PROCEDURES MANUAL FOR THE DETERMINATION OF INTERNATIONAL ROUGHNESS INDEX ON HPMS SITES IN OREGON

OPERATIONS AND CALIBRATION

by

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INTERNATIONAL ROUGHNESS INDEX - OVERVIEW

INTRODUCTION

The Oregon Department of Transportation (ODOT) is required to provide an annual measure of pavement condition based on International Roughness Index (IRI). The main coordination of this process with FHWA is done by the Highway Division's Planning Section. The data will be collected using a Mays Ride Meter (MRM). The Research Unit of the Materials and Research Section is responsible for calibration and operation of the MRM. The Data to be collected is on various highways across the State as directed by the Planning Section.

The equipment, calibration and data collection procedures will follow FHWA order M5600.1a, Appendix J, see reference 1.

EQUIPMENT

ODOT purchased a MRM system in November of 1983. The system consists of a tow vehicle and a trailer to measure 0.1 inch increments of vertical axle movement with respect to the trailer frame. A pavement condition recorder (PCR) is located in the tow vehicle to record all data collected, the data can then be processed through the data playback unit (DPU). The system, at the time of purchase, met the prevailing ASTM requirements.

This equipment falls into the Class III category, "Response Type Road Roughness Meters," as defined in Appendix J.

CREW

The crew will consist of an operator and an assistant. The operator will have the responsibility for checking all the data, directing retests, training the assistant and maintaining the equipment.

Before data collection begins the driver must learn to skillfully drive in the wheel path.

CALIBRATION

Class III equipment must be calibrated to known road profiles. These profiles must be obtained with Class I methods (manual profiling techniques), or Class II equipment (direct profile measuring equipment).

As long as Class III equipment is used for routine measurements the reference roughness values will be reestablished each year. (Calibration of Road Roughness Measuring Equipment, Volume II: Calibration Procedures)

ROUTINE OPERATIONS FOR DATA COLLECTION

GENERAL

Before data collection begins the operator will be completely familiar with the equipment and Appendix J as it applies to the MRM (class 3) equipment.

The normal test speed is 50 mph, however, conditions may require the test speed to be reduced to 20, 30, or 40 mph.

Before the start of testing the operator of the PCR enters the parameters that are discussed in "Mays Meter Operating Procedure" below.

During a test the data is recorded on a miniature cassette tape and/or printed out on a 2.5 inch wide paper tape. Normally two cassettes are used each day, one in the morning and one in the afternoon. However, a new cassette must be inserted each time the PCR is turned off.

Under continuous testing conditions 300 to 350 miles of highway can be tested each day.

SCHEDULING

The Planning Section provides a listing of the sites required for the Highway Performance Monitoring System (HPMS) program. This listing is by highway, by line prefix, by begin mile point and by end mile point.
Sites which are not part of the highway system have each been given a unique number that does not coincide with any highway number. The prefix designations used in the listing are given in Table 1.

Table 1

LINE PREFIX DESIGNATIONS

O	-	ON-LINE ADD MILEAGE
N	-	NON-ADD MILEAGE (NORTHBOUND)
W	-	NON-ADD MILEAGE (WESTBOUND)
X	-	MINUS MILEAGE
Z	-	OVERLAPPING MILEAGE
T	-	TEMPORARY TRAVELED ROUTE
C	-	CONNECTION

The site listing, a State map, county maps, and a straight line chart will be needed by the operator to plan the work.

MAYS METER OPERATING PROCEDURE

INITIALIZE THE MAGNETIC TAPES

Step 1) Demagnetize the tape with a bulk eraser.

Step 2) Insert the tape in the DPU.

Step 3) Key in the sequence <2> <func> <.>, this will rewind the tape. The func and wait lights should be on. When the wait light goes out the tape is rewound.

Step 4) Key in the sequence, <1> <2> <func> <.>, this will initialize the tape. The func and wait light should come on.

Step 5) When the wait light goes out remove the tape.

ALL MAGNETIC TAPES MUST BE INITIALIZED **BEFORE EACH USE** IN THE PCR UNIT OF THE MAYS TOW VEHICLE. (If the tapes are not initialized each time the PCR will not give you a warning that the tape is full).

POWER UP SEQUENCE

There are 3 switches on the PCR that have to be turned on in the proper sequence to avoid causing any damage. The location and sequence is as follows:

1- back lower left corner, first pullout and then up.
2- front upper left corner, flip all the way up.
3- front upper right corner, flip all the way up.

Turn the PCR off in the reverse order and leave the tape door open.

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SETUP SEQUENCE

Turn on the PCR, insert a tape, and close the tape door. Next push the date/calibrate button to start the visual prompts and then push the increment button(each time the PCR is turned off it goes out of increment mode).

PROMPT	ENTRY	
Date	mmddyy:	(6 digit input)
Time	hhmm:	(4 digit input)
Record mode	Three entries are possible: 1. Data goes to paper printer only. 2. Data goes to magnetic tape only. 3. Data goes to both (this is the normal mode).	
OPR/VEH/MAYS	oovvmm:	(6 digit input) your operator number will be assigned to you. The vehicle is 02 and the Mays meter is 01.
Dist. Incr.	0.100	
DCF:1	0.1636	The distance correction factor should be checked weekly by running the measured mile. All tires should be checked while cold to make sure they are inflated to the maximum recommended by the manufacturer. If there is a discrepancy, take corrective action.

