

# **RETARDATION OF REFLECTIVE CRACKING USING ADDITIVE 5990**

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**Final Report  
Iowa Highway Research Board  
Project HR-222**

**Highway Division  
February 1987**



**Iowa Department  
of Transportation**

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RETARDATION OF REFLECTIVE CRACKING  
USING  
ADDITIVE 5990

Final Report  
for  
Iowa Highway Research Board  
Project HR-222

*To Kevin  
Richard D. Smith*

By  
Richard D. Smith  
Research Technician  
515-239-1392

Office of Materials  
Highway Division  
Iowa Department of Transportation  
Ames, Iowa 50010

February 1987

## Table of Contents

	Page
Abstract.....	ii
Introduction.....	1
Objective.....	2
Design.....	2
Construction.....	3
Evaluation.....	4
Conclusions and Recommendations.....	6
Acknowledgement.....	7
Appendices.....	8

## ABSTRACT

Research was conducted in 1980 using Additive 5990 to prevent reflective cracking in asphalt cement concrete when placed over portland cement concrete. Test sections were placed with 0%, 3%, 6%, and 9% Additive 5990 by weight of asphalt cement at mix temperatures between 375°F and 415°F with AC-5 and AC-10 grade asphalt cement. Also, sections using AC-5 and AC-10 were constructed with the normal mix temperature (not to exceed 330°F). One section was placed using AC-20 mixed at the normal mix temperature.

It was concluded that the Additive 5990 did not prevent reflective cracking on this project.

Retardation of Reflective Cracking  
Using Additive 5990

INTRODUCTION

One of the most persistent problems with asphaltic concrete resurfacing is that cracks almost always appear in the resurfacing wherever cracks exist in the underlying pavement. This is generally referred to as reflection cracking. Highway engineers have tried for many years to eliminate reflection cracking. Variations of mix design and the placement of reinforcing fabrics between the original pavement and the resurfacing are methods that have been attempted. These attempts have met with only partial success.

In the spring of 1980, the 3M Company suggested that Additive 5990, commonly referred to as Asphadur, added to asphaltic concrete may prevent reflection cracking. They agreed to furnish 4000 lbs. of Additive 5990 without charge and assist in the evaluation if the Iowa DOT would include it in a resurfacing project.

Iowa Highway Research Board Project HR-222, "Retardation of Reflection Cracking Using Stabilizing Additive 5990", was initiated and included in the plans for project EACF-44-5(5)--20-25 in Dallas County on highway IA 44. The research sections are located east of Dallas Center and were constructed in June 1981.

The experimental sections totaled about 0.61 mile between stations 908+87 and 941+00. This section of road was originally portland cement concrete 18 feet wide, later widened to 24 feet by adding three feet of pcc to each side. Contraction joints were about 100 feet apart.

Prior to resurfacing, a crack survey was made which was later used to determine if cracks in the asphaltic concrete resurfacing were reflected cracks.

The average daily traffic in 1982 was 1950 vehicles of which 95 were trucks. By 1985, average daily traffic had increased to 3060 vehicles with 211 being trucks.

#### OBJECTIVE

The objective of the project was to evaluate the effectiveness of Stabilizing Additive 5990 as a method of reducing reflective cracking in asphaltic concrete overlays. Additive 5990 is a mixed polymer in granular form which is added to the asphaltic concrete at the pugmill.

#### DESIGN

The designated asphalt cement for the 3" asphaltic concrete resurfacing project was AC-10. The Special Provisions for the addition of Additive 5990 require the asphaltic concrete to be heated to between 375°F and 415°F (Appendix A). It was decided to include sections using AC-5 with Additive 5990 and one section with AC-20 without Additive 5990 at the normal temperature (not to exceed 330°F).

Additive 5990 was added at the rates of 3%, 6%, and 9% by weight of asphalt cement to the AC-10 and AC-5 sections. There were also sections of AC-10 and AC-5 mixed without Additive 5990 at temperatures between 375°F and 415°F. There are two sections of each combination listed in Table I.

TABLE I  
 A.C. Grade and Percent 5990  
 Mix Temperature 375°-415°F

AC Grade	% 5990 (Wt A.C.)
10	3
10	6
10	9
10	0
5	3
5	6
5	9
5	0

A control section with AC-5 or AC-10 mixed at the normal temperature (not to exceed 330°F) was placed in the middle of each series of test sections and the section with AC-20 mixed at the standard temperature was placed in the middle of the research project.

