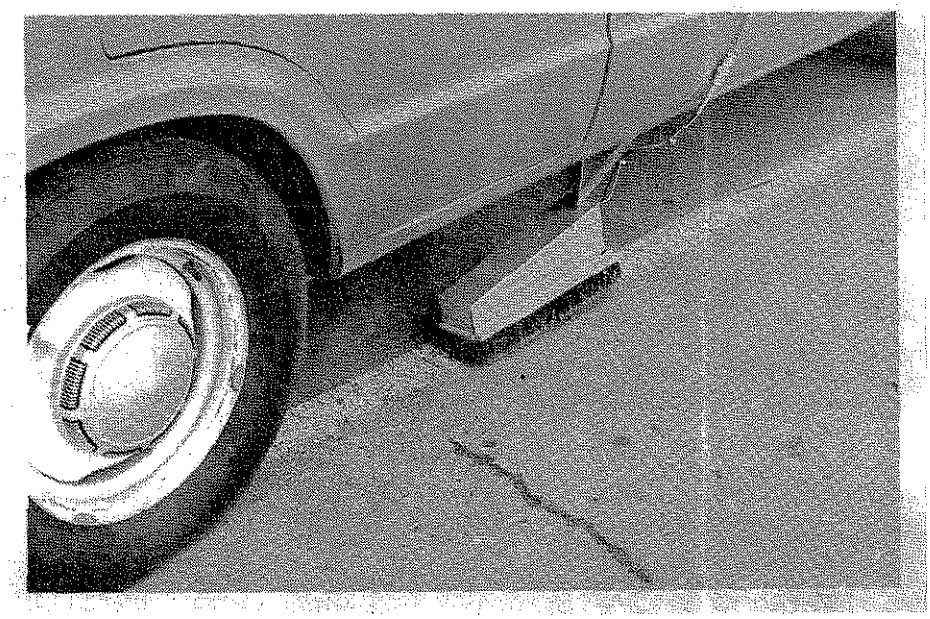
Field Evaluation of Electro-Reflective Measuring Apparatus (ERMA)



Highway Division
Office of Materials
March 1981

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FIELD EVALUATION OF ELECTRO-REFLECTIVE MEASURING APPARATUS (ERMA)

BY

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MARCH, 1981

IOWA DEPARTMENT OF TRANSPORTATION

HIGHWAY DIVISION

OFFICE OF MATERIALS

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ACKNOWLEDGEMENTS

Special thanks to Lyman Moothart, Materials Lab. Tech. 4, for successfully modifying the ERMA device; to Robert Johannes, District #1 Paint Foreman, Roy Franke, District #2 Paint Foreman, James Hall, District #3 Paint Foreman, Jack Johnson, District #4 Paint Foreman, Bert Jester, District #5 Paint Foreman, and Ron Larsen, District #6 Paint Foreman, for selecting and rating the test sections; and to Ralph Kalsem, Materials Lab. Tech 3, who supervised the ERMA field evaluation crew.

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ABSTRACT

The Electro-Reflective Measuring Apparatus (ERMA) was developed by the Minnesota Department of Highways in 1974 to measure the retro-reflective characteristics of pavement marking materials. Minnesota researchers recommended that due to the increased cost of pavement marking materials and reduced availability of these materials, ERMA can and should be used as a maintenance management tool to determine when painting is necessary rather than according to a fixed time schedule. ①

The Iowa DOT Office of Materials built an ERMA device patterned after Minnesota's design in 1976. Subsequent efforts to calibrate and correlate this ERMA device to District Paint Foremen ratings proved unsuccessful, and ERMA modification or abandonment was recommended in 1979.

Lyman Moothart, Materials Lab. Tech. 4, modified the ERMA device in 1980 and correlation attempts to District Paint Foremen ratings conducted in November 1980 have been moderately successful. A Paint/No Paint ERMA value has been established which will identify about 90% of the painting needs but will also include about 40% of the marking lines not needing repainting.

The Office of Maintenance should establish a trial ERMA program to study the accuracy and potential cost savings of using ERMA to identify pavement marking needs.

① E.R.M.A. A RETRO-REFLECTIVITY DEVICE
Materials, Research And Standards Division,
Minnesota Department of Highways,
Special Study 276, Preliminary Report 1974, MECHANICS
Prepared by H. J. Gillis, Research Assistant

FIELD EVALUATION
OF
ELECTRO-REFLECTIVE MEASURING APPARATUS
(ERMA)

Introduction:

The Electro-Reflective Measuring Apparatus (ERMA) was developed by the Minnesota Department of Highways in 1974 to measure the retro-reflective characteristics of pavement marking materials. The Iowa DOT Office of Materials built an ERMA device patterned after Minnesota's design in 1976. Subsequent efforts in 1977 and 1978 to calibrate and correlate the ERMA device to District Paint Foremen Ratings proved unsuccessful, and ERMA was not effective in evaluating the reflective quality of pavement marking materials during a study conducted in 1979. There was not enough range in the machine between the reflectivity of good and poor marking materials or between the reflectivity of marking materials and background portland cement concrete. Also, the ERMA device could not be calibrated to black and white standards statewide. It was recommended in 1979 that ERMA be modified to increase the range between black and white standards and to read the same on black and white standards at all times or be abandoned.

ERMA modification was performed in 1980 by Lyman Moothart, Materials Lab. Tech. 4. Modifications included: (1) Use of a co-axial scanner, which sends and receives light along a common axis, to minimize the effect of ambient light filtering into the sensor box; (2) Full scale graph deflection of 50 millimeters (50 minor divisions) to increase the machine range;

and (3) Increased sensor light angle with the pavement (from 17^{o} to 40^{o}) which provides calibration capability to adjust ERMA readings to black and white standards at all times.

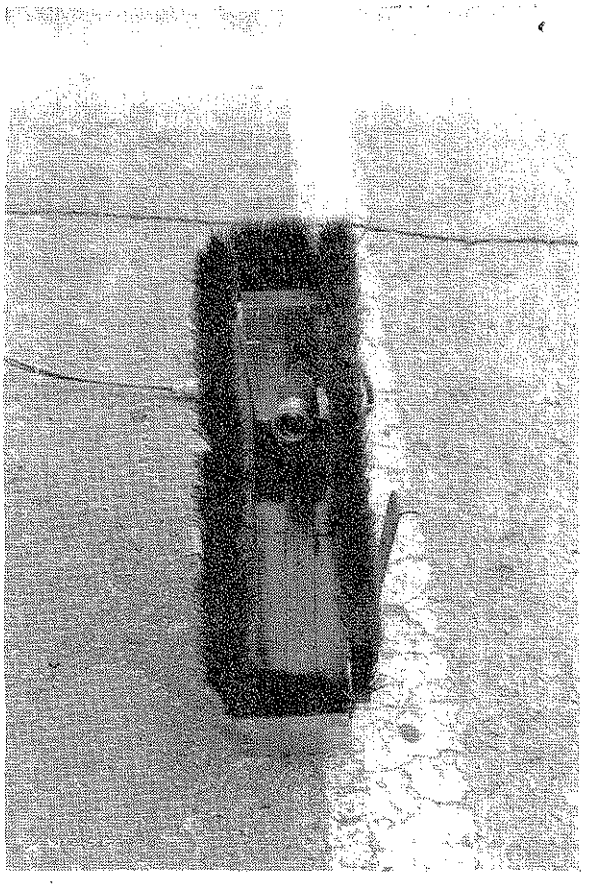


FIGURE NO. 1

ERMA SENSOR LIGHT

A work plan was written in September 1980 to evaluate the newly-modified ERMA device. This work plan is included in Appendix "A" of this report and briefly consisted of selecting fifty (50) one-mile test sections of various marking line condition, rating the test sections individually by six (6)

District Paint Foremen based on general condition and reflectivity alone, and using ERMA to measure marking line reflectivity and contrast in both the static and dynamic test positions. Contrast is the difference in reflectivity (ERMA Readings) of the marking line minus the background pavement reading. Static ERMA readings were taken in a stationary position (Figure No. 2 and Figure No. 3), and dynamic ERMA readings were taken at 40 miles per hour (Figure No. 4).

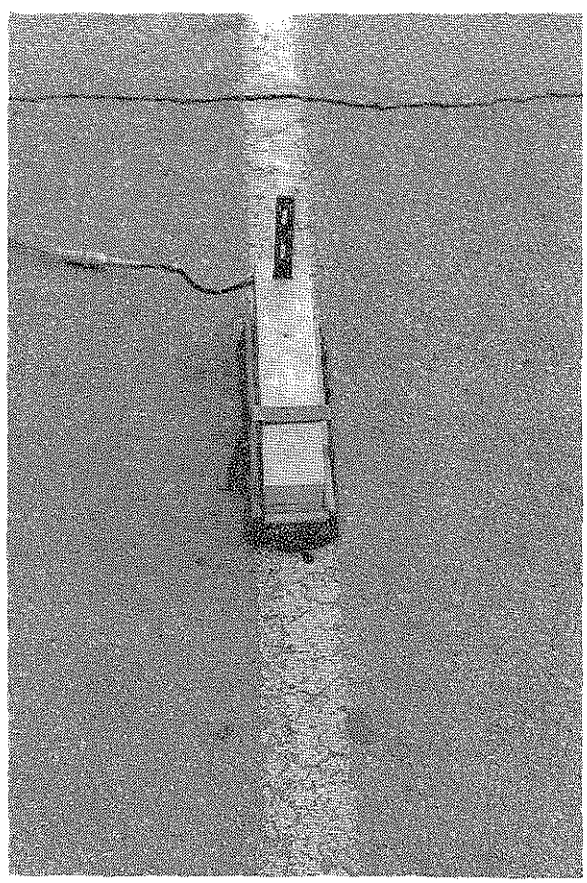


FIGURE NO. 2

STATIC ERMA TEST POSITION
ON MARKING LINE

FIGURE NO. 3

STATIC ERMA TEST POSITION
ON BACKGROUND PAVEMENT

FIGURE NO. 4

DYNAMIC ERMA TEST POSITION
PERFORMED AT 40 M.P.H.

Test section location, District Paint Foremen ratings on test sections, and ERMA readings on test sections are included in Appendix "B", Appendix "C", and Appendix "D", respectively, of this report. This information provided the raw test data for linear correlation studies on the computer. Those variables with the highest correlation coefficients were graphically plotted for further analysis.

ERMA Operation And Interpretation Of ERMA Test Data:

ERMA principle of operation and operating instructions are included in Appendix "E" of this report. ERMA calibration procedures consist of placing the sensor box on black and white standards and adjusting the position and gain controls of the recorder to achieve zero and full scale deflection, respectively, on the graphical output.

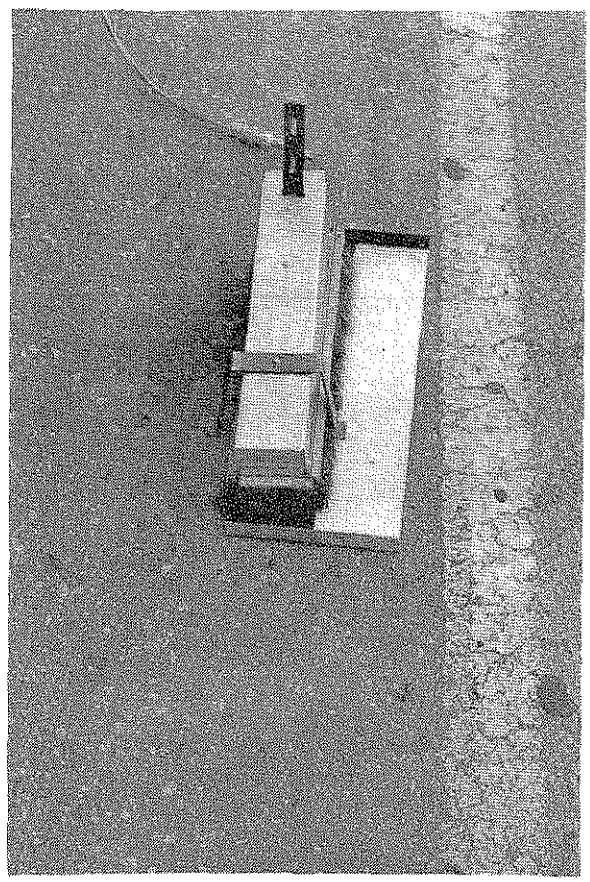


FIGURE NO. 5

ERMA SENSOR BOX ON
BLACK CALIBRATION STANDARD

FIGURE NO. 6

ERMA SENSOR BOX ON
WHITE CALIBRATION STANDARD

The black standard consists of flat black paint and the white standard consists of 3M brand Stamark marking material. Originally, it was felt that a third yellow Stamark calibration standard would be required, but this proved not to be the case. The ERMA device deflected the same on both white and yellow Stamark calibration standards thereby eliminating the need for the yellow standard. Evidently, the white and yellow colors are similar enough not to affect ERMA readings, and reflectivity is mostly due to impregnated glass beads.