Constant:1 100

COEF.:1 .01

INPUT 0'S FOR THE REMAINDER OF THE PROMPTED DCF'S, CONSTANTS, AND COEFFICIENTS.

DSTRCT/HWY ddchhh: (6 digit input)

dd: district number is 01 thru 14.

c: code of district is 0 = no code

1 = A
2 = B
3 = C

hhh: highway number with leading zeros.

SHK-TMP/WEAT sssww: (5 digit input)

sss: is the shock temperature.

ww: Weather is entered using the following code:

01 = clear
02 = partly cloudy
03 = cloudy
04 = overcast
05 = fog
06 = rain

PVMT-T/A/C ttaacc: (6 digit input)

pavement type, age and condition.

00 = asphalt pavement
01 = portland cement concrete pavement

No entry is required for age or condition.

Speed	Usually this will be 50.
Begin m.p.	Enter the beginning mile point to the nearest 0.010 mile.
Direction	Indicates the direction in relation to mile points. E gives increasing mile points. W gives decreasing mile points.
Lane	1 indicates the outside (right hand) commonly used lane. The number increases toward the median.
Select DCF	1

THE REMAINDER OF PROMPTS: INPUT 0'S.

Push the verify button: this will cause a verify operation which will prompt for missing data. Successful completion is indicated by:

VERIFY START = OK.

Start will then set up the machine for start up indicated by:

READY TO START.

A second start will begin the mileage counters and counting.

NOTES:

- The landmark button should be used to indicate structures, railroad tracks, construction sites, and changes in pavement.

- Speed and Temperature are important variables. The speed should be 50 mph whenever possible. If the temperature changes more than 4 degrees, stop the run and update the setting.

- Routinely check the mile point logging by referring to the landmarks on the straight line chart.

- The record mode must be cleared and re-entered whenever a new tape is inserted if the PCR has not been turned off.

HANDLING THE DATA

When the cassettes are returned to the office, they are run in the DPU to up-load the data to an IBM PC. The up-load procedure is controlled by a basic program named maystran.bas. A temporary data set, N:\MAYSDATA\TESTOUT.MAY, is created. Each time data is up-loaded, the existing testout.may data set is deleted and a new testout.may is created. The newly created data set holds only the current up-loaded data from a single tape. The data in testout.may is identical to the data output from the PCR's paper tape.

(NOTE: **DO NOT EDIT TESTOUT.MAY**)

A second basic program, maysread.bas, reads the data in testout.may and reorganizes it to a format that is compatible with many report oriented programs. This data is stored on a PC in a new data set that is named by the month-day-year (for example, N:\MAYSDATA\SEPT0789.DAT) that the data was taken.

BUILDING THE DATABASE

After the "month-day year" files are created they are edited and moved up to the main-frame where they are stored as "HWYE71.MAYS89(month-day)". For new years, new data sets would be created that reflect the current year in the name.

When the data collection is complete, the main-frame files are concatenated in a file named HWYE71.MAYS89.DATA(HPMS).

ROUTINE CALIBRATION CHECKS

Calibration checks are done on a routine basis to assure the equipment is measuring consistently. All sites used for calibration verification have been previously tested and have a known mean ($\bar{X}$) and standard deviation (σ). For any given calibration check, the determined IRI shall be in the interval expressed by $\bar{X} +/- 3\sigma$.

Calibration and repeatability data is stored in the directory N:\MAYSDATA\CAL on the PC. This is used to develop the statistics for the database.

CALIBRATION PROCEDURES

DATA COLLECTION

The initial data collection was started August 30, 1989. Future data collection should start in May or Early June.

The data from the calibration sites is up-loaded to TESTOUT.MAY just as the site data. However, now TESTOUT.MAY is edited, using SPF/PC by Command Technology Corporation, to put the file in a form suitable for import to a Lotus (Symphony) spreadsheet[1]. The spreadsheets are named for each calibration site. If the calibration site is on I-5 the sheet is named N:\MAYSDATA\CAL\NNN-MM.WR1 where NNN-MM is the beginning mile point to the nearest hundredth (MM). The other sites are named N:\MAYSDATA\CAL\HWYNNN.WR1 where NNN is the highway number.

When the data collection is complete, statistics for the subject year are developed.

DISTANCE CALIBRATION

The sender unit is located on the transmission output shaft of the tow vehicle. Since the tow vehicle has steel belted radial tires, small changes in tire pressure, or runs at different speeds, does not noticeably effect the distance calibration. For routine operation the tire pressure is to be kept at the maximum recommended by the tire manufacturer.

For the distance calibration one three mile long site has been prepared. The distances on the site were determined with a wheel. The site is at m.p. 20.40 to m.p. 17.40 on Route 22, Highway 30. When travelling westbound in the right lane, m.p. 20.40 is m.p. 0.00 of the calibration site.

The distance calibration factor can also be checked against two other one mile long calibration sites that were laid out by chaining. These sites are located Eastbound and Westbound at m.p. 2.43 to m.p. 3.43 on Route 22, Highway 162.

The results indicate that 1.0% accuracy is easily obtained at all speeds.

[1] Data sets that are ASCII files that have the numeric fields separated by commas or spaces and alphanumeric fields enclosed in double quotes (".. ...") are suitable for import into a spread sheet as a structured data set.