The mix was designed with 5.5% asphalt cement. The aggregate was 60% 1/2" crushed gravel, 30% 3/8" limestone chips, and 10% fine sand (Appendix B).

#### CONSTRUCTION

The project was constructed in June 1981 by Iowa Road Builders of Des Moines. The asphaltic concrete was mixed in a Barber-Greene Batchpac plant at Adel and transported about 8 miles to the site.

The Additive 5990 was added by hand at the pugmill. The mixing sequence was 5 seconds aggregate only, 20 seconds wet mixing after the asphalt cement was added, 5 seconds to add Additive 5990, and 60 seconds mixing after the Additive 5990 was added. Before leaving the plant site the temperature of the mix was recorded (Appendix C), a sample was taken representing each section, and the



section number was taped to the truck door to prevent confusion at the paving site. This was done by 3M personnel.

The asphaltic concrete was placed with two Blaw Knox PF-500 pavers, one in each lane as the road was closed due to reconstruction in other areas. The 1 1/2" binder course was placed the full length of the test area and the pavers were moved back and the surface course was placed in the same manner, matching the mix locations as nearly as possible. As illustrated in Appendix D, some sections having the same percent of Additive 5990 in both courses in a lane are very short and sections having the same mix in both courses and both lanes are even shorter.

The surface was treated with a sprinkle aggregate using a Bristowes spreader prior to rolling. Compaction rollers were a Dynapac-CC-42A and a Hyster-C350A.

#### EVALUATION

The 3M Company is no longer the agent for Additive 5990, consequently their assistance in the long term evaluation was not forthcoming.

The analysis of the cracking is for the westbound lane because the sections of the same percent of Additive 5990 in both courses and both lanes would be shorter than in only one lane because making two passes with two pavers did not match the sections full width and full depth. Results of the crack survey three years after construction are shown in Table II.

TABLE II  
Reflected Cracks After 5½ Years

Asphalt Cement	% 5990	% Cracks Reflected
AC-10	0 (375°F-415°F)	68.8
AC-10	3 (375°F-415°F)	80.0
AC-10	6 (375°F-415°F)	88.9
AC-10	9 (375°F-415°F)	77.8
AC-10 Control	0 (<330°F)	83.3
AC-5	0 (375°F-415°F)	52.9
AC-5	3 (375°F-415°F)	50.0
AC-5	6 (375°F-415°F)	72.7
AC-5	9 (375°F-415°F)	100.0
AC-5 Control	0 (<330°F)	62.5
AC-20	0 (<330°F)	68.0

There has been no surface bleeding observed nor any rutting or raveling of the surface after five years of service. As shown in Table III, the viscosities and penetrations of recovery samples of the binder course are very erratic. The surface course test results indicate that the asphalt cement generally became at least one grade harder after mixing. It was suspected the elevated temperature required to utilize the Additive 5990 may cause the viscosity to increase and the penetration to decrease more than the usual changes at normal asphaltic concrete mixing temperatures. That suspicion was not supported by this project.

As shown in Table II, the section with AC-20 asphalt cement mixed at the standard temperature had a smaller percentage of reflective cracking than the AC-10 control section and a higher percentage than the AC-5 control section.

TABLE III  
Viscosity and Penetration

Section	AC Type	% 5990	Binder		Surface	
			Poises	Pen.	Poises	Pen
1	10	9	450	238	2810	65
2	10	0	---	---	----	--
3	10	3	1040	103	2830	61
4	10	6	487	228	----	--
5	10	0	---	---	2000	72
6	5	6	566	139	1280	94
7	5	0	---	---	----	--
8	5	3	566	173	996	107
9	5	9	2090	77	1650	82
10	20	0	---	---	4420	46
11	10	0	592	186	2250	69
12	10	9	911	141	2530	70
13	10	6	980	123	2170	71
14	10	3	564	175	1800	79
15	5	0	---	---	1220	93
16	5	6	510	188	1300	93
17	5	9	1360	95	1180	99
18	5	0	1690	83	1440	88
19	5	3	566	143	1230	95

#### CONCLUSIONS AND RECOMMENDATIONS

It is concluded that Additive 5990 does not retard or prevent reflection cracking when added to asphalt cement concrete for re-surfacing portland cement concrete pavement.

