	56	2037	24-Jun-89		5								5	45

Table 28. Profile runs with lost lock (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Left Whp Lost Lock Run No.	Right Whp Lost Lock Run No.
NAR	10	0101	05-Dec-96			All							All
NAR	10	0102	05-Dec-96			All							All
NAR	10	0103	05-Dec-96			All							All
NAR	10	0104	05-Dec-96			All							All
NAR	10	0105	05-Dec-96			All							All
NAR	10	0106	05-Dec-96			All							All
NAR	10	0107	05-Dec-96			All							All
NAR	10	0108	05-Dec-96			All							All
NAR	10	0109	05-Dec-96			All							All
NAR	10	0110	05-Dec-96			All							All
NAR	10	0111	05-Dec-96			All							All
NAR	10	0112	05-Dec-96			All							All
NAR	10	0159	05-Dec-96			All							All
NCR	20	1009	23-Apr-96			1					01-Jan-96	1	1
NAR	37	5827	06-Nov-90			All						All	
SR	48	1183	17-Apr-94			All						All	All
SR	48	E330	18-Apr-94			All						All	All
SR	48	E340	18-Apr-94			All						All	All
SR	48	H320	18-Nov-96			2							2
SR	48	H320	18-Nov-96			5							5
WR	53	7322	19-Aug-94			3							3
NAR	54	4004	16-Nov-89			All						All	
WR	56	6032	20-Jul-95			All						All	
NAR	89	1021	30-Apr-90			All						All	

Table 29. Profile runs with shifted start locations (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	IMS Spike Run No.	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Shifted Start Offset (m)
SR	1	0101	27-Jan-98			All				All			3
SR	1	0102	27-Jan-98			All				All			3
SR	1	0103	27-Jan-98			All				All			3
SR	1	0161	27-Jan-98			All				All			4
WR	4	0113	08-Apr-98							All			4
WR	4	0113	04-Dec-98							All			4
WR	4	0114	08-Apr-98			All				All			3
WR	4	0114	04-Dec-98							All			3
WR	4	0116	23-Jan-97							All			3
WR	4	0118	23-Jan-97							All			3
WR	4	0121	08-Apr-98			All				All			3
WR	4	0121	04-Dec-98			All				All			3
WR	4	0122	08-Apr-98							All			4
WR	4	0122	04-Dec-98							All			4
WR	4	0161	08-Apr-98			All				All			3
WR	4	0161	04-Dec-98			All				All			3
WR	4	0162	08-Apr-98							All			3
WR	4	0162	04-Dec-98							All			3
WR	4	0260	27-Jan-97							All			5
WR	4	0260	04-Dec-97							All			5
WR	4	0260	08-Dec-98							All			5
WR	4	0264	27-Jan-97							1			6
WR	4	0266	27-Jan-97							All			6
WR	4	0501	15-Jan-92							All			12
WR	4	0502	05-Feb-90							All			11
WR	4	0502	15-Jan-92							All			9
WR	4	0502	03-Feb-97							All			5
WR	4	0502	09-Dec-97							All			8
WR	4	0502	11-Dec-98							All			4
WR	4	0505	21-Sep-90							All			11
WR	4	0505	15-Jan-92							All			29
WR	4	0505	22-Feb-93							All			11
WR	4	0505	03-Feb-97							All			4
WR	4	0505	11-Dec-98							All			12
WR	4	0506	21-Sep-90							All			11
WR	4	0506	15-Jan-92							All			26
WR	4	0506	22-Feb-93							All			11
WR	4	0506	03-Feb-97							All			4
WR	4	0506	11-Dec-98							All			10
WR	4	0508	15-Jan-92							All			12
WR	4	0508	11-Dec-98							All			5
WR	4	0509	21-Sep-90							All			6
WR	4	0509	15-Jan-92							All			13
WR	4	0509	22-Feb-93							All			6
WR	4	0509	03-Feb-97							All			4
WR	4	0509	11-Dec-98							All			7
WR	4	0559	21-Sep-90							All		01-Sep-90	11
WR	4	0559	15-Jan-92							1			29
WR	4	0559	22-Feb-93							All			11
WR	4	0559	03-Feb-97							All			7
WR	4	0559	11-Dec-98							All			13
WR	4	0560	21-Sep-90							All			12
WR	4	0560	15-Jan-92							All			31
WR	4	0560	22-Feb-93							All			12
WR	4	0560	03-Feb-97							All			5
WR	4	0560	11-Dec-98							All			20
WR	4	0604	17-Apr-98							All			3
WR	4	0664	17-Apr-98							All			3
WR	4	0665	17-Apr-98			All				All			5
WR	4	0666	17-Apr-98							All			4