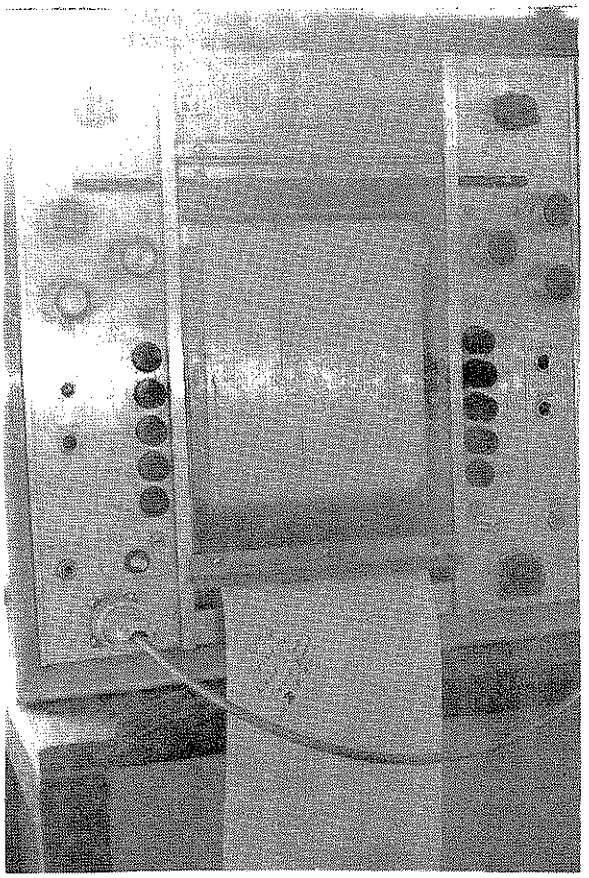


FIGURE NO. 7

ERMA RECORDER

Examples of ERMA graphical output for calibration, static test position, and dynamic test position are shown in Figure No. 8, Figure No. 9, and Figure No. 10, respectively. Note that the marking line reflectivity and background pavement reading are rather well-defined for the static test position shown in Figure No. 9. The ERMA static contrast would be 24 for this example (34-10 = 24).

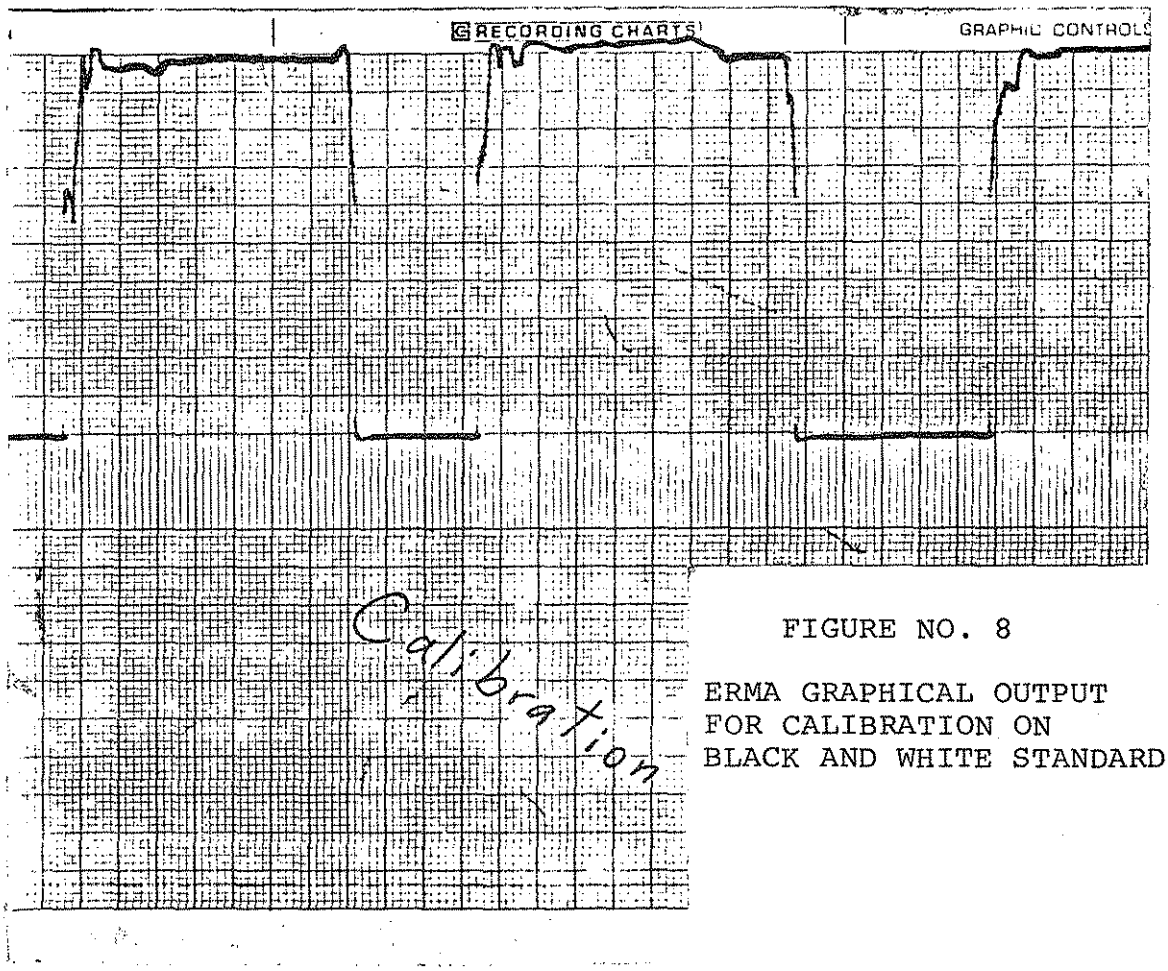


FIGURE NO. 8

ERMA GRAPHICAL OUTPUT
FOR CALIBRATION ON
BLACK AND WHITE STANDARDS

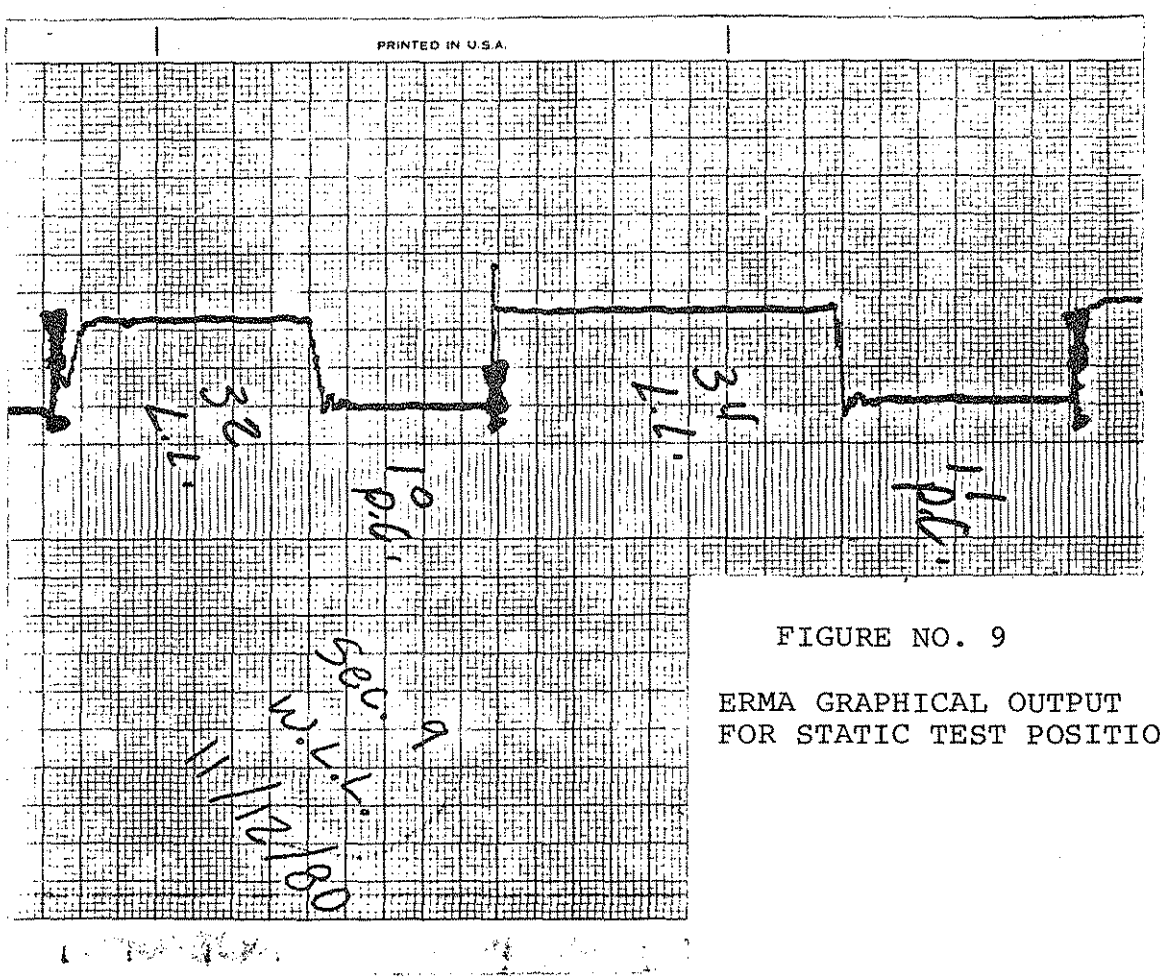


FIGURE NO. 9

ERMA GRAPHICAL OUTPUT
FOR STATIC TEST POSITION

The graphical output of ERMA dynamic testing at 40 m.p.h. is evaluated by visually placing a line through the average peaks and valleys as illustrated in Figure No. 10. The ERMA dynamic contrast would be 24 for this example (30-6 = 24).

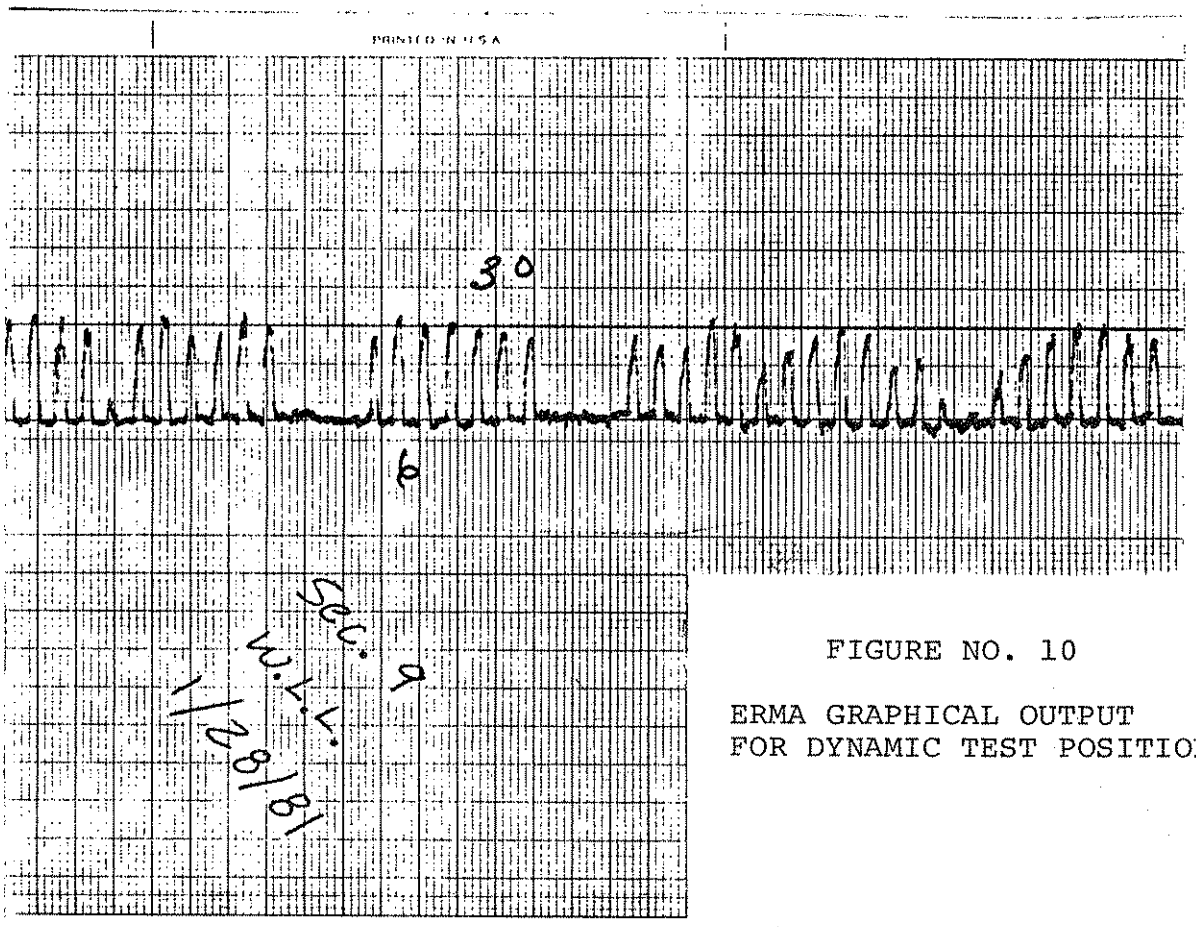


FIGURE NO. 10

ERMA GRAPHICAL OUTPUT
FOR DYNAMIC TEST POSITION

Dynamic ERMA readings are not always well-defined and some variance in interpretation of test data from person to person may be experienced. This variance should be tolerable considering that ERMA reflectivity testing is not an exact science, but rather only gives a general indication of pavement marking condition.

Erratic dynamic ERMA readings may sometimes be encountered when driving toward the sunlight (Figure No. 11). This is due to the infiltration of sunlight into the ERMA sensor box and can be alleviated by either testing in the opposite direction or testing at another time of day.