It could not be determined if heating the asphaltic concrete without Additive 5990 to the higher temperature required for utilization of the Additive 5990 caused increased reflective cracking.

On this project, the section mixed with AC-20 had more cracking than the section mixed with AC-5 at the normal mix temperature and less cracking than the section mixed with AC-10 at the normal mix temperature.

It is believed by some people that drum mix asphalt plants cause less oxidation of the asphalt cement than batch plants,

therefore, there is less change in the viscosity of the asphalt cement in drum mix plants. It is recommended that research be conducted to determine if this is true, and if so, the type of mixing plant should be considered when determining the grade of asphalt cement for asphalt concrete mixes.

ACKNOWLEDGEMENT

Appreciation of the Creston Construction Residency is gratefully acknowledged, especially for their sampling and record keeping during construction of this research project.

APPENDICES

IOWA DEPARTMENT OF TRANSPORTATION  
Ames, Iowa

## SPECIAL PROVISIONS

FOR

ASPHADUR MODIFIED TYPE B ASPHALT CEMENT CONCRETE

BINDER AND SURFACE

May 14, 1980

Dallas-Polk  
F-44-5(5)--20-25

THE STANDARD SPECIFICATIONS, SECTION 2304, SERIES OF 1977, ARE AMENDED BY THE FOLLOWING ADDITIONS. THESE ARE SPECIAL PROVISIONS AND SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

DELETE the first sentence of 2203.02A and substitute in lieu thereof the following:

A. Asphalt Cement shall meet requirements for Grade AC-5, AC-10 and AC-20 as shown on the experimental layout plan.

ADD the following paragraph to 2304.02.

D. Special Additive. A grained, mixed polymer, as manufactured by Schicker and Company of Austria under the trade name "ASPHADUR" or an approved equal, shall be added to the ACC at the pugmill. A target of 3, 6, and 9 percent of the bitumen weight shall be used. The additive shall be capable of improving the viscosity, stability, flow, and strength characteristics of the ACC, making it less susceptible to rutting and shoving.

The additive for this experimental project is distributed by the 3M Company of Minneapolis, Minnesota, under the trade name "Stabilizing Additive 5990". It is to be provided to the contractor, without cost, at the contractor's plant site.

DELETE all of 2203.03 and substitute in lieu thereof the following:  
2303.03 PAVING PLANT EQUIPMENT. Paving Plant proportioning and mixing equipment and all other equipment incidental to the paving plant shall meet requirements of 2201.01 and 2001.22 except that continuous plants or drum-mixing plants shall not be used.

ADD the following paragraph to 2303.04A.

The additive shall be stored in bags as shipped, and it shall be kept in a dry storage place until used.

ADD the following paragraph to 2303.04C.

The additive shall be fed directly to the pugmill by a method approved by the engineer. This method shall provide for a means of accurately weighing the additive and for feeding it into the pugmill at the appropriate time.

DELETE the last two sentences of 2303.04 E and substitute in lieu thereof the following:

The temperature of the mix as discharged from the pugmill shall not be less than 375 degrees F and shall not exceed 415 degrees F.

DELETE all of 2303.04 F and substitute in lieu thereof the following:

F. Mixing Rate. The normal size of batch shall range between 80 and 100 percent of the manufacturer's rated capacity of the mixer. Dry mixing time, after all aggregates are in the mixer shall not be less than 5 seconds. Wet mixing time, after all the AC has been added to the mixer shall not be less than 20 seconds. Continued mixing time, after the grained polymer has been added to the mixer and before opening the discharge gate shall not be less than 60 seconds.

ADD the following new paragraph to 2303.20 A.

The price bid per ton of Asphalt Cement Concrete shall include the cost of incorporating the additive into the mixture placed on finished roadway surface.

APPENDIX B  
IOWA DEPARTMENT OF TRANSPORTATION  
OFFICE OF MATERIALS  
ASPHALT CONCRETE MIX DESIGN  
LAB LOCATION AMES

B-1

MIX, TYPE AND CLASS: TYPE B SURFACE LAB NO. ABD1-56

INTENDED USE:

SIZE 1/2" SPEC. NO. SP-315 DATE REPORTED 5/29/81

COUNTY DALLAS PROJECT EACF-44-5(15)--2K-25

CONTRACTOR IOWA ROAD BUILDERS

PROJ. LOCATION FROM U.S. 169 EASTERLY 12.6 MILES TO GRIMES

AGG. SOURCES 1/2" GRAVEL - ADEL PIT - DALLAS CO.; 3/8" LST. CHIPS-EARLHAM QR.-  
MADISON CO.; FINE SAND - BOONEVILLE SAND & GRAVEL - DALLAS CO.