Table 29. Profile runs with shifted start locations (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	IMS Spike Run No.	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Shifted Start Offset (m)
WR	4	0667	17-Apr-98							All			3
WR	4	0668	19-Feb-97							1			4
WR	4	0668	17-Apr-98			All				All			6
WR	4	0669	17-Apr-98			All				All			6
WR	4	A320	19-Feb-92							All			5
WR	4	A330	19-Feb-92							All			5
WR	4	A410	31-Jan-97							1			6
WR	4	A410	13-Jan-98							All			3
WR	4	A430	13-Jan-98							All			3
WR	4	A441	31-Jan-97							1			6
WR	4	A441	13-Jan-98							All			3
WR	4	A442	31-Jan-97							1			6
WR	4	A442	13-Jan-98							All			5
WR	4	A443	31-Jan-97							1			7
WR	4	A443	13-Jan-98							All			5
WR	4	A444	31-Jan-97							1			8
WR	4	A444	13-Jan-98							All			6
WR	4	A445	31-Jan-97							1			8
WR	4	A445	13-Jan-98							All			6
WR	4	A446	31-Jan-97							1			8
WR	4	A446	13-Jan-98							All			6
WR	4	A447	31-Jan-97							1			8
WR	4	A447	13-Jan-98							All			6
WR	4	A448	27-Feb-92							All			2
WR	4	A448	16-Feb-93							All			2
WR	4	A448	31-Jan-97							1			8
WR	4	A448	13-Jan-98							All			6
WR	4	A449	31-Jan-97							1			8
WR	4	A449	13-Jan-98							All			6
WR	4	A450	27-Feb-92							All			2
WR	4	A450	16-Feb-93							All			2
WR	4	A450	31-Jan-97							1			8
WR	4	A450	13-Jan-98							All			6
WR	4	A452	27-Feb-92							All			5
WR	4	A452	16-Feb-93							All			5
WR	4	A453	27-Feb-92							All			8
WR	4	A453	16-Feb-93							All			8
WR	4	A454	27-Feb-92							All			8
WR	4	A454	16-Feb-93							All			8
WR	4	A455	27-Feb-92							All			7
WR	4	A455	16-Feb-93							All			7
WR	4	A455	31-Jan-97							1			2
WR	4	A456	27-Feb-92							All			6
WR	4	A456	16-Feb-93							All			6
WR	4	A456	31-Jan-97							1			2
WR	4	A457	27-Feb-92							All			6
WR	4	A457	16-Feb-93							All			6
WR	4	A457	31-Jan-97							1			3
WR	4	A458	27-Feb-92							All			5
WR	4	A458	16-Feb-93							All			5
WR	4	A458	31-Jan-97							1			2
WR	4	A459	31-Jan-97							1			3
WR	4	A460	27-Feb-92							All			5
WR	4	A460	16-Feb-93							All			5
WR	4	A460	31-Jan-97							1			3
WR	4	A461	27-Feb-92							All			4
WR	4	A461	16-Feb-93							All			4
WR	4	A461	31-Jan-97							1			3
WR	4	A462	27-Feb-92							All			3
WR	4	A462	16-Feb-93							All			3

Table 29. Profile runs with shifted start locations (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	IMS Spike Run No.	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Shifted Start Offset (m)
WR	4	A462	31-Jan-97							1			3
WR	4	A462	13-Jan-98							All			3
WR	4	A901	08-Apr-98							All			3
WR	4	B901	29-Jan-97							All			11
WR	4	B901	05-Dec-97							All			7
WR	4	B902	29-Jan-97							All			6
WR	4	B902	05-Dec-97							All			6
WR	4	B903	29-Jan-97							All			5
WR	4	B903	05-Dec-97							All			6
WR	4	B961	29-Jan-97							All			7
WR	4	B963	02-Feb-97							All			7
WR	4	B963	05-Dec-97							All			3
WR	4	B964	05-Dec-97							All			20
SR	5	0213	06-Feb-97							1,4			3
SR	5	0216	06-Feb-97							1,4			3
SR	5	0217	06-Feb-97							1,4			3
SR	5	0218	06-Feb-97							1,4			2
SR	5	0219	06-Feb-97							1,4			2
SR	5	0220	06-Feb-97							1,4			3
SR	5	0221	06-Feb-97							1,4			3
SR	5	0222	06-Feb-97							1,4			2
SR	5	0224	06-Feb-97							1,4			3
SR	5	3071	10-Feb-97							All			2
SR	5	A430	09-Feb-97			All				2			1
WR	6	0505	27-Feb-97							All			26
WR	6	0505	11-Feb-98							All			26
WR	6	0505	05-Mar-99							All			30
WR	6	0506	27-Feb-97							All			5
WR	6	0506	11-Feb-98							All			6
WR	6	0507	27-Feb-97							All			6
WR	6	0507	11-Feb-98							All			6
WR	6	0508	27-Feb-97							All			8
WR	6	0508	11-Feb-98							All			7
WR	6	0509	27-Feb-97							All			8
WR	6	0509	11-Feb-98							All			7
WR	6	0559	27-Feb-97							All			20
WR	6	0559	11-Feb-98							All			14
WR	6	0560	27-Feb-97							All			10
WR	6	0561	27-Feb-97							All			11
WR	6	0561	11-Feb-98							All			8
WR	6	0562	27-Feb-97							All			12
WR	6	0562	11-Feb-98							All			8
WR	6	0563	27-Feb-97							All			12
WR	6	0563	11-Feb-98							All			11
WR	6	0564	27-Feb-97							All			13
WR	6	0564	11-Feb-98							All			9
WR	6	0565	27-Feb-97							All			17
WR	6	0565	11-Feb-98							All			11
WR	6	0566	27-Feb-97							All			19
WR	6	0566	11-Feb-98							All			12
WR	6	0567	27-Feb-97							All			19
WR	6	0567	11-Feb-98							All			11
WR	6	0568	27-Feb-97							All			19
WR	6	0568	11-Feb-98							All			12
WR	6	0569	27-Feb-97							All			6
WR	6	0569	11-Feb-98							All			6
WR	6	0570	27-Feb-97							All			6
WR	6	0570	11-Feb-98							All			5
WR	6	0571	27-Feb-97							All			6
WR	6	0571	11-Feb-98							All			5