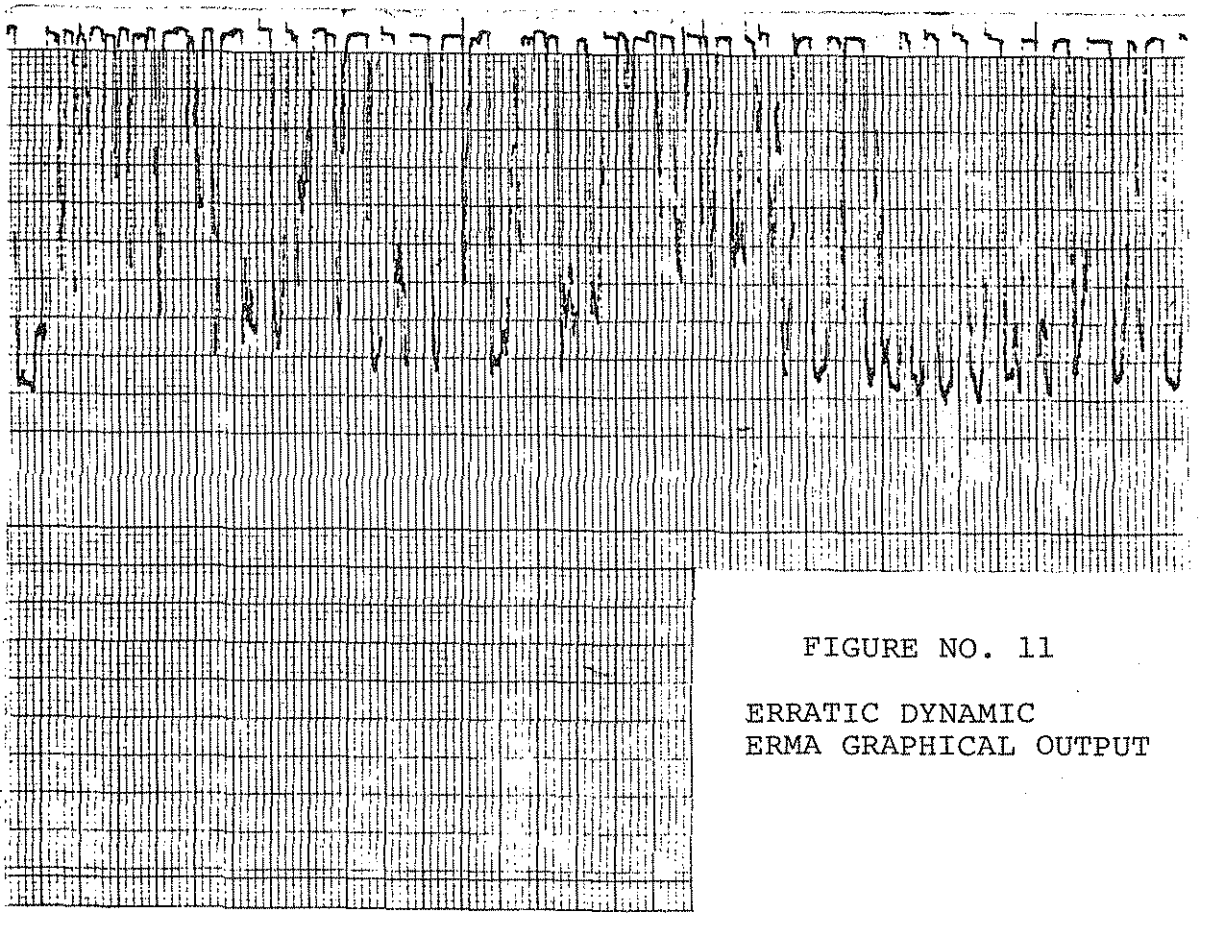


FIGURE NO. 11

ERRATIC DYNAMIC
ERMA GRAPHICAL OUTPUT

Other ERMA limitations include:

1. The 40 m.p.h. dynamic testing speed, which is the fastest speed the driver can keep the sensor box directly over the marking line;

2. The time of year, which is restricted to non-winter months since salt residue can obscure marking lines and cause unusually high pavement background readings;

3. ERMA mounting, which is presently restricted to the left-hand side of the test van preventing edge line evaluation in some cases; and

4. Sensor light intensity, which presently restricts the pavement angle to 40^{o} and is more difficult to calibrate than a higher intensity light would be.

Evaluation Of ERMA Correlation To District Paint Foremen Ratings:

The work plan in Appendix "A" of this report established a large number of variables for study. Linear correlation programming on the computer based on the least squares method was used to search for significant correlation coefficients among these variables. A perfect correlation coefficient is 1.0000 where all points lie along a line, and one variable can accurately be used to predict what the other variable will be throughout the entire range of points. A correlation coefficient of 0.0000 represents a random distribution of points with no correlation whatsoever.

A list of variables correlated on the computer and their respective correlation coefficients is included in Appendix "F" of this report. ERMA static and dynamic contrast readings correlated better to the District Paint Foremen nighttime reflectivity ratings than the ERMA static and dynamic marking line reflectivity readings did. This is not surprising since, intuitively, a good marking line is dependent not only on the reflectivity of the marking line itself but also on the reflectivity of the material on which it is placed. Any given marking line would be better-defined on black asphaltic concrete pavement, for instance, than on white portland cement concrete pavement.

District Paint Foremen nighttime reflectivity ratings consisted of six (6) independent 0 to 100 ratings of each

test section based on nighttime reflectivity alone. The rating panel members were instructed that a rating of 100 would be a perfect installation just repainted while a rating of 0 would be an installation invisible at night. The six independent ratings were later averaged to produce an average District Paint Foremen nighttime reflectivity rating for each test section.

In a similar manner, District Paint Foremen daytime general condition ratings consisted of six (6) independent 0 to 100 ratings of each test section based on daytime general condition. Rating panel mamebers were instructed to consider the amount of paint missing, faded, etc., and to assign a value of 100 to a perfect installation just repainted and a value of 0 to an installation with paint completely missing. These ratings were later averaged to produce an average District Paint Foremen daytime general condition rating for each test section.

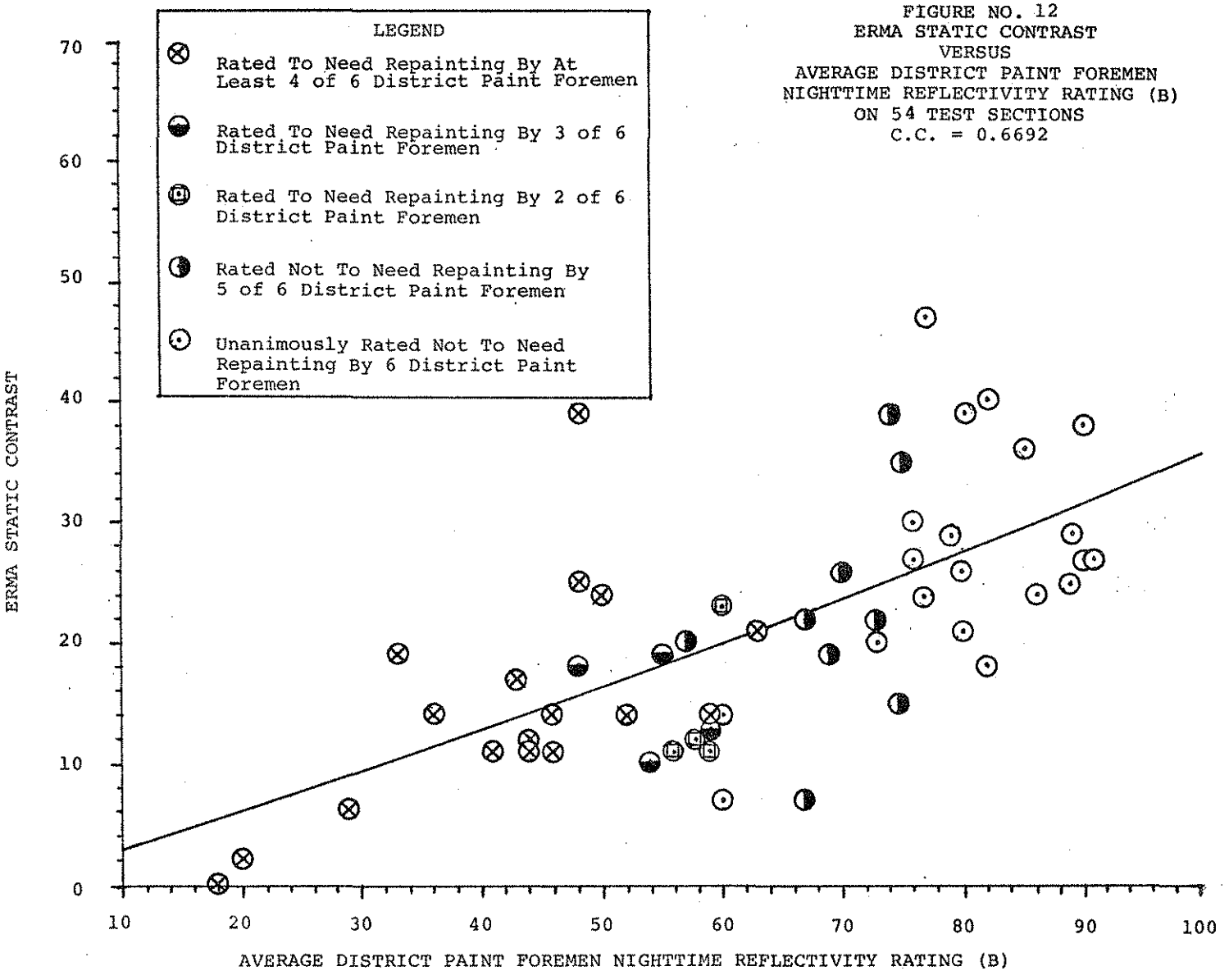
Average District Paint Foremen composite ratings were determined for each test section by averaging daytime and nighttime ratings together. Each District Paint Foreman also independently judged each test section to need repainting or not.

Figure No. 12 and Figure No. 13 illustrate the relationships between ERMA static and dynamic contrast readings and average District Paint Foremen nighttime reflectivity ratings. The correlation coefficients were not as high as hoped, but

still proved significant since the study objective was to determine an ERMA paint/no paint value and not necessarily to predict what a District Paint Foreman rating would be from any given ERMA contrast reading. In addition, the ERMA device correlated almost as well to the average District Paint Foremen nighttime reflectivity ratings as any two (2) District Paint Foremen correlated to each other.

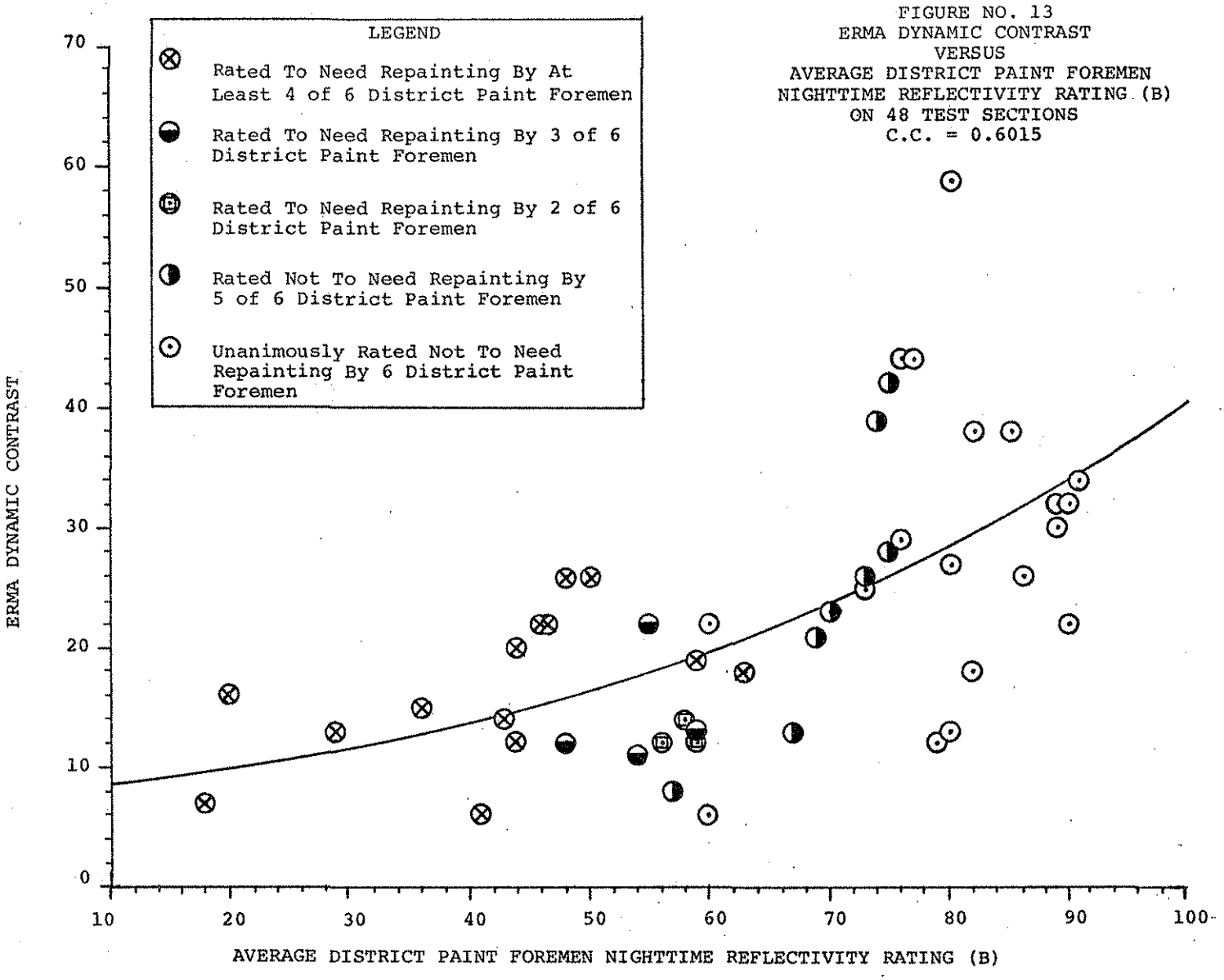
(See Page F-4)

FIGURE NO. 12
ERMA STATIC CONTRAST
VERSUS
AVERAGE DISTRICT PAINT FOREMEN
NIGHTTIME REFLECTIVITY RATING (B)
ON 54 TEST SECTIONS
C.C. = 0.6692



Assuming a test section should be repainted if at least two (2) District Paint Foremen rated the section to need repainting, then 25 test sections need repainting and 29 test sections do not need repainting in Figure No. 12. At a static ERMA contrast value of 20, 20 of 25 or 80% of the test sections requiring repainting are identified, but 8 of 29 or 28% of the test sections not requiring painting are also included. At a static ERMA contrast value of 25, 24 of 26 or 96% of the needs are identified, but 14 of 29 or 48% of the test sections not requiring painting are also included.