JOB MIX FORMULA AGGREGATE PROPORTIONS: 60% AAT1-76; 30% AAT1-97; 10% AAT1-78

JOB MIX FORMULA - COMBINED GRADATION

1-1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
	100	99	95	68	44	34	26	13	8.1	6.0	+1.2
TOLERANCE:	98/100	7	7	6			5				-3
% ASPHADUR ADDED (WT. ASPHALT)						3.0		6.0		9.0	
ASPHALT SOURCE AND APPROXIMATE VISCOSITY							KOCH - 1100 POISES				
PLASTICITY INDEX							N. P.				
% ASPH. IN MIX						5.50		5.50		5.50	
NUMBER OF MARSHALL BLOWS						50		50		50	
MARSHALL STABILITY - LBS.						2488		2735		2775	
FLOW - 0.01 IN.						9		9		9	
SP.GR. BY DISPLACEMENT(LAB DENS.)						2.35		2.34		2.34	
BULK SP. GR. COMB. DRY AGG.						2.648		2.648		2.648	
SP. GR. ASPH. @ 77 F.						1.024		1.024		1.024	
CALC. SOLID SP.GR.						2.46		2.46		2.46	
VOIDS - CALC.						4.6		5.0		5.0	
RICE SP. GR.						2.41		2.40		2.40	
% VOIDS - RICE						2.6		2.6		2.4	
% WATER ABSORPTION - AGGREGATE						0.97		0.97		0.97	
% VOIDS IN THE MINERAL AGGREGATE						16.1		16.5		16.5	
% V.M.A. FILLED WITH ASPHALT						71.7		69.9		69.9	
CALCULATED ASPH.FILM THICKNESS(MICRONS)						8.7		8.7		8.7	
FILLER/BITUMEN RATIO								1.1			

A CONTENT OF 5.50% ASPHALT IS RECOMMENDED WITH THE VARIOUS AMOUNTS OF ASPHADUR.

COPIES:

- ASPH. MIX DESIGN
- EACF-44-5(15)--2K-25, DALLAS
- V. R. SNYDER
- H. OLSON
- D. JORDISON
- R. SHELQUIST
- IOWA ROAD BUILDERS
- L. ZEARLEY
- W. MARKS
- C. JONES

SIGNED: BERNARD C. BROWN  
TESTING ENGINEER



IOWA DEPARTMENT OF TRANSPORTATION  
OFFICE OF MATERIALS  
ASPHALT CONCRETE MIX DESIGN  
LAB LOCATION                      AMES

MIX, TYPE AND CLASS: TYPE B SURFACE                      LAB NO. ABD1-58

INTENDED USE:

SIZE 1/2"                      SPEC. NO. SP-315      DATE REPORTED 6/22/81

COUNTY DALLAS                      PROJECT EACF-44-5(15)--2K-25

CONTRACTOR IOWA ROAD BUILDERS

PROJ. LOCATION FROM U.S. 169 EASTERLY 12.6 MILES TO GRIMES

AGG. SOURCES 1/2" GRAVEL - ADEL PIT - DALLAS CO.; 3/8" LST. CHIPS - EARLHAM QR. -  
MADISON CO.; FINE SAND - BOONEVILLE SAND & GRAVEL - DALLAS CO.