Table 29. Profile runs with shifted start locations (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	IMS Spike Run No.	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Shifted Start Offset (m)
WR	6	0602	11-May-91							All			5
WR	6	0602	14-Apr-92							All			9
WR	6	0603	11-May-91							All			14
WR	6	0604	11-May-91							All			17
WR	6	0605	11-May-91							All			10
WR	6	0606	11-May-91							All			15
WR	6	0607	11-May-91							All			14
WR	6	0607	06-May-98							All			7
WR	6	0608	11-May-91							All			10
WR	6	0608	06-May-98							All			5
WR	6	0662	11-May-91							All			12
WR	6	0662	14-Apr-92							All			6
WR	6	0662	06-May-98							All			3
WR	6	0664	11-May-91							All			16
WR	6	0664	09-Jun-94							All			15
WR	6	0664	06-May-98							All			4
WR	6	2041	13-Dec-89							All			7
WR	6	2041	11-Feb-91							All			7
WR	6	3005	06-May-98							All			4
WR	6	A411	20-Sep-90							All			5
WR	6	A411	12-Mar-91							All			6
WR	6	A411	02-Mar-93							All			11
WR	6	A412	20-Sep-90							All			5
WR	6	A412	12-Mar-91							All			6
WR	6	A412	02-Mar-93							All			11
WR	6	A421	20-Sep-90							All			28
WR	6	A421	12-Mar-91							All			9
WR	6	A421	29-Feb-92							All			25
WR	6	A421	10-Apr-95							All			7
WR	6	A421	24-Feb-97							All			7
WR	6	A422	20-Sep-90							All			22
WR	6	A422	12-Mar-91							All			12
WR	6	A422	29-Feb-92							All			18
WR	6	A422	24-Feb-97							All			7
WR	6	A422	16-Feb-98							All			13
WR	6	A423	20-Sep-90							All			11
WR	6	A423	12-Mar-91							All			8
WR	6	A423	29-Feb-92							All			8
WR	6	A423	24-Feb-97							All			7
WR	6	A423	16-Feb-98							All			23
WR	6	A441	20-Sep-90							All			16
WR	6	A441	12-Mar-91							All			8
WR	6	A441	29-Feb-92							All			13
WR	6	A441	24-Feb-97							All			3
WR	6	A441	16-Feb-98							All			22
WR	6	A442	20-Sep-90							All			16
WR	6	A442	29-Feb-92							All			11
WR	6	A442	24-Feb-97							All			6
WR	6	A442	16-Feb-98							All			14
WR	6	A443	20-Sep-90							All			9
WR	6	A443	12-Mar-91							All			20
WR	6	A443	16-Feb-98							All			22
WR	6	B413	02-May-91							All			5
WR	6	B423	02-May-91							All			5
WR	6	B443	11-Apr-97							All			3
WR	6	B451	02-May-91							All			6
WR	6	B452	02-May-91							All			6
WR	8	7035	19-Nov-91							1			10
WR	8	7035	19-Nov-91							5			10
WR	8	7035	19-Nov-91							7			10

Table 29. Profile runs with shifted start locations (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	IMS Spike Run No.	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Shifted Start Offset (m)
WR	8	9019	19-Nov-91							All			5
WR	8	0501	28-May-91							All			10
WR	8	0501	13-Nov-91							All			10
WR	8	0506	28-May-91							All			10
WR	8	0506	13-Nov-91							All			10
WR	8	0507	28-May-91							All			10
WR	8	0507	13-Nov-91							All			10
WR	8	0509	28-May-91							All			10
WR	8	0560	28-May-91							All			8
WR	8	7036	19-Nov-91							All			8
WR	8	7776	19-Nov-91							All			6
WR	8	7780	20-Nov-91							All			5
WR	8	A310	29-Aug-90							All			30
SR	12	0110	15-Sep-97							All			2
SR	12	0110	05-Feb-98							All			3
SR	13	0562	27-Apr-99							All			4
SR	13	0563	27-Apr-99							All			4
SR	13	0564	27-Apr-99							All			4
SR	13	0565	08-May-96							All			4
SR	13	0566	27-Apr-99							All			4
WR	16	3023	17-Oct-89							All			5
WR	16	3023	20-Apr-93							All			5
WR	16	1005	21-Apr-93							All			5
WR	16	1021	23-Jul-97							1,2			4
WR	16	1021	14-Jun-98							All			4
WR	16	A310	01-Oct-90							All			5
WR	16	A310	16-Jun-98							All			4
WR	16	B310	21-Sep-91							All			8
WR	16	B310	23-Jul-97							1,2			8
WR	16	B310	14-Jun-98							All			3
WR	16	B330	23-Jul-97							1,2			4
WR	16	B350	20-Sep-91							All			17
WR	16	B350	23-Jul-97							1,2			11
WR	16	B350	14-Jun-98							All			6
WR	16	C310	20-Jul-90							All			6
WR	16	C310	05-Oct-90							All			6
WR	16	C310	15-Dec-96							All			5
WR	16	C330	15-Dec-96							All			4
WR	16	C350	20-Jul-90							All			7
WR	16	C350	05-Oct-90							All			7
WR	16	C350	15-Dec-96							All			5
NCR	18	1028	02-Dec-89							3			9
NCR	18	2009	31-May-91							All			22
NCR	18	3031	03-Dec-89							All			9
NCR	18	0670	04-Apr-90							3			15
NCR	19	0659	01-Nov-93							All			15
NCR	19	0701	30-Nov-93							All			15
NAR	24	0506	25-Jun-94		2,3,4					All			5
NAR	24	0507	24-Jan-92		2,3,4					All			17
NAR	24	0559	05-Nov-90		2,3,4					All			3
NAR	24	A340	25-Jun-92							3			12
NAR	24	A340	25-Jun-92		2,3,4					5			12
NAR	24	A340	25-Jun-92		2,3,4					6			12
NAR	24	A350	25-Jun-92		2,3,4					All			12
SR	28	3093	24-Sep-98							All			3
SR	28	A330	27-Jan-98							All			2
WR	30	0114	19-Nov-98			All				1			1
WR	30	0122	19-Nov-98			All				1			1
WR	30	0502	03-May-90							All			5
WR	30	0502	09-Nov-91							All			7