DISTANCE CONTROL FACTOR (DCF)

The DCF is initially determined by five or more runs over the 3 mile course at speeds of 30, 40 and 50 mph with the DCF set at 1.0000. The 3.000 mile distance is used to calculate the working DCF with the following equation:

$$DCF\ (working) = 1/(dx1/dx2) \qquad 1.$$

where: dx1 is the distance recorded with DCF = 1
dx2 is the length of the test course (3 miles)

The working DCF is calculated for each run. The mean ($\overline{X}$), standard deviation (σ) and coefficient of variation (CV) (in %) can be calculated from the data .

Note: The CV is given by:

$$CV\ (\%) = (\sigma\ /\ \overline{X})100 \qquad 2.$$

The acceptable range of values for the DCF are defined by the following equation:

$$DCF\ (range) = \overline{X}\ +/-\ 3 \times \sigma \qquad 3.$$

If the DCF is redetermined and found to be outside this range corrective action must be taken.

The initial working DCF was determined by taking a total of 19 passes, at 30, 40 and 50 mph, over the three mile course. The results are:

Table 2

DISTANCE CONTROL FACTOR

$\overline{X}$	=	0.163631
σ	=	0.000051
CV	=	0.031%
DCF(working)	=	0.1636
DCF(range)	=	0.16363 +/- 0.00015 (0.16347 TO 0.16378)

The data and calculations are in Appendix 1.

ROUGHNESS CALIBRATION

Appendix J requires a minimum of 9 calibration sites that are at least 0.2 miles long. Further, when data is collected using a MRM, the MRM values are to be converted to IRI values. This requires that the "known profile" of each calibration site be determined by application of a Class I or II device/method.

The roughness calibration ranges, as defined in Appendix J, are given in Table 3 below.

Table 3

Roughness Calibration Ranges

Group	IRI Roughness Range (inches per mile)
Smooth	0 - 190
Medium	191 - 320
Rough	> 320

Appendix J suggests that at least 3 calibration sites fall into each group. In the event that a state does not have sites in the rough category, the calibration sites should encompass the IRI values found in that state.

The 1989 database indicates that there are no rough sites. The number of medium sites is only 2.2% of the 736 sites tested. Consequently, calibration sites in the medium range were not identified and tested. If a significant number of medium sites develop in the future, corresponding calibration sites will be identified and developed.

It is intended that the 1990 data collection will be done with a South Dakota Road Profiler. As a part of that package a Class I calibration device known as a "Dipstick" will be obtained. This will enable Oregon to be completely independent in developing and maintaining satisfactory calibration sites.

As backup, The SHRP profiler will be utilized for roughness verification on the selected sites listed below.

CALIBRATION SITES

The MRM is calibrated against IRI data reported by Austin Research Engineers (ARE) in conjunction with the Strategic Highway Research Program (SHRP). Table 4 is a list of the calibration sites tested by ARE using a Class II device:

Table 4

CALIBRATION SITES

SITE#	HIGHWAY	DIRECTION	BEGIN MILEPOINT	END MILEPOINT	PAVEMENT TYPE
417081*	I-82	East	8.70	9.70	PCC
415021*	I-5	North	181.84	182.84	PCC
415022*	I-5	South	185.99	184.99	PCC
416011*	I-5	South	210.09	209.09	AC
415005*	I-5	South	232.35	231.35	PCC
194E**	194	East	5.80	6.26	AC
194W**	194	West	6.26	5.80	AC
162E**	162	East	2.43	3.43	AC
162W**	162	West	3.43	2.43	AC
030W**	030	West	19.40	18.40	AC

* SHRP site identification number.
** Highway number and direction of testing.

MRM REPEATABILITY

A review of data taken for repeatability indicates that a site length of 1 mile results in good repeatability. The coefficient of variation, based on data taken repeatedly over the same 1 mile interval, is significantly better than the coefficient of variation for data taken over .1, .2, or .5 mile intervals. This is supported by the data taken on the calibration sites and the regression analysis discussed below. An example of the analysis is in Appendix 2.

NOTE: When making runs for repeatability do not turn the cruise control off, tap the brake to disengage it when not testing. To start testing at the same speed again, push the resume button.

CORRECTION FACTORS - FOR MAYS INCHES

The Mays speed and temperature correction factors were obtained from data contained in the report Pavement Roughness Evaluation Using a Mays Ride Meter, FHWA/NJ-82/003. These factors were developed to correct to standard conditions, 50 mph and 70 ° F. (21 °C). These corrections are:

$$TC = 0.31(70 - T) \qquad 4.$$

$$SC = 0.88(50 - S) \qquad 5.$$

where: TC is the correction for temperature.
T is the temperature.
SC is the correction for speed.
S is the speed.

The corrected Mays inches is given by:

$$Inches_{50} = IPM_{st} + TC + SC \qquad 6.$$

Where IPM_{st} is the measured inches per mile at a known speed and temperature.

CONVERSION OF MAYS INCHES TO IRI

The calibration sites tested by ARE were also tested by the Mays, the results are listed in Table 5. The IRI and the Mays data were then subjected to linear regression and the following result was obtained:

$$Y = 1.39X + 7.95 \qquad 7.$$

where: Y = IRI - inches/mile
X = MAYS - temperature and speed corrected inches/mile

The goodness of fit (r^2) was calculated and found to be 0.975. This is indicative of a good fit to the linear model. Also, this suggests that the repeatability of the MRM is also good.