JOB MIX FORMULA AGGREGATE PROPORTIONS: 60% AAT1-76, 30% AAT1-97, 10% AAT1-78

JOB MIX FORMULA - COMBINED GRADATION

1-1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
	100	99	95	68	44	34	26	13	8.1	6.0	+1.2
											-3.0
TOLERANCE:	98/100	7	7	6			5				
% ASPHADUR ADDED (WT. ASPHALT)							3.0	6.0		9.0	
ASPHALT SOURCE AND APPROXIMATE VISCOSITY							KOCH - 572 POISES				
PLASTICITY INDEX											
% ASPH. IN MIX							5.50	5.50		5.50	
NUMBER OF MARSHALL BLOWS							50	50		50	
MARSHALL STABILITY - LBS.							2447	2533		2508	
FLOW - 0.01 IN.							9	9		9	
SP.GR. BY DISPLACEMENT(LAB DENS.)							2.37	2.36		2.35	
BULK SP. GR. COMB. DRY AGG.							2.648	2.648		2.648	
SP. GR. ASPH. @ 77 F.							1.023	1.023		1.023	
CALC. SOLID SP.GR.							2.46	2.46		2.46	
% VOIDS - CALC.							3.7	4.2		4.6	
REL. SP. GR.							2.43	2.42		2.42	
% VOIDS - RICE							2.6	2.4		2.7	
% WATER ABSORPTION - AGGREGATE							0.97	0.97		0.97	
% VOIDS IN THE MINERAL AGGREGATE							15.4	15.8		16.1	
% V.M.A. FILLED WITH ASPHALT							75.7	73.7		71.8	
CALCULATED ASPH.FILM THICKNESS(MICRONS)							8.7	8.7		8.7	
FILLER/BITUMEN RATIO								1.1			

A CONTENT OF 5.50% ASPHALT IS RECOMMENDED WITH THE VARIOUS AMOUNTS OF ASPHADUR.

COPIES:

ASPH. MIX DESIGN

EACF-44-5(15)--2K-25, DALLAS

V. R. SNYDER

H. OLSON

D. JORDISON

R. SHELQUIST

L. ZEARLEY

IOWA ROAD BUILDERS

V. MARKS

C. JONES

SIGNED: BERNARD C. BROWN  
TESTING ENGINEER

IOWA DEPARTMENT OF TRANSPORTATION  
 OFFICE OF MATERIALS  
 ASPHALT CONCRETE MIX DESIGN  
 LAB LOCATION AMES

B-3

MIX, TYPE AND CLASS: TYPE B SURFACE

LAB NO. ABD1-35

INTENDED USE:

SIZE 1/2" SPEC. NO. SP-315 DATE REPORTED 5/29/81

COUNTY DALLAS

PROJECT EACF-44-5(15)--2K-25

CONTRACTOR IOWA ROAD BUILDERS

PROJ. LOCATION FROM U.S. 169 EASTERLY 12.6 MILES TO GRIMES

AGG. SOURCES 1/2" GRAVEL - ADEL PIT - DALLAS CO.; 3/8" LST. CHIPS - EARLHAM QR.-  
 MADISON CO.; FINE SAND - BOONEVILLE SAND & GRAVEL - DALLAS CO.

JOB MIX FORMULA AGGREGATE PROPORTIONS: 60% AAT1-76, 30% AAT1-97, 10% AAT1-78

JOB MIX FORMULA - COMBINED GRADATION

1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200										
100	99	95	68	44	34	26	13	8.1	6.0	+1.2	-3										
TOLERANCE:											98/100	7	7	6	5						
75 BLOW MARSHALL DENSITY																				2.36	
ASPHALT SOURCE AND APPROXIMATE VISCOSITY											KOCH - 2160 POISES										
PLASTICITY INDEX											N. P.										
% ASPH. IN MIX											5.0		6.0								
NUMBER OF MARSHALL BLOWS											50		50								
MARSHALL STABILITY - LBS.											2333		2133								
FLOW - 0.01 IN.											10		13								
SP.GR. BY DISPLACEMENT(LAB DENS.)											2.32		2.35								
BULK SP. GR. COMB. DRY AGG.											2.648		2.648								
SP. GR. ASPH. @ 77 F.											1.027		1.027								
CALC. SOLID SP.GR.											2.48		2.44								
% VOIDS - CALC.											6.5		3.9								
THE SP. GR.											2.42		2.39								
VOIDS - RICE											4.1		1.7								
% WATER ABSORPTION - AGGREGATE											0.97		0.97								
% VOIDS IN THE MINERAL AGGREGATE											16.8		16.6								
% V.M.A. FILLED WITH ASPHALT											61.2		76.5								
CALCULATED ASPH.FILM THICKNESS(MICRONS)											7.8		9.6								
FILLER/BITUMEN RATIO													1.1								

A CONTENT OF 5.5% ASPHALT IS RECOMMENDED TO START THE JOB.