FIGURE NO. 13
ERMA DYNAMIC CONTRAST
VERSUS
AVERAGE DISTRICT PAINT FOREMEN
NIGHTTIME REFLECTIVITY RATING (B)
ON 48 TEST SECTIONS
C.C. = 0.6015

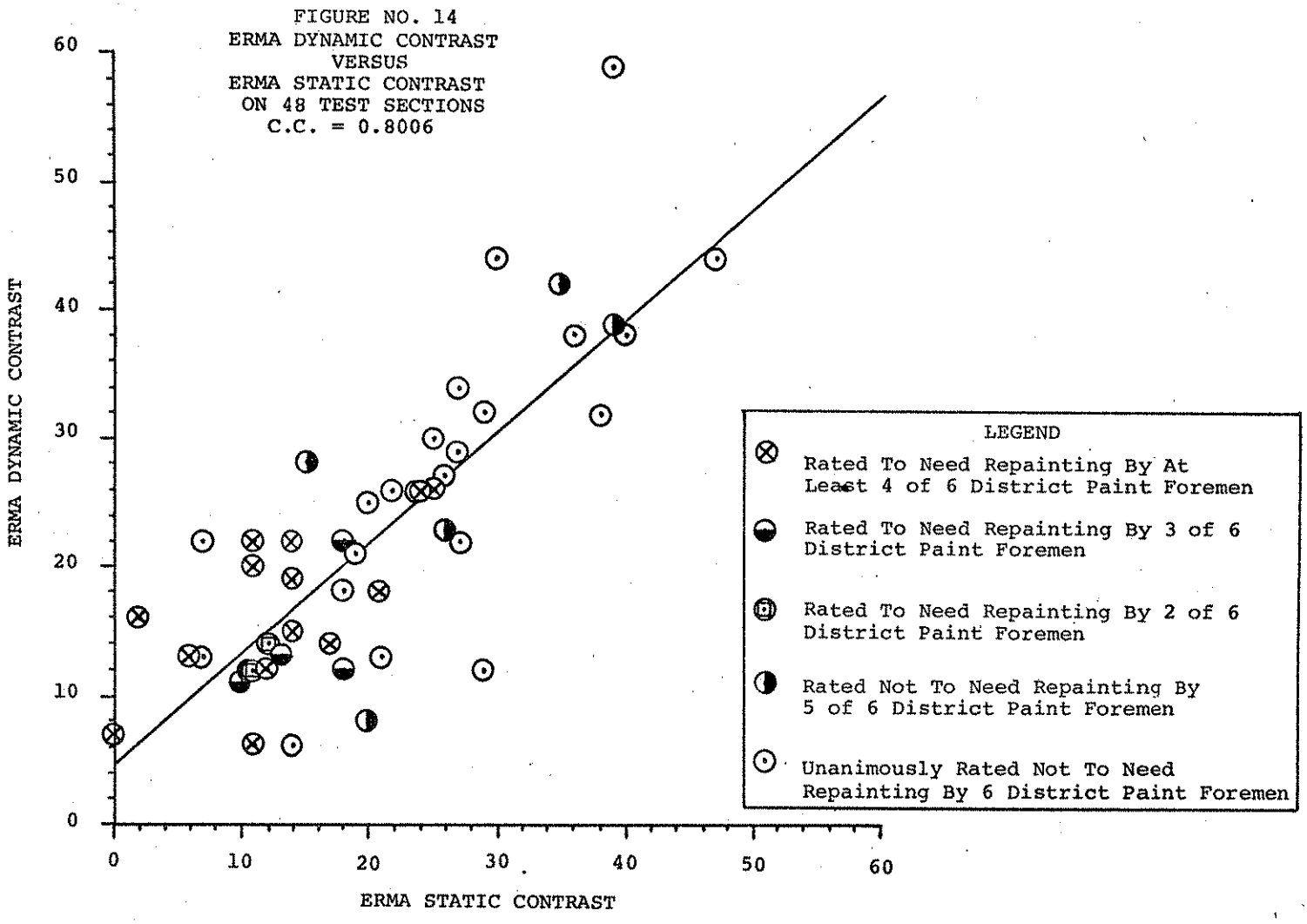


Using a similar analysis in Figure No. 13, at a dynamic ERMA contrast of 20, 76% of the needs are identified, but 22% of the test sections not requiring painting are also included. At a dynamic ERMA contrast of 25, 90% of the needs are identified, but 41% of the test sections not requiring painting are also included.

An ERMA contrast reading of 25 appears to be the best paint/no paint value. This value will identify about 90% of the painting needs but will also include about 40% of the marking lines not needing repainting. The following table was developed from Figure No. 12 and Figure No. 13 and can be used to generally categorize pavement marking line condition based on ERMA contrast readings:

ERMA CONTRAST	REFLECTIVITY RATING
20 Or Less	Poor Reflectivity - Needs Repainting
21 To 25	Marginal Reflectivity - May Or May Not Need Repainting
26 Or More	Good Reflectivity - Does Not Need Repainting

Figure No. 14 shows that ERMA static and dynamic contrast correlate very well together (c.c. = 0.8006). ERMA static contrast is a more accurate indicator of pavement marking line reflectivity than ERMA dynamic contrast since very little or no ambient light filters into the sensor box in the static test position, and since less graphical interpretation is required. For this reason, ERMA static testing is used to specially evaluate pavement marking materials while ERMA dynamic testing is used to determine maintenance painting requirements.



ERMA static contrast for yellow marking lines only correlated very well to District Paint Foremen nighttime reflectivity ratings as can be seen in Figure No. 15. The corresponding ERMA dynamic contrast for yellow marking lines only did not correlate well, however, as can be seen in Figure No. 16. The same problem occurred that all test sections below an ERMA contrast reading of 25 were not rated to need repainting by the District Paint Foremen.

Even though this problem exists, a substantial cost savings in painting materials may still be realized by using ERMA to identify maintenance painting needs. This will depend on the mileage of pavement marking lines with sufficient reflectivity not to need repainting as rated by the ERMA device that would have been repainted otherwise. A trial ERMA program by the Office of Maintenance would establish the ERMA dynamic contrast value of marking lines which would survive the winter with adequate reflectivity. This value may be 30 to 35.

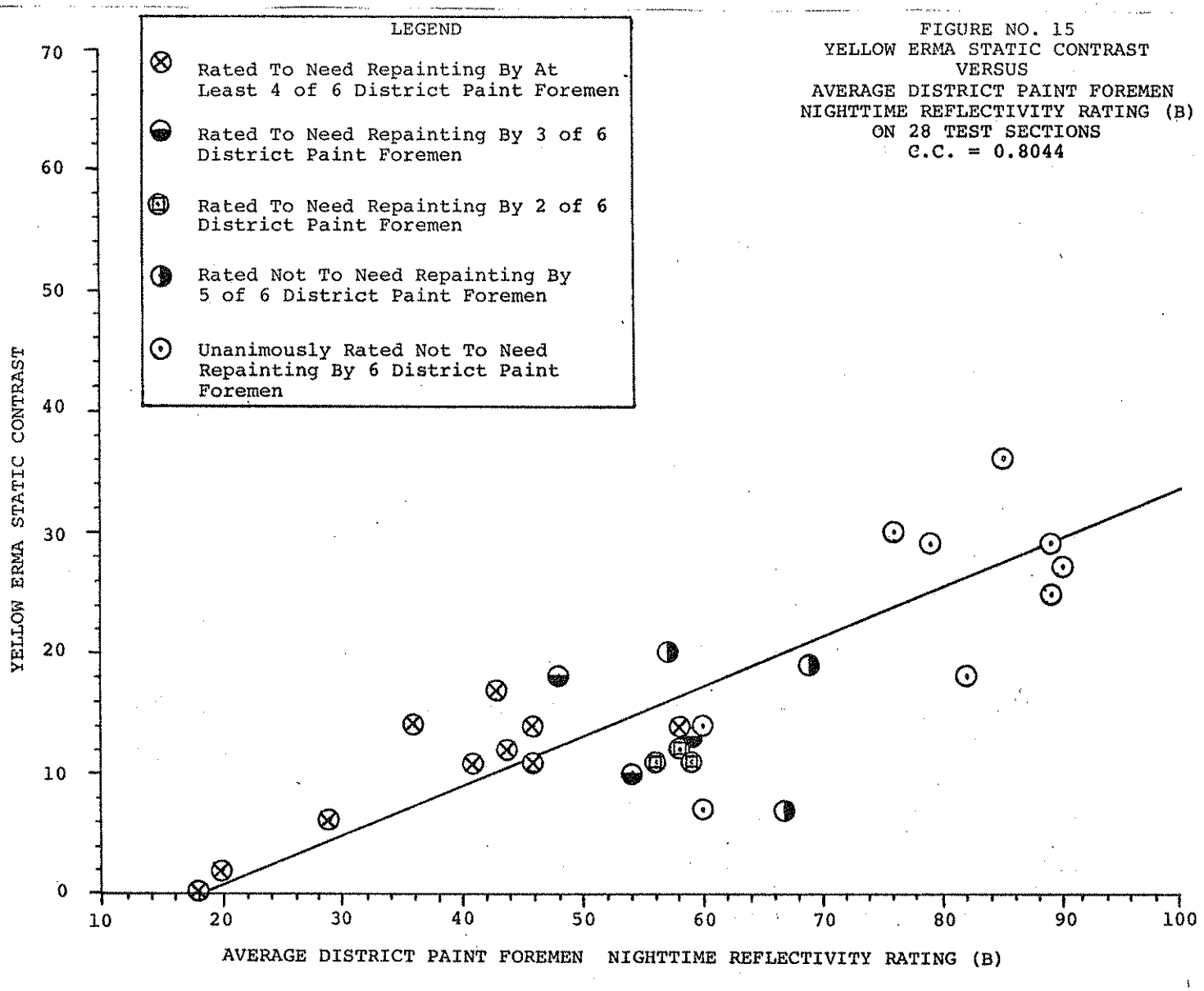
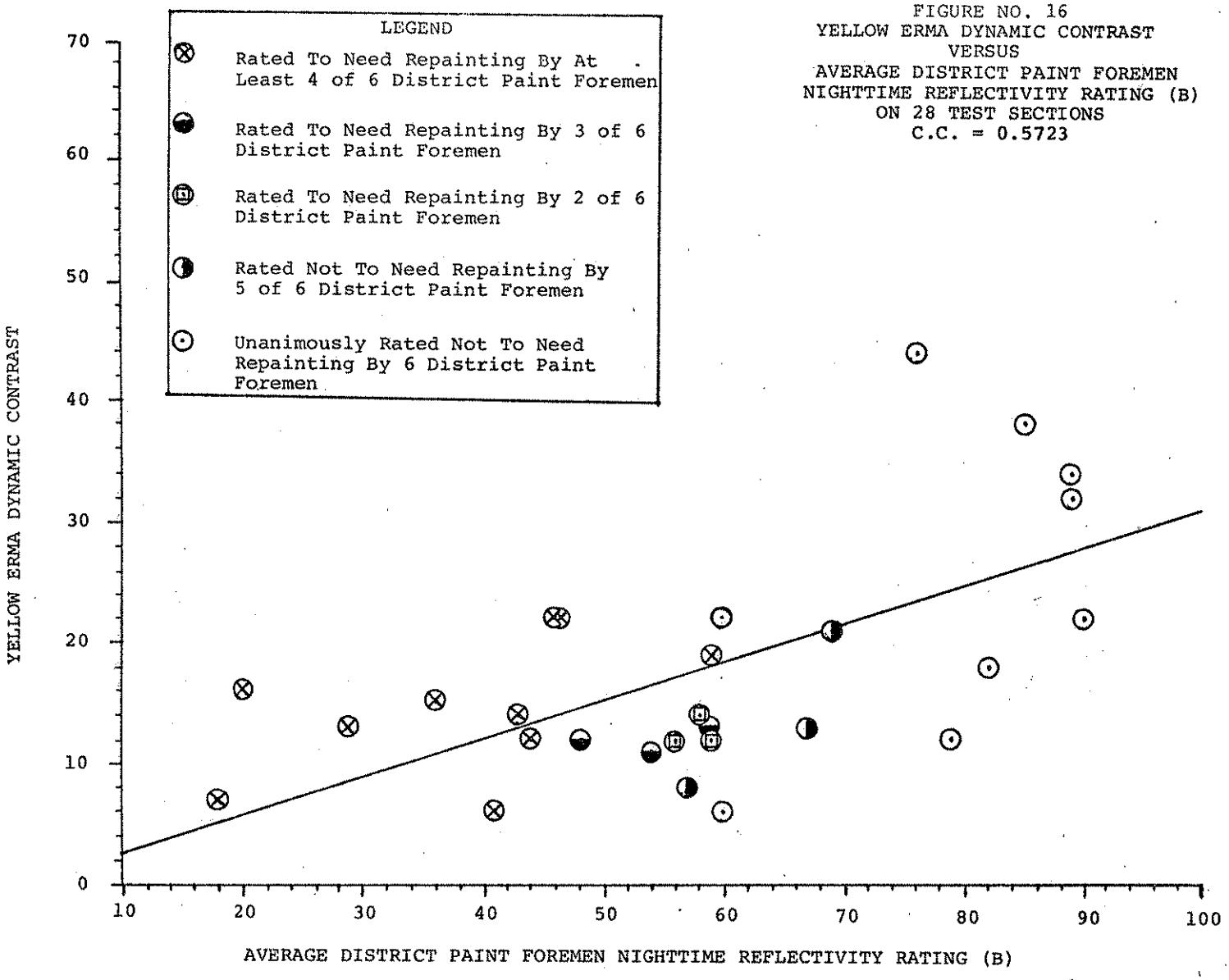