Table 5

CALIBRATION SITE DATA

	LENGTH	IRI(INCHES/MILE)				MAYS(INCHES/MILE)			
SITE#	MILES	MEAN	ST DEV	C/V	# RUNS	MEAN	ST DEV	C/V	#RUNS
417081*	1.00	56	0.1	0.25	2	----	----	----	---
415021*	1.00	83	0.9	1.12	3	58	2.1	3.62	5
415022*	1.00	78	1.4	1.82	3	52	2.3	4.39	5
416011*	1.00	63	1.8	2.85	3	40	1.8	4.57	5
415005*	1.00	98	0.2	0.16	3	70	1.5	2.15	5
194E**	0.46	168	2.8	1.68	7	107	0.8	1.42	6
194W**	0.46	179	2.8	1.55	5	128	2.0	4.13	6
162E**	1.00	68	1.9	2.78	3	45	3.4	7.46	10
162W**	1.00	73	0.5	0.63	3	45	2.3	5.04	9
030W**	1.00	91	0.8	0.92	5	53	3.8	7.22	6

* SHRP site identification number.
** Highway number and direction of testing.

Examination of Table 5 shows that the number of runs over each site is not the same. It is not desirable to have one site weight the regression analysis more than another site. Consequently, the regression was performed using the value of the mean for each site.

REPORTS

The file, HWYE71.IRISITE.DATA, is produced by the planning section and contains the information that defines the sites to be tested. The data set currently contains 736 lines. See Appendix 2 for the FOCUS file description, HWYE71.FOCMAST.DATA(IRISITE).

The file, HWYE71.MAYS89.DATA(HPMS), is the file that is produced by the Research Unit and contains the raw data for each site. This file contains approximately 12,500 lines. See Appendix 2 for the FOCUS file description HWYE71.FOCMAST.DATA(MAYS89).

The FOCEXEC for assembling the final report is HWYE71.FOCEXEC.DATA(HPMS89). This program creates extract files from IRISITE.DATA and MAYS89.DATA(HPMS), calculates the roughness for each site in inches per mile, and recombines the calculated roughness with the data from IRISITE. The results are written to the file HWYE71.HPMS89.DATA. The file description for the output file is HWYE71.FOCMAST.DATA(HPMS89). These are also in Appendix 2.

The FOCEXEC, HPMS89, should be run in batch since it requires approximately 2.5 minutes of CPU.

REFERENCES

1. FHWA order M5600.1a, Appendix J, Roughness Equipment, Calibration and Data Collection.

2. Calibration of Road Roughness Measuring Equipment, Volume 1: Experimental Investigation; Volume 2: Calibration Procedures, FHWA-RD-89-078, march 1989.

3. Standard Practice for Dealing With Outlying Observations, ASTM E 178 - 80.

4. Standard Specification for Trailers Used for Measuring Vehicle Response to Road Roughness, ASTM E 1215 - 87.

5. Standard Test Method for Measurement of Vehicular Response to Traveled Surface Roughness. ASTM E 1082 - 85.

DCF.WK1

APPENDIX 1

DISTANCE CORRECTION FACTOR DETERMINATION AND STATISTICS

WITH THE DISTANCE CORRECTION
FACTOR SET TO 1.0000 THE
FOLLOWING DATA WAS TAKEN
OVER THE THREE MILE SITE.
THE TOTAL COUNTS WERE TAKEN
AT 30 40 50 MPH

18.331	18.337	18.337	MEAN	18.334
18.333	18.332	18.329	STD DEV	0.0057
18.340	18.337	18.323	C/V	0.031
18.342	18.328	18.329	COUNT	19
18.336	18.336	18.338		
18.326	18.329	18.338		
		18.344		

THE DCF WAS CALCULATED
FOR EACH RUN

0.16366	0.16360	0.16360
0.16364	0.16365	0.16368
0.16358	0.16360	0.16373
0.16356	0.16368	0.16368
0.16361	0.16361	0.16359
0.16370	0.16368	0.16359
		0.16354