COPIES:

- ASPH. MIX DESIGN
- EACF-44-5(15)--2K-25, DALLAS
- V. R. SNYDER
- H. OLSON
- D. JORDISON
- R. SHELQUIST
- L. ZEARLEY
- IOWA ROAD BUILDERS
- ~~V. MARKS~~
- C. JONES

SIGNED: BERNARD C. BROWN  
 TESTING ENGINEER

\*Samples were taken from the trucks that the temperatures were taken from or as stated

TEST SECTION - HWY. 44 EAST OF DALLAS CENTER  
BINDER COURSE 6-12-81

\*All paving and compaction temperatures, are not known from which truck they are from.

SECTION NUMBER	PERCENT OF 5990	AC TYPE	TRUCK NUMBER	MIX TEMPERATURE	COMMENTS	LAY DOWN TEMPERATURE	COMMENTS
#19	3%	5	#1	388°F		355°F	
#18	0%	5	#1	440°F	Early Drop	310°F	
#17	9%	5	#1	401°F	Early Drop, 3 Batches	300°F	
#16	6%	5	#1	365°F	Shut down between #16 & #17	300°F	280°F-300°F compaction
#15	0%	5	#1 #2 #3 #6	395°F 351°F 285°F 350°F	4 full, 2-1/2 loads for this sec. Sample Taken Shut down between #2 & #3	205°F	Do not know what trucks the temps came from
#14	3%	10	#1	371°F		320°F	
#13	6%	10	#1 #2	401°F 385°F		330°F	
#12	9%	10	#1 #2	380°F 382.5°F		No Temp.	
#11	0%	10	#1	415°F		275°F	
#10	0%	20	#1 #2 #3	290°F 271°F 280°F	4 full, 2-1/2 loads for this sec. Sample Taken	200°F	
#9	9%	5	#1 #2	405°F 385°F	1st batch of the 2nd truck was too long of a mix time	355°F	
#8	3%	5	#2	391°F		345°F	
#7	0%	5	#1	375°F		275°F	
#6	6%	5	#1	382°F		335°F	
#5	0%	10	#1 #2 #4 #6	277°F 266°F 275°F 320°F	4 full, 2-1/2 loads for this sec. Sample Taken	220°F	

SECTION NUMBER	PERCENT OF 5990	AC TYPE	TRUCK NUMBER	MIX TEMPERATURE	COMMENTS	LAY DOWN TEMPERATURE	COMMENTS
#4	6%	10	#1	398°F		275°F	
#3	3%	10	#1 #2	420°F 380°F	Dumped 20 sec. early	335°F	
#2	0%	10	#1	372°F		315°F	
#1	9%	10	#1	380°F		285°F	

\*No samples taken this day

TEST SECTION - HWY. 44, EAST OF DALLAS CENTER  
SURFACE COURSE - WEST BOUND LANE 6-16-81

SECTION NUMBER	PERCENT OF 5990	AC TYPE	TRUCK NUMBER	MIX TEMPERATURE	COMMENTS	PAVER TEMPERATURE	COMMENTS
#19	3%	5	#1	400°F		350°F	
#18	0%	5	#1	325°F	1 Full, 1-1/2 truck loads	320°F 300°F	
#17	9%	5	#1	310°F	Shut down between #18 & #17	270°F	
#18	0%	5	#1	360°F	More mix was needed		
#16	6%	5	#1	398°F		350°F	
#15	0%	5	#1 #2 #4	260°F 285°F 314°F	2 Full, 1-1/2 truck loads Shut down between #1 & #2	250°F 260°F	
#14	3%	10	#1	420°F		305°F	
#13	6%	10	#1	370°F	Shut down between #13 & #12	330°F	
#12	9%	10	#1	360°F		300°F 320°F	
#11	0%	10	#1	405°F	5 to 10 min. shut down to change AC	340°F	
#10	0%	20	#1 #2 #3	300°F 267°F 295°F	2 Full, 1-1/2 truck loads Shut down between #10 & #9	270°F 260°F 170°F	Last truck sat with load while driveways were being paved
#9	9%	5	#1	385°F		355°F	
#8	3%	5	#1	332°F		355°F	
#7	0%	5	#1	405°F		380°F	
#6	6%	5	#1	340°F		320°F	
#5	0%	10	#1 #2 #3	265°F 245°F 320°F	Shut down between truck #1 & 2 3 full truck loads	245°F	Temp. from which unknown