Table 29. Profile runs with shifted start locations (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	IMS Spike Run No.	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Shifted Start Offset (m)
WR	30	0502	26-Aug-92							All			6
WR	30	0506	25-May-91							All			6
WR	30	0508	03-May-90							All			5
WR	30	0508	09-Nov-91							All			7
WR	30	0508	26-Aug-92							All			5
WR	30	0560	09-Nov-91							All			6
WR	30	0560	26-Aug-92							All			5
WR	30	0561	03-May-90							All			7
WR	30	7076	25-May-91							All			5
NCR	31	0902	18-Feb-97							1			9
NCR	31	0904	18-Feb-97			1				1			6
WR	32	0102	22-Apr-97							All			5
WR	32	0105	22-Apr-97							All			5
WR	32	0107	22-Apr-97							All			4
WR	32	0108	22-Apr-97							All			3
WR	32	0111	22-Apr-97							All			5
WR	32	0112	22-Apr-97							All			4
WR	32	0203	22-Apr-97							All			3
WR	32	0204	28-Jun-96							All			5
WR	32	0204	22-Apr-97							All			6
WR	32	0207	22-Apr-97							All			4
WR	32	0208	22-Apr-97							All			4
WR	32	0209	22-Apr-97							All			3
WR	32	0210	22-Apr-97							All			6
WR	32	0211	22-Apr-97							All			6
WR	32	A453	07-Dec-93							All			5
WR	32	A455	07-Dec-93							All			8
WR	32	A456	07-Dec-93							All			8
WR	32	A457	07-Dec-93							All			8
WR	32	A457	18-Nov-97							All			12
WR	32	A457	27-Aug-98							All			11
WR	32	A458	07-Dec-93							All			9
WR	32	A459	07-Dec-93							All			11
WR	32	A460	07-Dec-93							All			11
WR	32	A461	07-Dec-93							All			13
WR	32	A462	07-Dec-93							All			13
WR	32	A463	07-Dec-93							All			14
WR	32	A464	07-Dec-93							All			13
SR	35	0502	09-Mar-97			1				1			3
SR	35	0507	09-Mar-97			8				8			2
SR	35	0508	09-Mar-97			1				1			2
NAR	37	0965	14-May-98							All			3
NCR	39	0204	15-Aug-96							1			15
NCR	39	0208	14-Aug-96							1,3,4,6			12
NCR	39	0265	14-Aug-96							All			3
NCR	46	6600	23-Jun-98							1			6
NCR	46	3013	03-May-97							2			17
NCR	46	3053	18-Nov-89							All			15
SR	48	0113	08-Sep-97							All			15
SR	48	0114	08-Sep-97							All			23
SR	48	0116	08-Sep-97							All			2
SR	48	0117	08-Sep-97							All			12
SR	48	0118	08-Sep-97							All			13
SR	48	0119	08-Sep-97							All			30
SR	48	0119	02-Apr-98							1			2
SR	48	0120	08-Sep-97							All			29
SR	48	0120	02-Apr-98							1			2
SR	48	0121	08-Sep-97							All			25
SR	48	0121	02-Apr-98							1			2
SR	48	0122	08-Sep-97							All			10