THE STATISTICS ARE

MEAN	0.163631
STD DEV	0.000050
TESTS	19
C/V	0.031 %

A:\REPEAT

APPENDIX 2

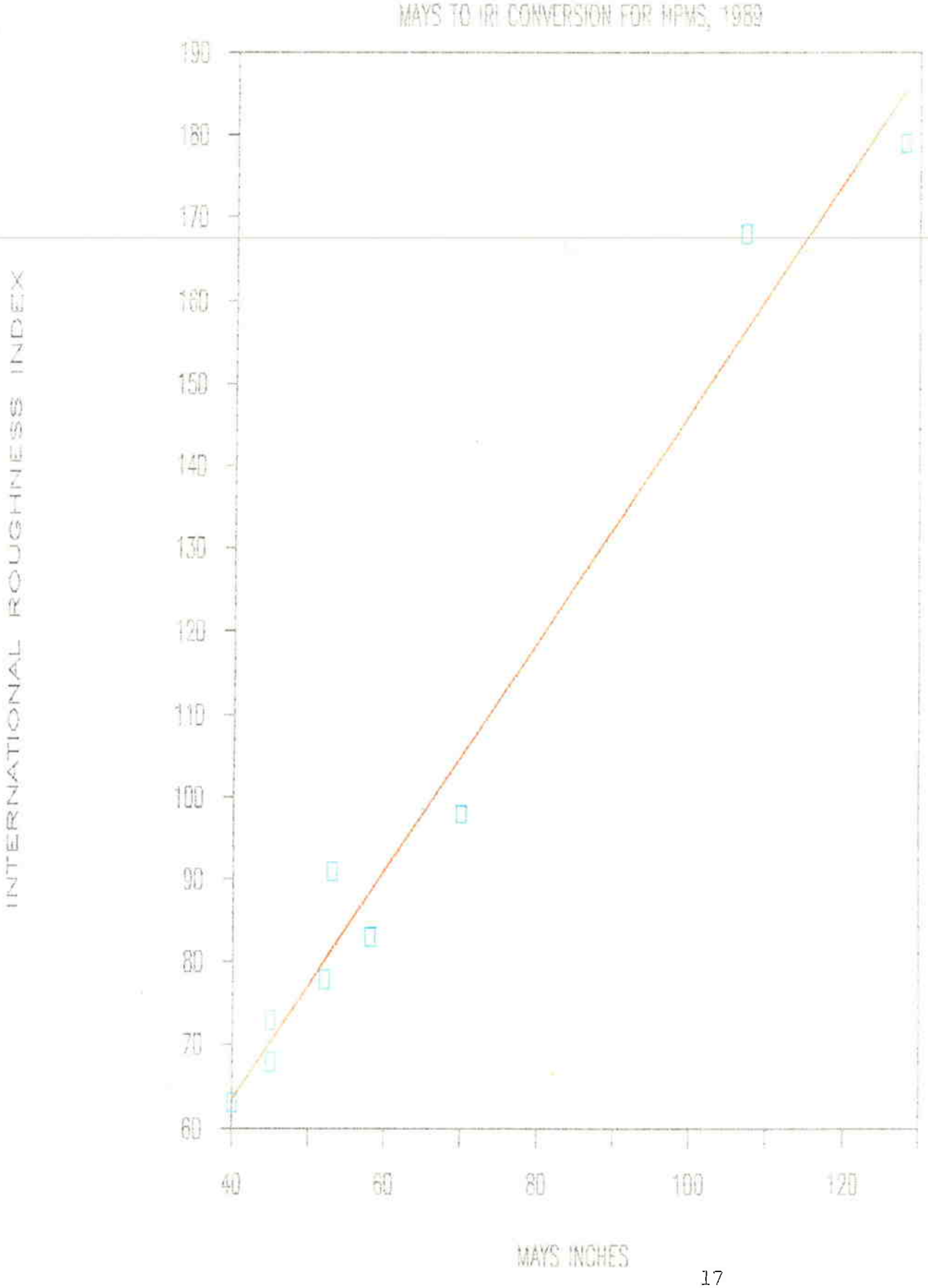
REPEATIBILITY

TO MEASURE THE REPEATIBILITY OF THE MAYS DATA, FIVE ONE MILE RUNS WERE MADE. DATA WAS TAKEN IN .1 MILE INCREMENTS. THE MEAN, STANDARD DEVIATION AND COEFFICIENT OF VARIATION (C/V) WERE CALCULATED FOR TEST LENGTHS OF .1, .2, .5 AND 1 MILE. THE AVERAGE C/V WAS CALCULATED FOR EACH TEST LENGTH. FROM THESE RESULTS IT WAS RECOMMENDED THAT TEST LENGTHS SHOULD BE AT LEAST BE .5 MILES LONG AND PREFERABLY 1 MILE LONG

	MAYS INCHES PER MILE					C/V
0.1 MILE	16	19	24	15	17	19.6
0.1 MILE	28	28	26	44	42	25.7
0.2 MILE	22	24	25	30	30	13.3
0.1 MILE	30	20	24	18	30	22.7
0.1 MILE	42	35	37	34	41	9.4
0.2 MILE	36	28	31	26	36	14.6
0.1 MILE	48	48	53	46	46	5.9
0.5 MILE	33	30	33	31	35	6.0
0.1 MILE	34	35	30	30	32	7.1
0.2 MILE	41	42	42	38	39	4.0
0.1 MILE	30	49	38	32	38	19.8
0.1 MILE	29	29	35	40	32	14.1
0.2 MILE	30	39	37	36	35	10.0
0.1 MILE	28	30	33	34	19	20.7
0.1 MILE	35	29	35	33	30	8.6
0.2 MILE	32	30	34	34	25	12.6
0.5 MILE	31	34	34	34	30	5.9
1.0 MILE	32	32	34	33	33	1.8