FIGURE NO. 15
YELLOW ERMA STATIC CONTRAST
VERSUS
AVERAGE DISTRICT PAINT FOREMEN
NIGHTTIME REFLECTIVITY RATING (B)
ON 28 TEST SECTIONS
C.C. = 0.8044

FIGURE NO. 16
YELLOW ERMA DYNAMIC CONTRAST
VERSUS
AVERAGE DISTRICT PAINT FOREMEN
NIGHTTIME REFLECTIVITY RATING (B)
ON 28 TEST SECTIONS
C.C. = 0.5723



ERMA's cost-effectiveness could be determined by subtracting ERMA testing costs from paint savings resulting from its use. A two-person test crew and test van are required for ERMA dynamic testing at 40 m.p.h. Assuming an hourly wage of $8 per hour, a test van operating rate of 10¢ per mile and no lodging, ERMA test data can be collected and reduced for approximately $2 per mile. This compares favorably to the potential cost savings of painting materials alone ($44 per mile for centerline and $59 per mile for edge line).

FIGURE NO. 17
ERMA STATIC CONTRAST REPEATABILITY
ON 54 TEST SECTIONS
C.C. = 0.6551

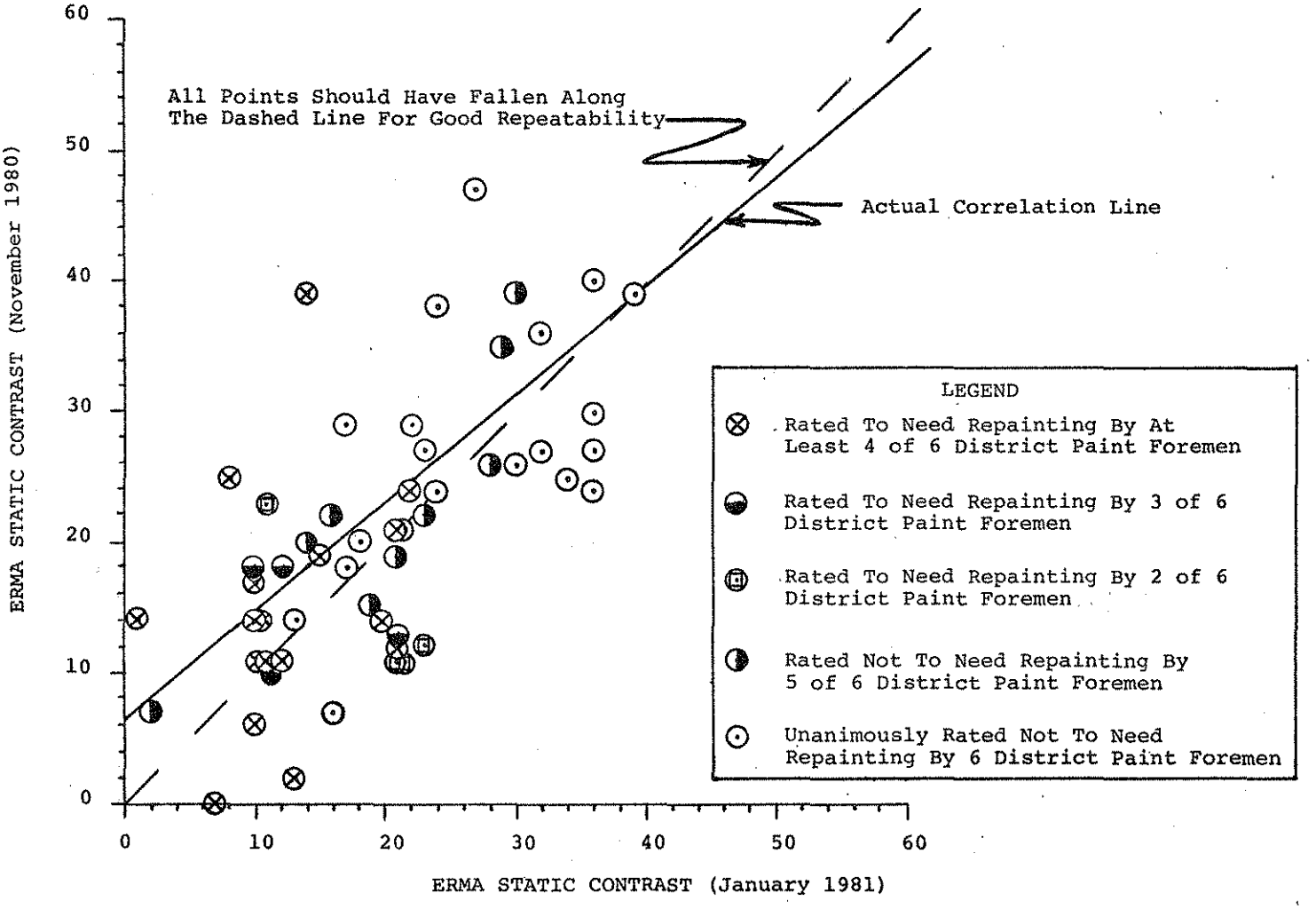
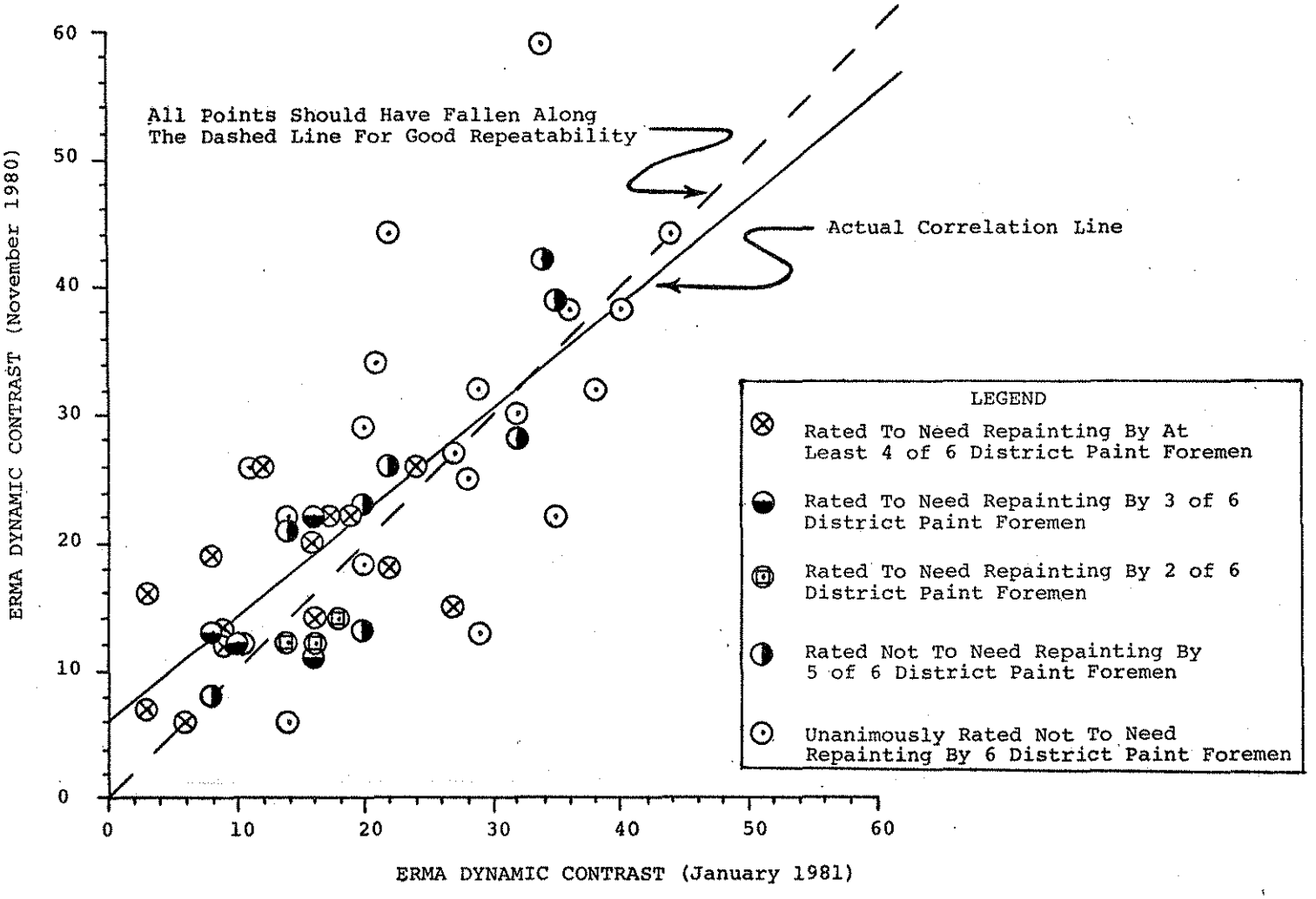


Figure No. 17 and Figure No. 18 demonstrate ERMA static and dynamic repeatability, respectively, between November 1980 and January 1981. Normally, salt residue would make marking line reflectivity very different between these two times, but Winter '80-'81 was especially mild resulting in fewer salt applications and less corresponding marking line and pavement discoloration.

FIGURE NO. 18
ERMA DYNAMIC CONTRAST REPEATABILITY
ON 48 TEST SECTIONS
C.C. = 0.7326



ERMA repeatability was not quite as good as expected but bad and good marking lines were still distinguished (with some interchange) at an ERMA contrast value of 25.

ERMA devices can be built for approximately $3,500 each. This includes $400 for the co-axial scanner, $3,000 for the recorder, and $100 for miscellaneous hardware. A test van would also be required, but could be used for other District Paint Foremen activities.

Conclusions:

1. Modifications to the ERMA device performed in 1980 including use of a co-axial scanner, full scale graph deflection of 50 millimeters and calibration capability, have greatly improved the machine.

2. The ERMA device (as presently constructed) is mostly detecting reflectivity due to glass beads since the machine deflected the same on both white and yellow 3M Stamark calibration standards.

3. ERMA correlation attempts conducted in November of 1980 have been moderately successful. A Paint/No Paint ERMA value has been established which will identify about 90% of the painting needs but will also include about 40% of the marking lines not needing repainting.

4. The ERMA device correlated almost as well to average District Paint Foremen nighttime reflectivity ratings as any two (2) District Paint Foremen correlated to each other.

5. ERMA testing to identify maintenance painting needs appears to have good cost-saving potential since ERMA test data can be collected and reduced for about $2 per mile while centerline painting costs $44 per mile and edgeline painting costs $59 per mile for materials alone.

Recommendations:

1. Future ERMA devices (if any) should use a higher intensity sensor light to simplify calibration procedures.

2. Identical ERMA sensor box assemblies should be mounted on both sides of the test van to permit either centerline or edgeline testing at 40 m.p.h. by the flip of a switch by the recorder operator.

3. The Office of Maintenance should establish a trial ERMA program to determine the ERMA contrast value of marking lines which would survive the winter, and to study the accuracy and potential cost savings of using ERMA to identify pavement marking needs.

4. If this trial ERMA program proves successful, more ERMA devices should be constructed and made available to District Paint Foremen at a cost of $3,500 each plus test van.

APPENDIX "A"

WORK PLAN TO EVALUATE ERMA

WORK PLAN TO EVALUATE ERMA
(Electro-Reflective Measuring Apparatus)

1. Select 50 one-mile sections in District #1 with paint lines of various condition (I.E. some just repainted, some badly needing repainting, etc.)

   A. Robert Johannes, District #1 Paint Foreman, will select the sections.
   B. Include I-80 at the N.E. Mixmaster in Des Moines (3M Stamark installation)

2. The 6 District Paint Foremen will drive the 50 test sections at day and at night and independently assign a value from 0 to 100 to each test section based on general condition and reflectivity.