Table 29. Profile runs with shifted start locations (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	IMS Spike Run No.	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Shifted Start Offset (m)
SR	48	0123	08-Sep-97							All			6
SR	48	0124	08-Sep-97							All			5
SR	48	0160	08-Sep-97							All			40
SR	48	0160	02-Apr-98							1			2
SR	48	0161	08-Sep-97							All			37
SR	48	0161	02-Apr-98							1			2
SR	48	0162	08-Sep-97							All			33
SR	48	0162	02-Apr-98							1			2
SR	48	0163	08-Sep-97							All			32
SR	48	0163	02-Apr-98							1			2
SR	48	0164	08-Sep-97							All			19
SR	48	0165	08-Sep-97							All			18
SR	48	0166	08-Sep-97							All			40
SR	48	0166	02-Apr-98							1			3
SR	48	0167	08-Sep-97							All			22
SR	48	0167	02-Apr-98							1			2
SR	48	1174	09-Apr-98							All			2
SR	48	3010	27-Mar-98							All			2
SR	48	3559	26-Mar-98							All			3
SR	48	3699	29-Mar-98							All			3
SR	48	3719	26-Mar-98							All			3
SR	48	4146	27-Mar-98							All			3
SR	48	4152	10-Jun-97							1			3
SR	48	4152	10-Jun-97							4			3
SR	48	4152	10-Jun-97							6			3
SR	48	4152	10-Jun-97							9			3
SR	48	5026	27-Mar-98							All			3
SR	48	5154	30-Mar-98							All			3
SR	48	D420	10-Jun-97							3			2
SR	48	D430	10-Jun-97							3			3
SR	48	I310	26-Mar-98							All			6
SR	48	I320	26-Mar-98							All			9
SR	48	I330	26-Mar-98							All			10
SR	48	I340	26-Mar-98							All			13
SR	48	I350	26-Mar-98							All			17
WR	49	1004	29-Jun-90							All			5
WR	49	A310	29-Jun-90							All			5
WR	49	A351	29-Jun-90							All			7
WR	49	A352	29-Jun-90							All			7
WR	49	A361	29-Jun-90							All			8
WR	49	B310	02-Dec-98							All			6
WR	49	B330	02-Dec-98							All			4
WR	49	B331	25-Oct-91							All			6
WR	49	B350	25-Oct-91							All			6
WR	49	B350	02-Dec-98							All			5
WR	49	C310	01-Jul-90							All			5
WR	49	C331	01-Jul-90							All			10
WR	49	C331	13-Nov-97							All			3
WR	49	C350	01-Jul-90							All			6
WR	49	C351	01-Jul-90							All			6
WR	49	C352	01-Jul-90							All			12
WR	49	C361	01-Jul-90							All			15
WR	49	C361	13-Nov-97							All			3
WR	49	C410	18-Sep-91							All			10
WR	49	C410	21-Aug-98							All			10
WR	49	C430	18-Sep-91							All			11
WR	49	C430	21-Aug-98							All			15
WR	49	C431	18-Sep-91							All			18
WR	49	C431	03-Dec-93							All			5
WR	49	C431	21-Aug-98							All			18

Table 29. Profile runs with shifted start locations (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	IMS Spike Run No.	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Shifted Start Offset (m)
WR	49	C440	21-Aug-98							All			12
WR	49	C441	18-Sep-91							All			10
WR	49	C441	21-Aug-98							All			10
WR	49	C443	18-Sep-91							All			11
WR	49	C443	21-Aug-98							All			12
WR	49	C444	18-Sep-91							All			11
WR	49	C444	21-Aug-98							All			15
WR	49	C445	18-Sep-91							All			12
WR	49	C445	21-Aug-98							All			17
WR	49	C446	18-Sep-91							All			11
WR	49	C446	21-Aug-98							All			17
WR	49	C447	18-Sep-91							All			12
WR	49	C447	21-Aug-98							All			18
WR	49	C448	18-Sep-91							All			19
WR	49	C448	03-Dec-93							All			6
WR	49	C448	21-Aug-98							All			17
WR	49	C449	18-Sep-91							All			16
WR	49	C449	03-Dec-93							All			5
WR	49	C449	21-Aug-98							All			18
WR	49	C450	18-Sep-91							All			16
WR	49	C450	03-Dec-93							All			6
WR	49	C450	21-Aug-98							All			18
WR	49	C451	18-Sep-91							All			18
WR	49	C451	03-Dec-93							All			6
WR	49	C451	21-Aug-98							All			18
WR	49	C452	18-Sep-91							All			18
WR	49	C452	03-Dec-93							All			6
WR	49	C452	21-Aug-98							All			18
WR	49	C453	18-Sep-91							All			16
WR	49	C453	15-Nov-92							All			6
WR	49	C453	03-Dec-93							All			10
WR	49	C453	21-Aug-98							All			18
WR	49	C454	18-Sep-91							All			20
WR	49	C454	15-Nov-92							All			6
WR	49	C454	03-Dec-93							All			10
WR	49	C454	21-Aug-98							All			19
WR	49	C455	18-Sep-91							All			23
WR	49	C455	15-Nov-92							All			7
WR	49	C455	03-Dec-93							All			11
WR	49	C455	21-Aug-98							All			18
WR	49	C458	15-Nov-92							All			14
WR	49	D410	30-Jul-95							All			5
WR	49	D410	17-Nov-97							All			7
WR	49	D440	17-Nov-97							All			6
WR	49	D441	30-Jul-95							All			7
WR	49	D441	17-Nov-97							All			7
WR	49	D443	30-Jul-95							All			5
WR	49	D443	17-Nov-97							All			5
WR	49	D444	30-Jul-95							All			15
WR	49	D444	17-Nov-97							All			37
WR	49	D445	30-Jul-95							All			5
WR	49	D445	17-Nov-97							All			8
WR	49	D446	17-Nov-97							All			6
WR	49	D450	30-Jul-95							All			5
WR	49	D450	17-Nov-97							All			4
WR	49	D452	30-Jul-95							All			5
WR	49	D452	17-Nov-97							All			4
WR	49	D454	17-Nov-97							All			3
WR	49	D455	30-Jul-95							All			5
WR	49	D455	17-Nov-97							All			3