TEST LENGTH	AVERAGE C/V
.1 MILE	15.4
.2 MILE	10.9
.5 MILE	5.9
1 MILE	1.8

APPENDIX 3


MAYS TO IRI CONVERSION FOR MPMS, 1989
INTERNATIONAL ROUGHNESS INDEX
190
180
170
160
150
140
130
120
110
100
90
80
70
60
40
60
80
100
120
MAYS INCHES
DATA POINTS
IRI=1.39xMAYS+7.95

```
HWYE71J,90.011,16:57:16,HWYE71.FOCMAST.DATA(IRISITE)
00010003 FILENAME=IRISITE,SUFFIX=FIX
00020002   SEGNAME=ROOT
00030004     FIELDNAME=COUNTY_CODE ,CNTY        ,A3      ,A3      ,$
00040004     FIELDNAME=RU_DESIGNATN,RRL         ,A1      ,A1      ,$
00050004     FIELDNAME=URBAN_A_CODE,URB         ,A5      ,A5      ,$
00060024     FIELDNAME=PHWY_ROUTE  ,PHWY        ,A5      ,A5      ,$
00070004     FIELDNAME=MP_PREFIX   ,PFX         ,A1      ,A1      ,$
00080015     FIELDNAME=BEG_MP      ,PBMP        ,D8.3    ,Z6.3    ,$
00090015     FIELDNAME=END_MP      ,PEMP        ,D8.3    ,Z6.3    ,$
00100018     FIELDNAME=SECTN_LENGTH,LENGTH      ,D12.3   ,Z6.3    ,$
00110009     FIELDNAME=FUNC_CLASS  ,CLS         ,A2      ,A2      ,$
00120004     FIELDNAME=DEVEL_TYPE  ,TYPE        ,A1      ,A1      ,$
00130004     FIELDNAME=DESCRIPTION ,DESC        ,A42     ,A42     ,$
00140017     FIELDNAME=ROUGHNESS   ,PIRI        ,F4.0    ,A4      ,$
00150004     FIELDNAME=FILLER83S   ,FIL2        ,A8      ,A8      ,$
00151020 DEFINE NEWPEMP/D8.3=PEMP+.005 ;$
00160009 DEFINE COUNTY/A12=DECODE CNTY (001 'BAKER' 003 'BENTON' 005 'CLACKMAS'
00170007     007 'CLATSOP' 009 'COLUMBIA' 011 'COOS' 013 'CROOK' 015 'CURRY'
00180007     017 'DESCHUTES' 019 'DOUGLAS' 021 'GILLIAM' 023 'GRANT'
00190007     025 'HARNEY'
00200007     027 'HOOD RIVER' 029 'JACKSON' 031 'JEFFERSON' 033 'JOSEPHINE'
00210007     035 'KLAMATH' 037 'LAKE' 039 'LANE' 041 'LINCOLN' 043 'LINN'
00220007     045 'MALHEUR' 047 'MARION' 049 'MORROW' 051 'MULTNOMAH' 053 'POLK'
00230007     055 'SHERMAN' 057 'TILLAMOOK' 059 'UMATILLA' 061 'UNION'
00240008     063 'WALLOWA' 065 'WASCO' 067 'WASHINGTON' 069 'WHEELER'
00250007     071 'YAMHILL' ELSE 'OTHER') ;$
00260010 DEFINE FUNCLASS/A20=DECODE CLS (01 'INTERSTATE' 02 'PRINCIPLE ARTERIAL'
00270010     06 'MINOR ARTERIAL' 07 'MAJOR COLLECTOR' 08 'MINOR COLLECTOR'
00280010     11 'URBAN INTERSTATE' 12 'OTHER - EXPRESS/FWY'
00290010     14 'PRINCIPAL ART' 16 'MINOR ARTERIAL' 17 'COLLECTOR'
00300009     ELSE 'OTHER');$
00310009 DEFINE DESIGNATION/A10=DECODE RRL (1 'RURAL' 2 'URBAN' 3 'URBANIZED');$
00320010 DEFINE AREA/A13=DECODE URB (00000 'RURAL' 01000 'ALBANY' 03050 'ASHLAND'
00330010     03150 'ASTORIA' 03650 'BAKER' 05800 'BEND' 10750 'CANBY'
00340010     15250 'COOS BAY' 15800 'CORVALLIS' 15950 'COTTAGE GROVE'
00350010     17700 'DALLAS' 11161 'EUGENE' 30550 'GRANTS PASS'
00360010     33700 'HERMISTON' 39700 'KLAMATH FALLS' 40350 'LA GRANDE'
00370010     41650 'LEBANON' 45000 'MC MINNVILLE' 11351 'MEDFORD'
00380010     48600 'MILTON FRWTR' 49550 'MONMOUTH' 52100 'NEWBERG'
00390010     52450 'NEWPORT' 42600 'LINCOLN CITY' 54900 'ONTARIO'
00400010     57150 'PENDELTON' 11027 'PORTLAND' 59850 'PRINEVILLE'
00410011     11286 'RAINIER' 61200 'REDMOND' 63650 'ROSEBURG' 11225 'SALEM'
00420010     65950 'SEASIDE' 67650 'SILVERTON' 64600 'ST HELENS'
00430010     71950 'SWEET HOME' 72950 'THE DALLES' 83750 'WOODBURN') ;$
00440010 DEFINE PREFIX/A80= DECODE PFX ( C 'CONNECTION(NOT ON MAIN ROUTE)'
00450010     F 'FRONTAGE ROAD (NOT ON MAIN ROUTE)'
00460010     N 'NORTHBOUND COUPLET'