   A. Worksheets with instructions will be developed and provided by the Special Investigations Section.
   B. A daytime field review of each test section will result in 6 independent 0-100 ratings for each test section based on general condition alone. Consider amount of paint missing, faded, etc. A rating of 100 would be a perfect installation just repainted, while a rating of 0 would be an installation with paint completely missing.
   C. A nighttime field review of each test section will result in 6 independent 0 to 100 ratings for each test section based on reflectivity alone. A rating of 100 would be a perfect installation just repainted, while a rating of 0 would be an installation not visible at all at night.
   D. An average 0 to 100 composite rating for each test section will be determined by adding the daytime and nighttime ratings together and dividing by 2.
   E. Each test section will be independently judged to need repainting or not by the 6 District Paint Foremen.

3. ERMA will be used to assign a 0 to 6 reflectivity rating to each test section. A rating of 6 will result on a newly painted installation, while a rating of 0 will result on an installation with no nighttime reflectivity at all.

   A. Contrast will also be determined for each test section by subtracting the background ERMA reading from the paint marking ERMA reading.
   B. Five stationary readings (with corresponding background readings) will be taken and averaged for each test section to assign an ERMA rating to each test section.
   C. A moving (Mobile) ERMA rating will also be assigned to each test section.

4. Computer correlations of Paint Foreman ratings and ERMA ratings will be made.

   A. If no correlation exists, further ERMA development or abandonment is required.

   B. If a meaningful correlation does exist, a Paint/No Paint ERMA Value will be determined and a trial ERMA Program established with Ron Hagen of Central Maintenance.

ERMA FIELD EVALUATION WORKSHEET

Name _____

Date _____

Section Number	Location	A Daytime Rating Based On General Condition (0-100)	B Nighttime Rating Based On Reflectivity Alone (0-100)	Composite Rating $(\frac{A+B}{2})$	Does This Section Need Repainting? Yes	No

APPENDIX "B"
TEST SECTION LOCATION

B-1

TEST SECTION LOCATION

ABBREVIATION LIST

Abbreviation	Meaning
NB	Northbound
SB	Southbound
EB	Eastbound
WB	Westbound
AC	Asphaltic Concrete Pavement
PC	Portland Cement Concrete Pavement
WLL	White Lane Line
YCL	Yellow Center Line
WEL	White Edge Line
LT.YEL	Left Yellow Edge Line
RT.WEL	Right White Edge Line

TEST SECTION LOCATION

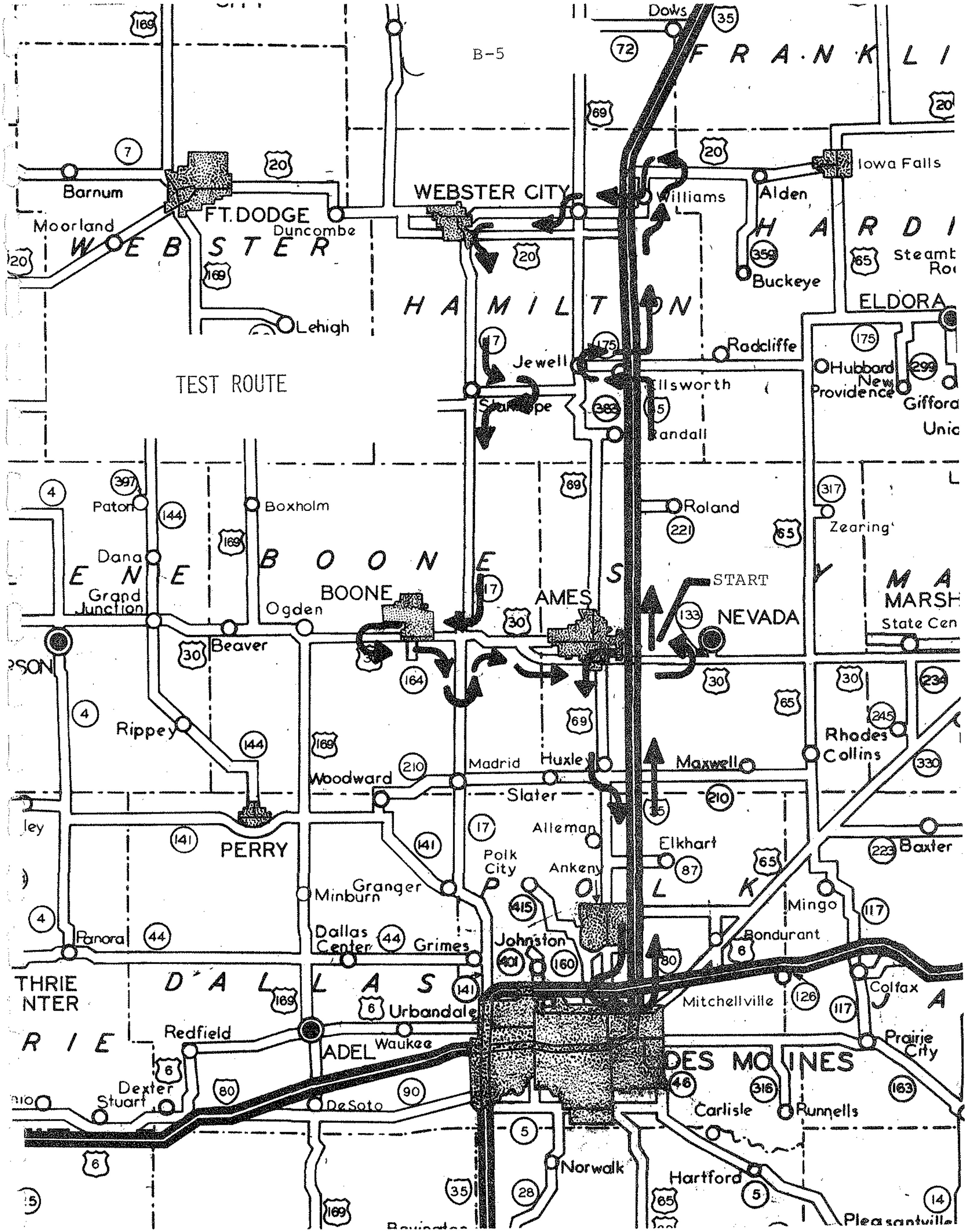
Test Section Number	Route	Milepost	Surface Type	Line Type
1	NB I-35	115	PC	WLL
2	NB I-35	118	PC	LT. YEL
3	NB I-35	121	PC	RT. WEL
4	NB I-35	126	PC	WLL
5	NB I-35	129	PC	LT. YEL
6	NB I-35	131	PC	RT. WEL
7	Iowa 175	157	New PC	YCL
8	Iowa 175	157	New PC	WEL
9	NB I-35	140	PC	WLL
10	NB I-35	142	PC	LT. YEL
11	U.S. 20	155	AC	YCL
12	U.S. 20	160	AC	WEL
13	U.S. 20	159	AC	YCL
14	U.S. 20	153	AC	YCL
15	U.S. 20	152	AC	WEL
16	U.S. 69	147	AC	YCL
17	WB 520	147	PC	RT. WEL
18	WB 520	145	PC	WLL
19	WB 520	143	PC	LT. YEL
20	Iowa 17	48	PC	YCL
21	Iowa 17	45	PC	YCL
22	Iowa 17	39	PC	YCL
23	Iowa 17	37	PC	YCL

TEST SECTION LOCATION (CON'D)

Test Section Number	Route	Milepost	Surface Type	Line Type
24	Iowa 175	147	AC	YCL
25	Iowa 175	146	AC	YCL
26	Iowa 17	34	PC	YCL
27	Iowa 17	30	PC	YCL
28	Iowa 17	27	PC	YCL
29	Iowa 17	24	PC	YCL
30	WB U.S. 30	136	PC	WLL
31	WB U.S. 30	134	PC	LT.YEL
32	WB U.S. 30	132	PC	RT.WEL
33	EB U.S. 30	133	PC	RT.WEL
34	EB U.S. 30	134	PC	WLL
35	EB U.S. 30	136	PC	LT.YEL
36	Iowa 17	18	AC	YCL
37	EB U.S. 30	139	PC	WLL
38	EB U.S. 30	141	PC	LT.YEL
39	EB U.S. 30	144	PC	RT.WEL
40	EB U.S. 30	146	PC	WLL
41	EB U.S. 30	149	PC	WLL
42	WB U.S. 30	149	PC	WLL
43	U.S. 69	109	AC	YCL
44	Iowa 210 (From Iowa 69 to I-35)	6	AC	YCL
45	SB I-35	101	PC	WLL

TEST SECTION LOCATION (CON'D)

Test Section Number	Route	Milepost	Surface Type	Line Type
46	SB I-35	99	PC	LT.YEL
47	SB I-35	97	PC	RT.WEL
48	NB I-35	98	PC	WLL
49	NB I-35	100	PC	LT.YEL
50	NB I-35	103	PC	RT.WEL
51	NB I-35	106	PC	WLL
52	NB I-35	108	PC	LT.YEL
53	WB I-35, 80(From NE Mixmaster to U.S. 69)	-	AC	All Lines
54	EB I-35, 80(From NE Mixmaster to U.S. 69)	-	AC	All Lines


TEST ROUTE
START
FRANKLI
WEBSTER
HAMILTON
HARDI
BOONE
POLK
DALLAS
FT. DODGE
WEBSTER CITY
Iowa Falls
Barnum
Moorland
Duncombe
Lehigh
Dows
Williams
Alden
Buckeye
Steamb
ELDORA
Radcliffe
Jewell
Ellsworth
Stanhope
Randall
Hubbard
New Providence
Gifford
Paton
Boxholm
Dana
Grand Junction
Ogden
BOONE
AMES
NEVADA
Beaver
Roland
Zearing
MARSH
State Cen
Rippey
Madrid
Huxley
Maxwell
Rhodes
Collins
Woodward
Slater
PERRY
Alleman
Elkhart
Baxter
Polk City
Ankeny
Granger
Minburn
Mingo
Dallas Center
Grimes
Johnston
Bondurant
Panora
Colfax
Mitchellville
Urbandale
Redfield
ADEL
Waukee
DES MOINES
Prairie City
Dexter
Stuart
DeSoto
Carlisle
Runnells
Norwalk
Hartford
Pleasantville

APPENDIX "C"
DISTRICT PAINT FOREMEN
RATINGS ON 54 TEST SECTIONS

DISTRICT PAINT FOREMEN RATINGS ON 54 TEST SECTIONS

LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviation Or Symbol	Meaning
AC	Asphaltic Concrete Pavement
PC	Portland Cement Concrete Pavement
WLL	White Lane Line
YCL	Yellow Centerline
WEL	White Edge Line
LT.YEL	Left Yellow Edge Line
RT.WEL	Right Yellow Edge Line
A	Daytime District Paint Foremen Rating Based on General Condition (0-100)
B	Nighttime District Paint Foremen Rating Based on Reflectivity Alone (0-100)
(A+B)/2	Composite District Paint Foremen Rating (0-100) Which Is The Average Rating Of A Plus B Above
⊗	Rated To Need Repainting By At Least 4 of 6 District Paint Foremen
◒	Rated To Need Repainting By 3 Of 6 District Paint Foremen
◍	Rated To Need Repainting By 2 Of 6 District Paint Foremen
◑	Rated Not To Need Repainting By 5 of 6 District Paint Foremen
⊙	Unanimously Rated Not To Need Repainting By 6 District Paint Foremen

DISTRICT PAINT FOREMEN RATINGS ON 54 TEST SECTIONS

11/12/80

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TEST SECTION NO.	MARKING LINE TYPE	PAVEMENT TYPE	DISTRICT #1				DISTRICT #2				DISTRICT #3				DISTRICT #4				DISTRICT #5				DISTRICT #6				AVERAGE			
			A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?
1	WLL	PC	75	65	70	No	85	75	80	No	89	87	88	No	85	95	90	No	75	80	77	No	85	75	70	No	82	80	81	⊙
2	LT.YEL	PC	85	85	85	No	87	90	89	No	87	90	88	No	85	95	90	No	77	80	78	No	95	100	97	No	86	90	88	⊙
3	RT.WEL	PC	85	80	82	No	70	90	80	No	82	87	85	No	80	95	87	No	84	90	87	No	85	95	90	No	81	90	86	⊙
4	WLL	PC	45	60	53	Yes	50	60	55	Yes	72	75	73	No	75	80	78	No	40	45	42	Yes	65	55	60	Yes	58	63	61	⊗
5	LT.YEL	PC	95	80	87	No	85	90	88	No	90	90	90	No	90	95	92	No	70	65	67	No	85	90	87	No	86	85	85	⊙
6	RT.WEL	PC	85	60	72	No	51	65	58	Yes	82	86	84	No	90	95	92	No	65	60	62	No	75	80	77	No	75	74	74	◕
7	YCL	PC	85	50	62	No	40	30	35	Yes	45	30	37	Yes	60	65	62	Yes	50	45	47	Yes	40	35	38	Yes	53	43	48	⊗
8	WEL	PC	45	30	38	Yes	40	30	35	Yes	27	30	28	Yes	40	45	42	Yes	60	35	47	Yes	30	25	27	Yes	40	33	36	⊗
9	WLL	PC	45	50	47	Yes	50	40	45	Yes	72	60	66	Yes	75	60	68	No	60	50	55	No	50	40	45	Yes	59	50	55	⊗
10	LT.YEL	PC	90	85	88	No	90	91	90	No	86	87	87	No	90	95	92	No	80	85	82	No	95	90	92	No	89	89	89	⊙
11	YCL	AC	45	30	37	Yes	40	20	30	Yes	27	40	33	Yes	40	60	50	Yes	45	15	30	Yes	65	50	58	Yes	44	36	40	⊗
12	WEL	AC	65	40	52	Yes	60	45	52	No	75	60	68	Yes	65	60	62	Yes	40	20	30	Yes	50	60	55	Yes	59	48	54	⊗
13	YCL	AC	45	30	37	Yes	55	22	38	No	72	50	61	Yes	65	65	65	No	50	40	45	Yes	45	40	42	Yes	55	41	48	⊗
14	YCL	AC	45	30	37	Yes	75	25	50	No	75	50	62	Yes	55	50	52	Yes	75	70	72	No	65	60	62	No	65	48	57	◒
15	WEL	AC	65	50	57	Yes	55	60	58	No	60	55	58	Yes	65	70	67	No	60	57	58	No	70	65	67	No	63	60	62	◎