Table 29. Profile runs with shifted start locations (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	IMS Spike Run No.	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab	Estimated Shifted Start Offset (m)
WR	49	D456	17-Nov-97							All			10
WR	49	D458	17-Nov-97							All			10
WR	49	D461	17-Nov-97							All			6
WR	49	E445	24-Aug-98							All			3
WR	49	E446	24-Aug-98							All			3
WR	49	E456	15-Nov-97							All			3
WR	49	E456	24-Aug-98							All			3
WR	49	E458	24-Aug-98							All			5
WR	49	E461	24-Aug-98							All			3
WR	53	0201	06-Oct-97							All			3
WR	53	0204	06-Oct-97							All			3
WR	53	0206	06-Oct-97							All			3
WR	53	0208	06-Oct-97							All			3
WR	53	0209	06-Oct-97							All			3
WR	53	0212	06-Oct-97							All			3
WR	53	1007	20-Nov-90							All			5
WR	53	1801	08-May-98							All			3
NCR	55	3009	29-Sep-95							4			10
NCR	55	0901	18-Sep-95		3					All			20
NCR	55	0903	18-Sep-95		2,7					All			15
NCR	55	0907	18-Sep-95							2			40
NCR	55	0907	18-Sep-95							5,6			10
NCR	55	0909	18-Sep-95							All			20
NCR	55	A909	28-Jul-98							1			9
WR	56	7775	22-Sep-97							All			6
WR	56	B330	05-Aug-98							All			3
WR	81	1805	16-Jun-91							All			5
WR	81	0502	05-Jun-98							All			4
NCR	83	A350	27-Apr-95							All			16

Table 30. Profile runs tested in the wrong location (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	IMS Spike Run No.	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab
WR	8	0220	13-Apr-94					All				
SR	12	0901	23-Jan-97					All				
SR	12	0959	23-Jan-97					All				
SR	12	C320	04-Feb-98					All				
SR	12	C330	04-Feb-98					All				
NCR	19	0222	20-Sep-97					All				
NCR	21	A410	06-Nov-91					All				
NCR	21	A410	04-Feb-93					All				
NCR	21	A410	06-Apr-94					All				
NCR	21	A430	06-Nov-91					All				
NCR	21	A430	04-Feb-93					All				
NCR	21	A430	06-Apr-94					All				
NCR	26	0218	29-Dec-96					4				
NCR	26	0219	29-Dec-96					4				
NCR	26	0220	29-Dec-96					4				
NCR	26	0221	29-Dec-96					4				
NCR	26	0222	29-Dec-96					4				
NCR	26	0223	29-Dec-96					4				
NCR	26	0224	29-Dec-96					4				
NCR	26	0259	29-Dec-96					4				
SR	28	A320	09-Aug-90					All				
SR	28	A330	09-Aug-90					All				
NCR	31	0902	17-Apr-96					All				
NCR	31	0903	17-Apr-96					All				
NAR	37	0259	30-Mar-94					All				
NAR	37	0259	28-Feb-96					All				
NCR	38	3005	01-May-97					All				
NAR	42	7025	28-Oct-98					All				
NCR	46	3009	25-Jun-90					All				
SR	47	0602	30-Jan-96					Short				
SR	47	0605	30-Jan-96					Short				
NCR	90	6410	29-Aug-92					All				

Table 31. Profile runs with IRI values of zero (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab
NAR	37	0961	14-May-98					9			
WR	49	C352	17-Nov-97					All			
WR	49	C361	17-Nov-97					All			
WR	49	D460	17-Nov-97					All			

Table 32. Profile runs with unreported maintenance or rehabilitation (1997-1999).