00470010     S 'SOUTHBOUND COUPLET'
00480010     E 'EASTBOUND COUPLET'
00490010     W 'WESTBOUND COUPLET'
00500010     T 'TEMPORARY TRAVLED ROUTE (ON MAIN ROUTE)'
00510010     K 'NON-ADD COUPLET ON A SPUR (Y)'
00520010     L 'NON-ADD COUPLET WITH NEGATIVE MILLAGE (X)'
00530013     X 'NEGATIVE MILEPOINT'
00540010     Y 'SPUR ON STATE HIGHWAY (ON MAIN ROUTE)'
00550012     Z 'OVERLAPPING MILEAGE DUE TO POSITIVE EQUATION (ON MAIN ROUTE)');$
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HWYE71J,90.011,16:55:54,HWYE71.FOCMAST.DATA(MAYS89)
00010010 FILENAME=MAYS89,SUFFIX=FIX
00020000   SEGNAME=ROOT
00030000     FIELD=YEAR,          ALIAS=YR,         USAGE=P2,   ACTUAL=Z2, $
00040000     FIELD=PVMT_TYPE,     ALIAS=PTYPE,      USAGE=P1,   ACTUAL=Z1, $
00050000     FIELD=HWY_NUMBER,    ALIAS=HWY,        USAGE=P3,   ACTUAL=Z3, $
00060000     FIELD=DIR_OF_TRAV,   ALIAS=DOT,        USAGE=A1,   ACTUAL=A1, $
00070000     FIELD=BEG_MILE_PT,   ALIAS=BMP,        USAGE=P6.2, ACTUAL=Z5.2, $
00080007     FIELD=XCOUNT,        ALIAS=CNT,        USAGE=P6,   ACTUAL=Z4, $
00090000     FIELD=INCR_LENGTH,   ALIAS=INC,        USAGE=P8.3, ACTUAL=Z4.3, $
00100000     FIELD=MONTH,         ALIAS=MO,         USAGE=P2,   ACTUAL=Z2, $
00110000     FIELD=DAY,           ALIAS=DAY,        USAGE=P2,   ACTUAL=Z2, $
00120000     FIELD=DISTRICT,      ALIAS=DIST,       USAGE=P2,   ACTUAL=Z2, $
00130000     FIELD=DISTR_CODE,    ALIAS=DCODE,      USAGE=A1,   ACTUAL=A1, $
00140000     FIELD=SPEED,         ALIAS=SPEED,      USAGE=P2,   ACTUAL=Z2, $
00150000     FIELD=TEMPERATURE,   ALIAS=TEMP,       USAGE=P3,   ACTUAL=Z3, $
00160000     FIELD=WEATHER,       ALIAS=WEATH,      USAGE=P1,   ACTUAL=Z1, $
00170000     FIELD=DIST_COR_FA,   ALIAS=DCF,        USAGE=P4,   ACTUAL=Z4, $
00180000     FIELD=LANE_NUM,      ALIAS=LANE,       USAGE=P1,   ACTUAL=Z1, $
00190000     FIELD=LANDMARK,      ALIAS=LMK,        USAGE=A1,   ACTUAL=A1, $
00200000     FIELD=XYZ,           ALIAS=XYZ,        USAGE=A1,   ACTUAL=A1, $
00210005     FIELD=RUNINDEX  ,    ALIAS=RI    ,     USAGE=I6,   ACTUAL=A6, $
00211005     FIELD=NEWFIELD1 ,    ALIAS=NF1   ,     USAGE=A4,   ACTUAL=A4, $
00212005     FIELD=NEWFIELD2 ,    ALIAS=NF2   ,     USAGE=A5,   ACTUAL=A5, $
00213005     FIELD=NEWFIELD3 ,    ALIAS=NF3   ,     USAGE=A5,   ACTUAL=A5, $
00214005     FIELD=NEWFIELD4 ,    ALIAS=NF4   ,     USAGE=A5,   ACTUAL=A5, $
00215005     FIELD=NEWFIELD5 ,    ALIAS=NF5   ,     USAGE=A5,   ACTUAL=A5, $
00216005     FIELD=NEWFIELD6 ,    ALIAS=NF6   ,     USAGE=A5,   ACTUAL=A5, $
00217005     FIELD=NEWFIELD7 ,    ALIAS=NF7   ,     USAGE=A5,   ACTUAL=A5, $
00220000       DEFINE NEWDIR/A1 = IF DOT EQ 'E' THEN '+' ELSE '-' ; $
00230000       DEFINE AVGCOUNT/P6 = IF INC EQ 0 THEN 0 ELSE
00240008                            CNT / INCR_LENGTH ; $
00250000       DEFINE IPM/P6 = AVGCOUNT / 10 ;$
00260000       DEFINE TEMPCOR/P6 = (.308 * (70 - TEMP)) ;$
00270000       DEFINE SPEEDCOR/P6 = (.88 * (50 - SPEED)) ;$
00280000       DEFINE INPERMILE/P6 = IF IPM EQ 0 THEN 0 ELSE
00290000                             IPM + TEMPCOR + SPEEDCOR ;$
00300012       DEFINE IRI/P6.0 = 1.39*INPERMILE + 7.95 ;$
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HWYE71J,90.011,16:54:44,HWYE71.FOCMAST.DATA(HPMS89)
00010000 FILENAME=HPMS89,SUFFIX=FIX
00020000   SEGNAME=ROOT
00030000     FIELDNAME=COUNTY_CODE ,CNTY        ,A3      ,A3      ,$