DISTRICT PAINT FOREMEN RATINGS ON 54 TEST SECTIONS

11/12/80

TEST SECTION NO.	MARKING LINE TYPE	PAVEMENT TYPE	DISTRICT #1				DISTRICT #2				DISTRICT #3				DISTRICT #4				DISTRICT #5				DISTRICT #6				AVERAGE			
			A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?
16	YCL	AC	85	65	75	No	90	75	82	No	89	87	88	No	85	90	87	No	80	75	77	No	90	80	85	No	87	79	83	
17	RT.WEL	PC	75	65	70	No	85	80	82	No	90	91	90	No	85	95	90	No	70	65	67	No	75	85	80	No	80	80	80	
18	WLL	PC	60	50	55	Yes	70	75	72	No	85	86	85	No	70	90	80	No	70	65	67	No	75	85	80	No	72	75	73	
19	LT.YEL	PC	70	55	62	Yes	60	60	60	No	80	85	83	No	70	85	78	No	67	60	63	No	85	70	78	No	72	69	71	
20	YCL	PC	70	60	65	Yes	65	70	68	No	35	40	37	Yes	50	70	60	Yes	70	50	60	No	75	65	70	No	61	59	60	
21	YCL	PC	70	50	60	Yes	85	50	68	No	79	40	60	Yes	75	60	68	No	50	20	35	Yes	60	45	53	Yes	70	44	57	
22	YCL	PC	60	20	40	Yes	40	10	25	Yes	75	25	50	Yes	50	10	30	Yes	40	20	30	Yes	35	20	28	Yes	50	18	34	
23	YCL	PC	60	10	35	Yes	60	20	40	No	45	27	36	Yes	50	40	45	Yes	40	10	25	Yes	30	15	23	Yes	48	20	34	
24	YCL	AC	70	50	60	No	60	40	50	No	81	75	78	No	75	60	68	Yes	75	60	68	No	75	55	65	No	73	57	65	
25	YCL	AC	70	50	60	No	50	40	45	No	81	76	78	No	75	70	72	No	70	60	65	No	80	65	73	No	71	60	66	
26	YCL	PC	85	50	67	No	90	60	75	No	89	55	72	Yes	90	80	85	No	65	60	62	No	75	40	57	Yes	82	58	70	
27	YCL	PC	85	50	67	No	88	60	74	No	85	56	71	Yes	70	75	72	No	65	60	62	No	70	55	63	Yes	77	59	68	
28	YCL	PC	85	50	67	No	91	60	76	No	87	49	68	Yes	70	75	72	No	65	60	62	No	70	40	55	Yes	78	56	67	
29	YCL	PC	75	50	62	Yes	93	62	78	No	86	30	58	Yes	70	65	68	Yes	70	65	67	No	75	50	62	No	78	54	66	
30	WLL	PC	50	50	50	Yes	80	70	75	No	72	45	58	Yes	50	40	45	Yes	70	70	70	No	65	55	60	No	65	55	60	

DISTRICT PAINT FOREMEN RATINGS ON 54 TEST SECTIONS

11/12/80

C-4

TEST SECTION NO.	MARKING LINE TYPE	PAVEMENT TYPE	DISTRICT #1				DISTRICT #2				DISTRICT #3				DISTRICT #4				DISTRICT #5				DISTRICT #6				AVERAGE			
			A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?
31	LT.YEL	PC	50	50	50	Yes	60	60	60	No	35	30	32	Yes	45	40	42	Yes	40	30	35	Yes	70	65	67	No	50	46	48	⊗
32	RT.WEL	PC	50	50	50	Yes	65	65	65	No	45	60	53	Yes	45	40	42	Yes	40	50	45	Yes	60	45	53	Yes	51	52	51	⊗
33	RT.WEL	PC	50	50	50	Yes	90	60	75	No	40	50	45	Yes	45	40	42	Yes	40	30	35	Yes	65	55	60	No	55	48	52	⊗
34	WLL	PC	50	50	50	Yes	95	50	73	No	42	45	43	Yes	45	40	42	Yes	40	30	35	Yes	65	50	58	No	56	44	50	⊗
35	LT.YEL	PC	50	50	50	Yes	70	55	63	No	45	50	47	Yes	45	40	42	Yes	50	40	45	Yes	60	40	50	Yes	53	46	50	⊗
36	YCL	AC	60	60	60	Yes	38	70	54	Yes	40	50	45	Yes	35	55	45	Yes	45	35	40	Yes	80	85	82	No	50	59	55	⊗
37	WLL	PC	90	70	80	No	96	70	83	No	95	80	87	No	85	85	85	No	90	90	90	No	75	85	80	No	89	80	85	⊙
38	LT.YEL	PC	30	20	25	Yes	40	40	40	Yes	25	30	27	Yes	30	25	27	Yes	25	20	22	Yes	35	40	37	Yes	31	29	30	⊗
39	RT.WEL	PC	55	40	47	Yes	82	75	78	No	80	60	70	No	80	90	85	No	80	75	77	No	75	60	68	No	75	67	71	◑
40	WLL	PC	90	70	80	No	81	60	71	No	90	75	83	No	70	60	65	Yes	85	80	82	No	80	75	77	No	83	70	76	◑
41	WLL	PC	90	70	80	No	84	60	72	No	91	85	88	No	85	85	85	No	90	90	90	No	85	65	75	No	83	76	80	⊙
42	WLL	PC	90	70	80	No	85	60	72	No	91	86	88	No	85	85	85	No	90	90	90	No	80	70	75	No	87	77	82	⊙
43	YCL	AC	85	75	80	No	78	70	74	No	75	80	77	No	80	85	82	No	84	80	82	No	95	99	97	No	83	82	82	⊙
44	YCL	AC	80	75	83	No	77	80	79	No	90	95	92	No	85	90	87	No	90	95	92	No	95	99	97	No	86	89	87	⊙
45	WLL	PC	70	60	65	Yes	45	65	55	No	85	87	86	No	85	85	85	No	70	75	72	No	85	65	75	No	73	73	73	◑

DISTRICT PAINT FOREMEN RATINGS ON 54 TEST SECTIONS

11/12/80

TEST SECTION NO.	MARKING LINE TYPE	PAVEMENT TYPE	DISTRICT #1				DISTRICT #2				DISTRICT #3				DISTRICT #4				DISTRICT #5				DISTRICT #6				AVERAGE			
			A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?	A	B	(A+B)/2	REPAINT ?
46	LT.YEL	PC	75	60	67	No	60	30	45	No	80	85	82	No	80	65	73	No	55	60	58	No	75	60	68	No	71	60	65	⊙
47	RT.WEL	PC	80	65	72	No	85	70	78	No	83	88	85	No	85	90	87	No	70	65	67	No	80	85	82	No	81	77	79	⊙
48	WLL	PC	70	60	65	Yes	85	80	82	No	85	90	87	No	85	90	87	No	75	70	72	No	75	60	68	No	79	75	77	◑
49	LT.YEL	PC	75	55	65	Yes	80	50	65	No	86	93	89	No	80	70	75	No	65	70	68	No	80	65	73	No	78	67	72	◑
50	RT.WEL	PC	85	65	75	No	85	85	85	No	95	98	97	No	90	95	92	No	70	65	67	No	90	85	87	No	86	82	84	⊙
51	WLL	PC	75	60	67	No	90	60	75	No	85	90	87	No	85	90	87	No	70	65	67	No	95	75	85	No	83	73	78	⊙
52	LT.YEL	PC	90	65	77	No	85	70	78	No	92	98	95	No	85	90	87	No	70	65	67	No	80	65	73	No	84	76	80	⊙
53	All Lines	AC	90	85	87	No	90	90	90	No	–	–	–	–	95	95	95	No	–	–	–	–	95	95	95	No	93	91	92	⊙
54	All Lines	AC	90	85	87	No	70	70	70	No	–	–	–	–	95	95	95	No	–	–	–	–	95	95	95	No	88	86	87	⊙

APPENDIX "D"
ERMA READINGS ON
54 TEST SECTIONS

D-1

ERMA READINGS ON 54 TEST SECTIONS

LIST OF ABBREVIATIONS AND DEFINITIONS

Abbreviation Or Word Defined	Meaning
AC	Asphaltic Concrete Pavement
PC	Portland Cement Concrete Pavement
WLL	White Lane Line
YCL	Yellow Centerline
WEL	White Edge Line
RT.WEL	Right White Edge Line
LT.YEL	Left Yellow Edge Line
Static	ERMA Readings Taken In A Stationary Position
Contrast	The Difference In Reflectivity (ERMA Readings) Of The Marking Line Minus The Background Pavement Reading
Dynamic	ERMA Readings Taken At 40 Miles Per Hour

ERMA READINGS ON 54 TEST SECTIONS

TEST SECTION NO.	MARKING LINE TYPE	PAVEMENT TYPE	Individual Static Readings (5 Per Test Section)										Average Static Reading			Average Dynamic Reading		
			MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	CONTRAST	MARKING LINE	PAVEMENT	CONTRAST
1	WLL	PC	26	4	26	8	21	6	36	6	26	4	27	6	21	13	0	13
2	LT.YEL	PC	38	16	47	13	41	13	41	14	30	6	39	12	27	22	0	22
3	RT.WEL	PC	59	14	65	13	48	10	38	10	42	12	50	12	38	32	0	32
4	WLL	PC	33	14	34	10	32	10	32	10	30	10	32	11	21	18	0	18
5	LT.YEL	PC	51	14	50	16	58	16	44	18	52	11	51	15	36	40	2	38
6	RT.WEL	PC	49	13	58	12	40	4	48	10	50	11	49	10	39	39	0	39
7	YCL	PC	36	24	46	26	54	31	45	32	56	36	47	30	17	14	0	14
8	WEL	PC	34	23	46	24	46	22	60	30	34	24	44	25	19	-	-	-
9	WLL	PC	28	10	38	10	32	10	34	11	38	10	34	10	24	34	8	26
10	LT.YEL	PC	36	14	46	12	32	11	41	12	32	12	37	12	25	50	20	30
11	YCL	AC	22	9	14	13	33	16	28	10	34	13	26	12	14	15	0	15
12	WEL	AC	62	12	38	10	57	14	58	14	48	19	53	14	39	-	-	-
13	YCL	AC	22	16	16	4	20	0	10	8	24	8	18	7	11	6	0	6
14	YCL	AC	20	10	29	8	32	10	28	8	30	12	28	10	18	12	0	12
15	WEL	AC	42	10	46	18	40	18	32	20	36	13	39	16	23	-	-	-

ERMA READINGS ON 54 TEST SECTIONS

TEST SECTION NO.	MARKING LINE TYPE	PAVEMENT TYPE	Individual Static Readings (5 Per Test Section)										Average Static Reading			Average Dynamic Reading		
			MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	CONTRAST	MARKING LINE	PAVEMENT	CONTRAST
16	YCL	AC	34	4	28	2	30	2	38	6	-	-	33	4	29	12	0	12
17	RT.WEL	PC	53	14	50	12	52	10	50	6	38	6	49	10	39	60	1	59
18	WLL	PC	53	14	53	11	48	10	31	10	47	9	46	11	35	62	20	42
19	LT.YEL	PC	46	18	41	19	32	19	38	20	34	20	38	19	19	45	24	21
20	LT.YEL	PC	22	13	27	14	30	14	29	14	24	11	26	13	13	19	6	13
21	YCL	PC	36	26	30	20	28	22	30	22	41	17	33	21	12	22	10	12
22	YCL	PC	24	26	32	20	20	22	14	17	4	12	19	19	0	12	5	7
23	YCL	PC	18	20	22	20	20	18	22	16	-	-	21	19	2	18	2	16
24	YCL	AC	30	14	32	12	32	12	26	12	42	10	32	12	20	8	0	8
25	YCL	AC	20	10	30	6	28	8	12	8	21	8	22	8	14	6	0	6
26	YCL	PC	38	30	40	30	44	30	42	30	48	28	42	30	12	14	0	14
27	YCL	PC	45	32	40	30	46	28	36	28	40	30	41	30	11	12	0	12
28	YCL	PC	54	34	48	35	34	29	30	22	40	28	41	30	11	12	0	12
29	YCL	PC	33	25	34	22	32	20	30	24	34	22	33	23	10	11	0	11
30	WLL	PC	28	12	38	14	28	12	21	10	29	8	29	11	18	30	8	22