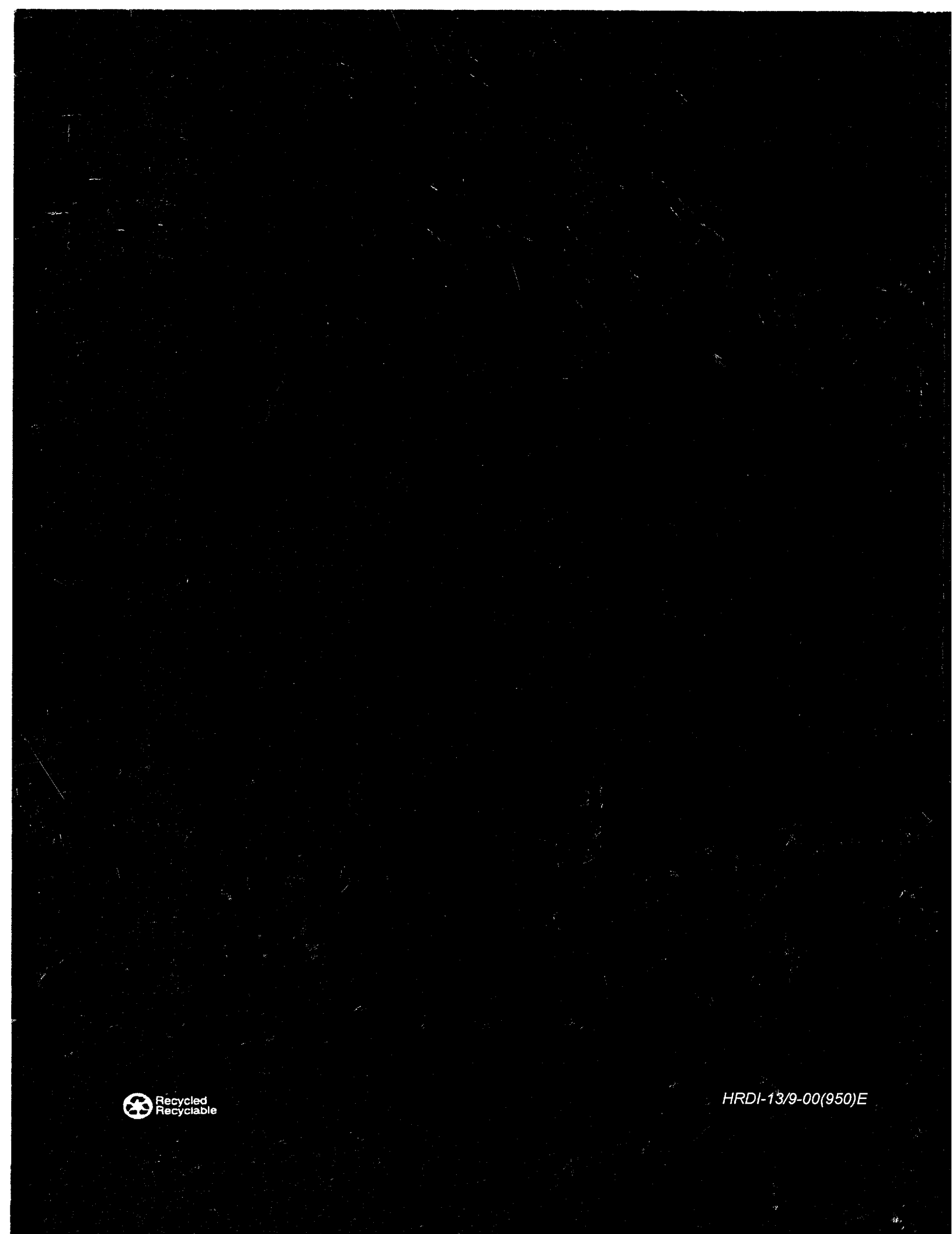
LTPP Region	State Code	SHRP ID	Profile Date	Test Time	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab
WR	16	1009	24-Oct-92							**01-Sep-92**	
NCR	18	0602	04-Apr-96							**01-Jan-96**	
NCR	18	0605	04-Apr-96							**01-Jan-96**	
NCR	27	1018	19-Jan-97							**01-Jan-97**	
NCR	38	2001	01-May-97							**01-Jan-97**	
NCR	46	3012	20-May-98							**01-Jan-98**	
SR	48	1077	06-Apr-98							**01-Jan-98**	
SR	48	1093	01-Jun-98							**01-Jan-98**	
SR	48	3669	25-Mar-98							**01-Mar-98**	
NCR	55	3014	12-Jul-94							**01-Jul-94**	
NCR	83	0501	26-Aug-92							**01-Jan-92**	
NCR	90	6410	30-May-90							**01-Jan-90**	
NCR	90	B340	28-Aug-98							**01-Jan-98**	
SR	1	4155	22-Apr-99								**01-Jan-98**
WR	4	1007	02-Feb-97								**01-Sep-96**
WR	4	1015	04-Feb-97								**01-Jan-97**
WR	4	1021	21-Feb-97								**13-Jun-96**
WR	4	0559	21-Sep-90						All		**01-Sep-90**
WR	4	1002	20-Feb-97								**13-May-96**
WR	4	1006	02-Mar-95								**01-Aug-92**
WR	4	1016	10-Dec-98								**01-Sep-98**
WR	4	1017	17-Dec-97								**01-Sep-97**
WR	4	1018	16-Dec-97								**01-Sep-96**
WR	4	1022	21-Feb-97								**13-Jun-96**
WR	4	1062	28-Apr-95								**NOT YET**
WR	4	6060	10-Dec-98								**01-Sep-98**
SR	5	2042	08-Sep-93								**01-May-94**
WR	6	2041	28-Mar-96								**01-Sep-95**
WR	6	7491	15-Apr-98								**01-Sep-97**
WR	8	1047	07-Nov-92								**01-Oct-92**
WR	8	1029	24-Oct-95								**01-Sep-94**
NAR	9	0901	28-Oct-97								**01-Jun-97**
NAR	9	0902	28-Oct-97								**01-Jun-97**
NAR	9	0903	28-Oct-97								**01-Jun-97**
NAR	9	0960	28-Oct-97								**01-Jun-97**
NAR	9	0961	28-Oct-97								**01-Jun-97**
NAR	9	0962	28-Oct-97								**01-Jun-97**
WR	16	1007	16-Jun-98								**01-May-98**
WR	16	5025	23-Sep-97								**01-Jun-96**
NCR	17	5423	25-Mar-99								**01-Jan-98**
NCR	17	5453	18-May-97								**01-Jan-97**
NCR	17	5854	14-Dec-98								**01-Jan-98**
NCR	18	2008	29-Mar-95								**01-Jan-95**
NCR	19	0601	10-Oct-98								**01-Jan-98**
NCR	19	0602	10-Oct-98								**01-Jan-98**
NCR	19	0605	10-Oct-98								**01-Jan-98**
NCR	19	6150	16-Jun-99								**01-May-99**
NCR	20	1006	23-Mar-99								**01-Jan-99**
NCR	20	1009	23-Apr-96			1					**01-Jan-96**