00040000     FIELDNAME=RU_DESIGNATN,RRL         ,A1      ,A1      ,$
00050000     FIELDNAME=URBAN_A_CODE,URB         ,A5      ,A5      ,$
00060002     FIELDNAME=HWY_ROUTE   ,HWY         ,A5      ,A5      ,$
00070000     FIELDNAME=MP_PREFIX   ,PFX         ,A1      ,A1      ,$
00080001     FIELDNAME=BEG_MP      ,BMP         ,D8.3    ,A8      ,$
00090001     FIELDNAME=END_MP      ,EMP         ,D8.3    ,A8      ,$
00100001     FIELDNAME=SECTN_LENGTH,LENGTH      ,D12.3   ,A12     ,$
00110000     FIELDNAME=FUNC_CLASS  ,CLS         ,A2      ,A2      ,$
00120000     FIELDNAME=DEVEL_TYPE  ,TYPE        ,A1      ,A1      ,$
00130000     FIELDNAME=DESCRIPTION ,DESC        ,A42     ,A42     ,$
00140000     FIELDNAME=ROUGHNESS   ,IRI         ,F4.0    ,A4      ,$
00150000     FIELDNAME=FILLER83S   ,FIL2        ,A8      ,A8      ,$
00152000 DEFINE COUNTY/A12=DECODE CNTY (001 'BAKER' 003 'BENTON' 005 'CLACKMAS'
00153000     007 'CLATSOP' 009 'COLUMBIA' 011 'COOS' 013 'CROOK' 015 'CURRY'
00154000     017 'DESCHUTES' 019 'DOUGLAS' 021 'GILLIAM' 023 'GRANT'
00155000     025 'HARNEY'
00156000     027 'HOOD RIVER' 029 'JACKSON' 031 'JEFFERSON' 033 'JOSEPHINE'
00157000     035 'KLAMATH' 037 'LAKE' 039 'LANE' 041 'LINCOLN' 043 'LINN'
00158000     045 'MALHEUR' 047 'MARION' 049 'MORROW' 051 'MULTNOMAH' 053 'POLK'
00159000     055 'SHERMAN' 057 'TILLAMOOK' 059 'UMATILLA' 061 'UNION'
00160000     063 'WALLOWA' 065 'WASCO' 067 'WASHINGTON' 069 'WHEELER'
00170000     071 'YAMHILL' ELSE 'OTHER') ;$
00180000 DEFINE FUNCLASS/A20=DECODE CLS (01 'INTERSTATE' 02 'PRINCIPLE ARTERIAL'
00190000     06 'MINOR ARTERIAL' 07 'MAJOR COLLECTOR' 08 'MINOR COLLECTOR'
00200000     11 'URBAN INTERSTATE' 12 'OTHER - EXPRESS/FWY'
00210000     14 'PRINCIPAL ART' 16 'MINOR ARTERIAL' 17 'COLLECTOR'
00220000     ELSE 'OTHER');$
00230000 DEFINE DESIGNATION/A10=DECODE RRL (1 'RURAL' 2 'URBAN' 3 'URBANIZED');$
00240000 DEFINE AREA/A13=DECODE URB (00000 'RURAL' 01000 'ALBANY' 03050 'ASHLAND'
00250000     03150 'ASTORIA' 03650 'BAKER' 05800 'BEND' 10750 'CANBY'
00260000     15250 'COOS BAY' 15800 'CORVALLIS' 15950 'COTTAGE GROVE'
00270000     17700 'DALLAS' 11161 'EUGENE' 30550 'GRANTS PASS'
00280000     33700 'HERMISTON' 39700 'KLAMATH FALLS' 40350 'LA GRANDE'
00290000     41650 'LEBANON' 45000 'MC MINNVILLE' 11351 'MEDFORD'
00300000     48600 'MILTON FRWTR' 49550 'MONMOUTH' 52100 'NEWBERG'
00310000     52450 'NEWPORT' 42600 'LINCOLN CITY' 54900 'ONTARIO'
00320000     57150 'PENDELTON' 11027 'PORTLAND' 59850 'PRINEVILLE'
00330000     11286 'RAINIER' 61200 'REDMOND' 63650 'ROSEBURG' 11225 'SALEM'
00340000     65950 'SEASIDE' 67650 'SILVERTON' 64600 'ST HELENS'
00350000     71950 'SWEET HOME' 72950 'THE DALLES' 83750 'WOODBURN') ;$
00360000 DEFINE PREFIX/A80= DECODE PFX ( C 'CONNECTION(NOT ON MAIN ROUTE)'
00370000     F 'FRONTAGE ROAD (NOT ON MAIN ROUTE)'
00380000     N 'NORTHBOUND COUPLET'
00390000     S 'SOUTHBOUND COUPLET'
00400000     E 'EASTBOUND COUPLET'
00410000     W 'WESTBOUND COUPLET'
00420000     T 'TEMPORARY TRAVLED ROUTE (ON MAIN ROUTE)'
00430000     K 'NON-ADD COUPLET ON A SPUR (Y)'
00440000     L 'NON-ADD COUPLET WITH NEGATIVE MILLAGE (X)'
00450000     X 'NEGATIVE MILEPOINT'
00460000     Y 'SPUR ON STATE HIGHWAY (ON MAIN ROUTE)'
00470000     Z 'OVERLAPPING MILEAGE DUE TO POSITIVE EQUATION (ON MAIN ROUTE)');$
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