TEST SECTION - HWY. 44, EAST OF DALLAS CENTER  
 SURFACE COURSE - WEST BOUND LANE 6-16-81

SECTION NUMBER	PERCENT OF 5990	AC TYPE	TRUCK NUMBER	MIX TEMPERATURE	COMMENTS	PAVER TEMPERATURE	COMMENTS
#4	6%	10	#1	362°F		280°F 310°F	
#3	3%	10	#1	425°F	Mixed too long	380°F	
#2	0%	10	#1	355°F		--	
#1	9%	10	#1	290°F		250°F 275°F	

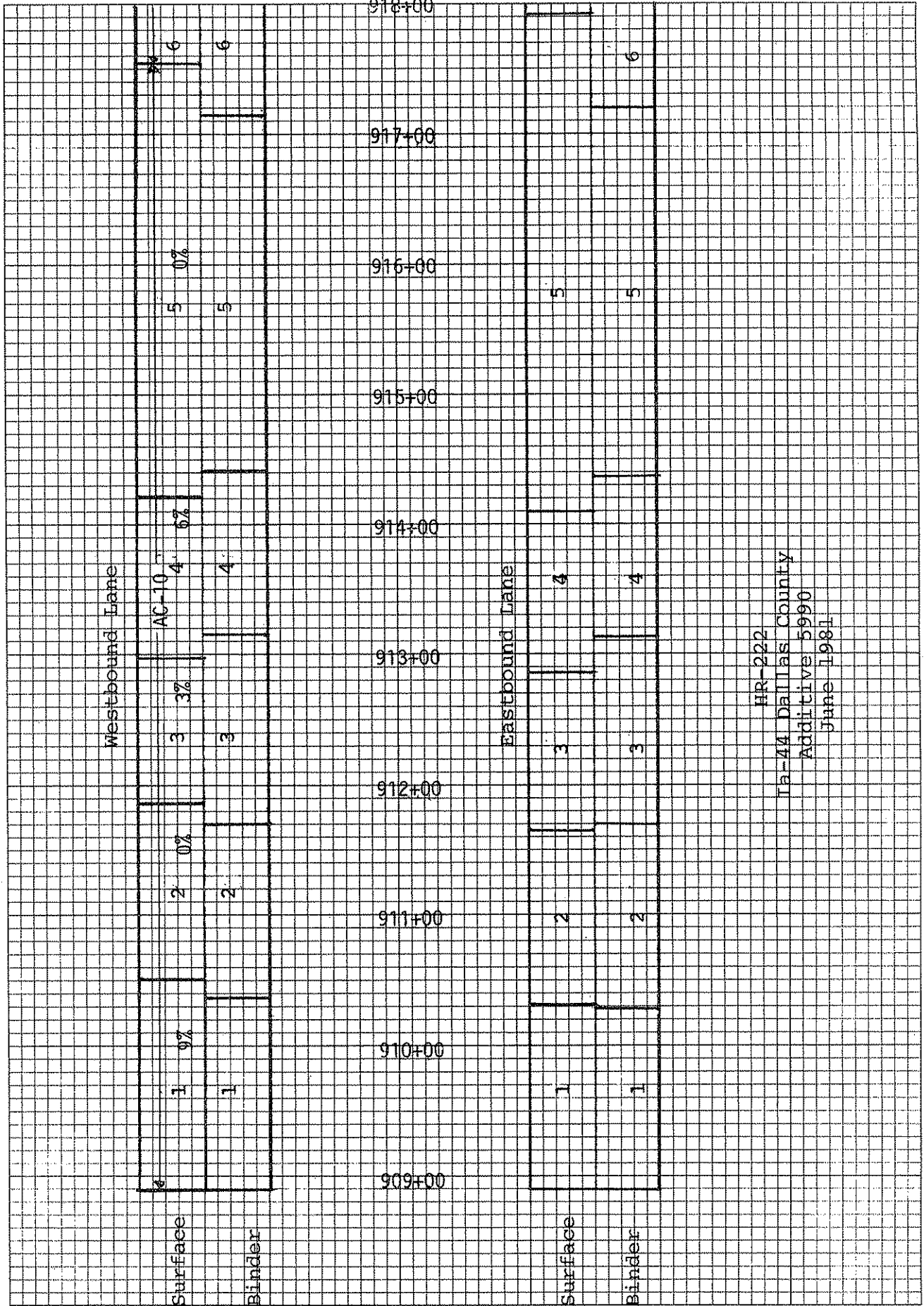
\*Samples were taken when checking temps.