Table 32. Profile runs with unreported maintenance or rehabilitation (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab
NCR	20	6026	23-Apr-98								01-Jan-98
NCR	20	0106	21-Aug-98								25-Jul-96
NCR	20	0108	21-Aug-98								25-Jul-96
NAR	24	0502	10-Oct-96								01-Dec-96
NAR	24	5807	04-Apr-91								01-Jan-91
NCR	26	1012	05-Nov-98								01-Jan-97
NCR	26	0601	03-Nov-98								01-Oct-98
NCR	26	0602	03-Nov-98								01-Oct-98
NCR	27	1016	30-Sep-98								01-Jan-98
NCR	27	1018	17-Jul-97								01-Jan-97
NCR	27	1019	03-Aug-97								01-Jan-97
NCR	27	1028	10-Sep-97								01-Jan-97
NCR	27	1029	03-Aug-97								01-Jan-97
NCR	27	7090	04-Oct-98								01-Jan-97
NCR	27	9075	01-Aug-97								01-Jan-97
NCR	27	A310	30-Sep-98								01-Jan-98
NCR	27	A320	30-Sep-98								01-Jan-98
NCR	27	A330	30-Sep-98								01-Jan-98
NCR	27	A340	30-Sep-98								01-Jan-98
NCR	27	C310	01-Oct-98								01-Jul-98
NCR	27	C320	01-Oct-98								01-Jul-98
NCR	27	C330	01-Oct-98								01-Jul-98
NCR	27	C340	01-Oct-98								01-Jul-98
NCR	27	C350	01-Oct-98								01-Jul-98
NCR	27	D310	05-Aug-92								01-Aug-92
NCR	27	D330	05-Aug-92								01-Aug-92
NCR	27	D330	22-Nov-93								01-Aug-92
NCR	27	D330	27-Jul-94								01-Aug-92
NCR	29	5473	12-Mar-99								01-Feb-99
WR	30	A310	10-Nov-91								NOT YET
NCR	31	6700	29-Oct-95								01-Jan-98
WR	32	A351	17-Sep-90								NOT YET
NAR	33	1001	08-Apr-97								01-Mar-97
NAR	34	1030	19-Jul-97								01-Apr-97
NAR	34	1033	08-Dec-97								01-Apr-97
NAR	36	A331	15-Sep-93								01-Jul-93
NAR	37	1992	23-Sep-97								01-Jun-97
NCR	38	2001	26-Jun-98								01-Jan-98
NCR	38	5002	01-Jul-98								01-Jan-98
NCR	39	0101	08-Dec-97								01-Jan-97
NCR	39	0102	27-Dec-96								01-Oct-96
NCR	39	0102	08-Dec-97								01-Jan-97
NCR	39	0105	12-Nov-98								01-Jan-98
NCR	39	0107	27-Dec-96								01-Oct-96
NCR	39	0107	08-Dec-97								01-Jan-97
NCR	39	0803	08-Dec-97								01-Jan-97
NCR	39	0803	14-Nov-98								01-Jan-97
NCR	39	0804	08-Dec-97								01-Jan-97
NCR	39	0804	14-Nov-98								01-Jan-97

Table 32. Profile runs with unreported maintenance or rehabilitation (1997-1999).

LTPP Region	State Code	SHRP ID	Profile Date	Test Time	Equip. Spike Reload Run No.	Lost Lock Del Run No.	Wrong Loc. Del Run No.	Zero IRI Load Runs	Early Start Del Run No.	Possibly Not Reported Prior Maint	Possibly Not Reported Prior Rehab
NAR	42	1605	31-Aug-95								**01-May-95**
NCR	46	3009	09-Jul-97								**01-Jan-97**
SR	48	1122	18-Aug-97								**01-Aug-97**
WR	53	6056	07-Oct-97								**01-Jun-97**
NAR	54	7008	05-Nov-93								**01-Jul-93**
NCR	55	5037	28-Sep-98								**01-Jan-98**
WR	56	2019	17-Jul-97								**01-Jan-97**
WR	56	7772	03-Aug-98								**01-Apr-98**
WR	56	A310	22-Oct-90								**NOT YET**
NCR	83	6454	29-Aug-98								**01-Jan-98**
NCR	90	6420	28-Aug-98								**01-Jan-98**



Recycled
Recyclable

HRDI-13/9-00(950)E