ERMA READINGS ON 54 TEST SECTIONS

TEST SECTION NO.	MARKING LINE TYPE	PAVEMENT TYPE	Individual Static Readings (5 Per Test Section)										Average Static Reading			Average Dynamic Reading		
			MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	CONTRAST	MARKING LINE	PAVEMENT	CONTRAST
31	LT.YEL	PC	22	12	21	11	19	10	20	10	28	10	22	11	11	30	8	22
32	RT.WEL	PC	28	12	32	10	30	12	16	10	20	10	25	11	14	-	-	-
33	RT.WEL	PC	44	8	38	10	32	9	28	7	20	2	32	7	25	34	8	26
34	WLL	PC	13	10	22	8	22	8	19	9	25	9	20	9	11	24	4	20
35	LT.YEL	PC	37	10	21	10	20	11	22	6	22	11	24	10	14	30	8	22
36	YCL	AC	24	10	25	10	20	12	29	13	28	10	25	11	14	24	5	19
37	WLL	PC	34	13	44	14	38	16	47	14	36	14	40	14	26	39	12	27
38	LT.YEL	PC	17	16	21	16	21	14	19	16	33	17	22	16	6	31	18	13
39	RT.WEL	PC	34	17	34	17	29	8	34	18	52	13	37	15	22	-	-	-
40	WLL	PC	40	16	39	13	41	12	34	10	40	14	39	13	26	41	18	23
41	WLL	PC	43	12	38	10	30	10	38	10	34	10	37	10	27	43	14	29
42	WLL	PC	40	10	36	12	32	12	41	10	33	14	36	12	24	-	-	-
43	YCL	AC	28	10	28	8	27	6	29	8	18	8	26	8	18	26	8	18
44	YCL	AC	34	8	38	8	36	8	50	6	28	8	37	8	29	38	6	32
45	WLL	PC	43	19	28	26	40	10	38	11	34	11	37	15	22	26	0	26

ERMA READINGS ON 54 TEST SECTIONS

TEST SECTION NO.	MARKING LINE TYPE	PAVEMENT TYPE	Individual Static Readings (5 Per Test Section)										Average Static Reading			Average Dynamic Reading		
			MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	MARKING LINE	PAVEMENT	CONTRAST	MARKING LINE	PAVEMENT	CONTRAST
46	LT.YEL	PC	39	26	26	20	23	11	18	13	16	13	24	17	7	22	0	22
47	RT.WEL	PC	78	16	43	14	59	14	61	10	64	17	61	14	47	44	0	44
48	WLL	PC	26	9	26	8	19	2	28	10	16	10	23	8	15	32	4	28
49	LT.YEL	PC	19	16	26	17	21	16	26	16	27	18	24	17	7	21	8	13
50	RT.WEL	PC	53	12	50	20	51	16	70	24	71	24	59	19	40	46	8	38
51	WLL	PC	30	10	29	11	16	11	40	10	34	10	30	10	20	30	5	25
52	LT.YEL	PC	41	12	42	14	46	10	36	11	38	10	41	11	30	52	8	44
53	All Lines	AC	27	3	38	0	28	0	20	0	29	4	28	1	27	35	1	34
54	All Lines	AC	30	2	28	4	25	5	28	1	26	1	27	3	24	27	1	26

APPENDIX "E"
ERMA PRINCIPLE OF
OPERATION AND
OPERATING INSTRUCTIONS

ERMA PRINCIPLE OF OPERATION

The ERMA device consists of an inverter, co-axial scanner, sensor and recorder as illustrated in Figure E-2. The inverter converts the test van's 12 Volt DC power to 120 Volt AC power for ERMA operation. A SC501 Co-Axial Scanner manufactured by General Electric Company is presently used to determine the reflectivity of pavement marking lines. A co-axial scanner sends and receives light along a common axis which minimizes the effect of ambient light that filters through the brushes into the sensor box (Figure E-1). Scanner output is amplified and has gain control which is necessary for calibration purposes.

The angle between the sensor light and pavement is presently restricted to 40^{o} to achieve enough reflectivity on the white calibration standard for full scale graph deflection. A higher intensity sensor light would allow a greater working range of angles for full scale graph deflection and thereby simplify calibration procedures.

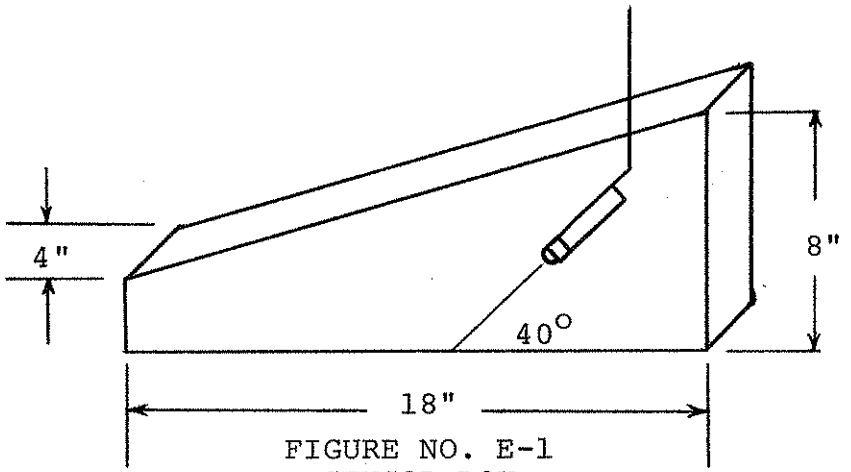

FIGURE NO. E-1
SENSOR BOX

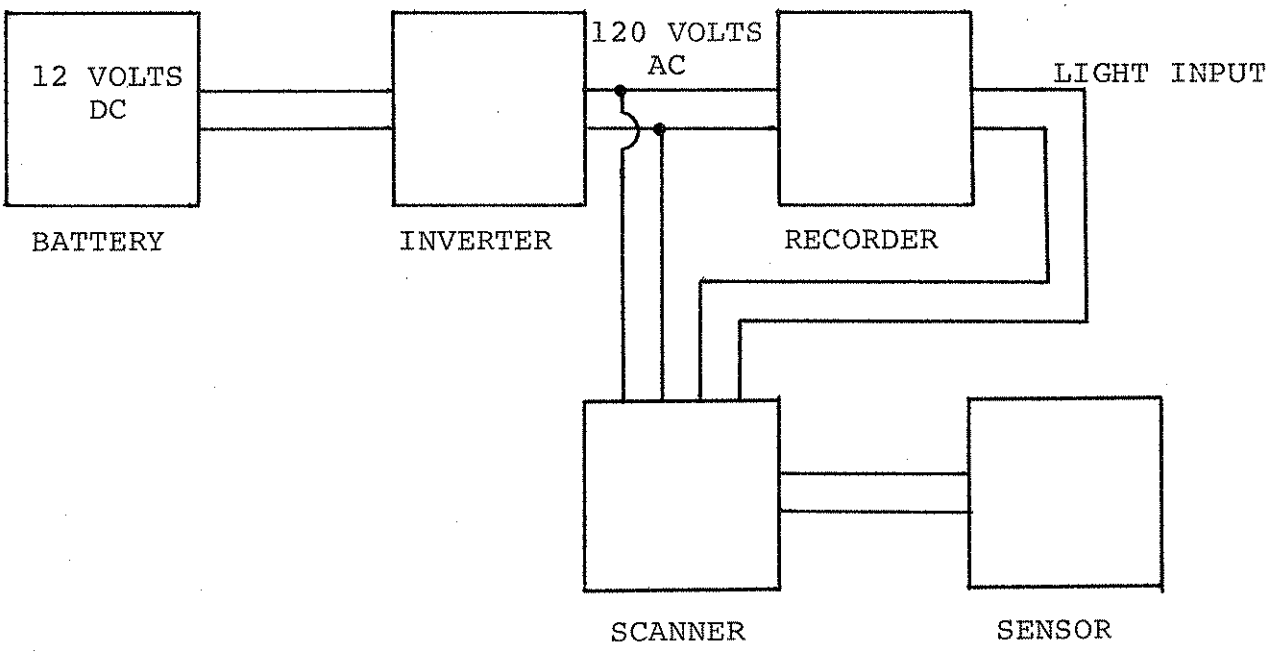

FIGURE NO. E-2
BLOCK DIAGRAM SHOWING
ERMA OPERATING
COMPONENTS

ERMA OPERATING INSTRUCTIONS

ERMA Activation

1. Start Test Van.
2. Turn Inverter Switch On.
3. Check That Recorder Switch Is On.
4. Check To See If Sensor Is Lit.

Recorder Operation

5. Range Switch In 0.5 Position.
6. V/CM-ZERO Switch In V/CM Position.
7. Paper Speed 5 MM/SEC.

Calibration Procedure

8. Place Sensor Over Black Portion Of Calibration Standard.
9. Use Position Control To Achieve Zero On Right Edge of Graph Paper.
10. Place Sensor Over White Portion Of Calibration Standard.
11. Use Gain Control To Achieve Full Scale Or 50 Millimeter Deflection.
12. Recheck At Least Twice To Assure Proper Deflections (Repeat Steps 8-11).

APPENDIX "F"
COMPUTER CORRELATIONS
OF ERMA STUDY VARIABLES

COMPUTER CORRELATIONS OF ERMA STUDY VARIABLES

Description Of Variables	Correlation Coefficient
Average ERMA Static Contrast Versus District #1 Paint Foreman Nighttime Reflectivity Ratings (B)	0.5604
Average ERMA Static Contrast Versus District #2 Paint Foreman Nighttime Reflectivity Ratings (B)	0.5942
Average ERMA Static Contrast Versus District #3 Paint Foreman Nighttime Reflectivity Ratings (B)	0.6369
Average ERMA Static Contrast Versus District #4 Paint Foreman Nighttime Reflectivity Ratings (B)	0.6379
Average ERMA Static Contrast Versus District #5 Paint Foreman Nighttime Reflectivity Ratings (B)	0.4506
Average ERMA Static Contrast Versus District #6 Paint Foreman Nighttime Reflectivity Ratings (B)	0.6635
Average ERMA Static Contrast Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.6692
Average ERMA Dynamic Contrast Versus District #1 Paint Foreman Nighttime Reflectivity Ratings (B)	0.5108
Average ERMA Dynamic Contrast Versus District #2 Paint Foreman Nighttime Reflectivity Ratings (B)	0.5988

COMPUTER CORRELATIONS OF ERMA STUDY VARIABLES (CONT'D)

Description Of Variables	Correlation Coefficient
Average ERMA Dynamic Contrast Versus District #3 Paint Foreman Nighttime Reflectivity Ratings (B)	0.5828
Average ERMA Dynamic Contrast Versus District #4 Paint Foreman Nighttime Reflectivity Ratings (B)	0.5256
Average ERMA Dynamic Contrast Versus District #5 Paint Foreman Nighttime Reflectivity Ratings (B)	0.3461
Average ERMA Dynamic Contrast Versus District #6 Paint Foreman Nighttime Reflectivity Ratings (B)	0.5619
Average ERMA Dynamic Contrast Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.6015
Average ERMA Static Contrast Versus Average ERMA Dynamic Contrast	0.8006
Average Yellow ERMA Dynamic Contrast Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.5723
Average White ERMA Static Contrast Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.4698
Average ERMA Static Contrast On A.C. Pavement Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.4076

COMPUTER CORRELATIONS OF ERMA STUDY VARIABLES (CONT'D)

Description Of Variables	Correlation Coefficient
Average ERMA Static Contrast On P.C.C. Pavement Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.7335
Average Yellow ERMA Static Contrast Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.8044
Average ERMA Static Marking Line Reflectivity Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.4263
Average ERMA Dynamic Marking Line Reflectivity Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.4993
Average ERMA Static Marking Line Reflectivity Versus Average ERMA Dynamic Marking Line Reflectivity	0.5249
Average Yellow ERMA Static Marking Line Reflectivity On P.C.C. Pavement Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.8192
Average ERMA Static Contrast Versus Average District Paint Foremen Daytime General Condition Ratings (A)	0.5058
Average ERMA Dynamic Contrast Versus Average District Paint Foremen Daytime General Condition Ratings (A)	0.4281
Average ERMA Static Contrast Versus Average District Paint Foremen Composite Ratings (A+B/2)	0.6175

COMPUTER CORRELATIONS OF ERMA STUDY VARIABLES (CONT'D)

Description Of Variables	Correlation Coefficient
Average ERMA Dynamic Contrast Versus Average District Paint Foremen Composite Ratings (A+B/2)	0.5456
District #1 Paint Foreman Nighttime Reflectivity Ratings (B) Versus District #6 Paint Foremen Nighttime Reflectivity Ratings (B)	0.8438
District #2 Paint Foreman Nighttime Reflectivity Ratings (B) Versus District #4 Paint Foreman Nighttime Reflectivity Ratings (B)	0.6990
Distirct #6 Paint Foreman Nighttime Reflectivity Ratings (B) Versus District #4 Paint Foreman Nighttime Reflectivity Ratings (B)	0.7286
District #3 Paint Foreman Nighttime Reflectivity Ratings (B) Versus District #5 Paint Foreman Nighttime Reflectivity Ratings (B)	0.7392
Average ERMA (Contrast/Marking Line Reflectivity) X 100 Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.7039
Average ERMA Static Marking Line Reflectivity Plus Contrast Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.5771
Average ERMA Dynamic Marking Line Reflectivity Plus Contrast Versus Average District Paint Foremen Nighttime Reflectivity Ratings (B)	0.5538

COMPUTER CORRELATIONS OF ERMA
STUDY VARIABLES (CONT'D)

Description Of Variables	Correlation Coefficient
Average ERMA Static Marking Line Reflectivity Plus Contrast Versus Average ERMA Dynamic Marking Line Reflectivity Plus Contrast	0.7068
Average ERMA Static Contrast (November 1980) Versus Average ERMA Static Contrast (January 1981)	0.6551
Average ERMA Dynamic Contrast (November 1980) Versus Average ERMA Dynamic Contrast (January 1981)	0.7326