TEST SECTION - HWY. 44, EAST OF DALLAS CENTER SURFACE COURSE - EAST BOUND LANE, 6-17-81

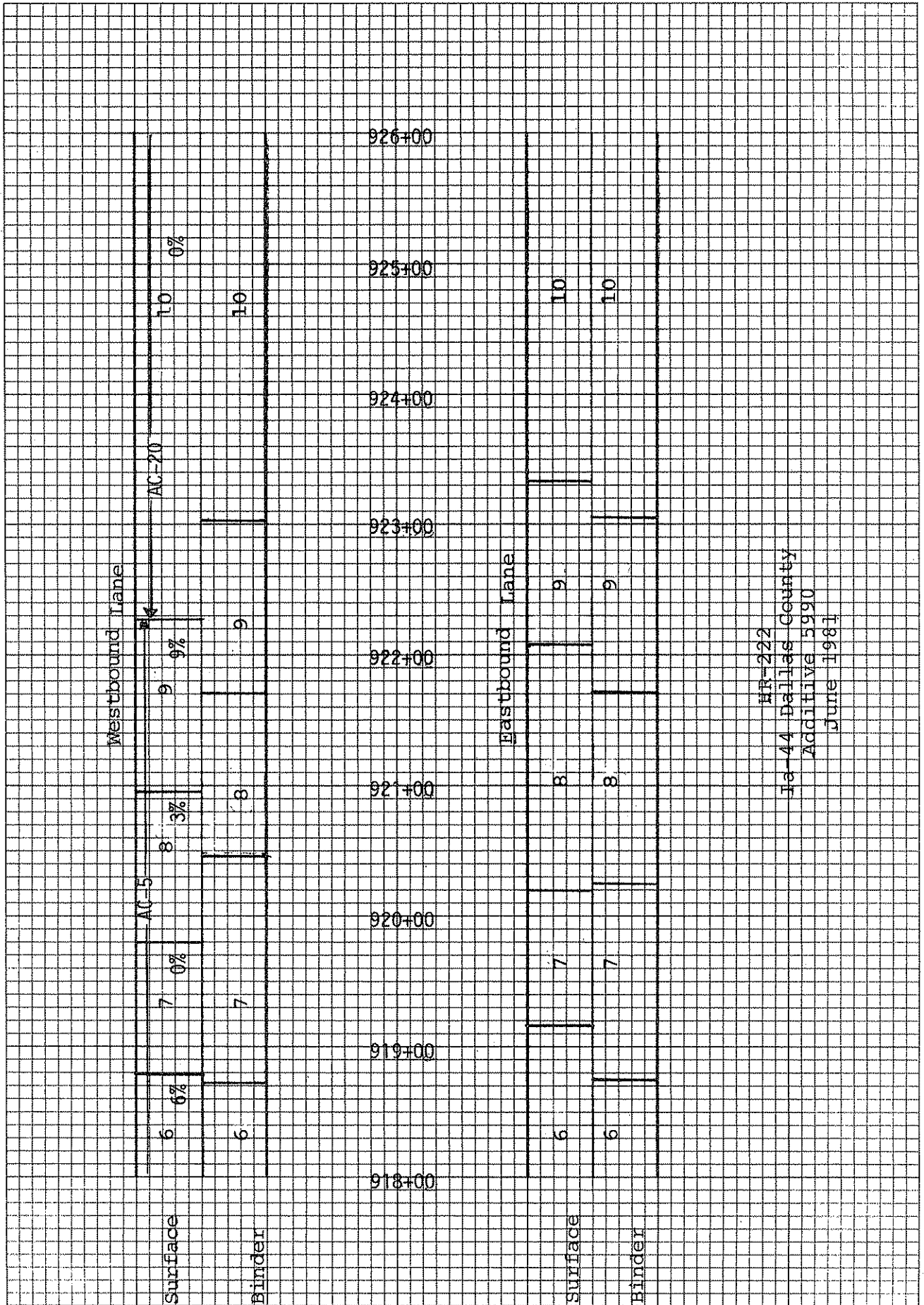
SECTION NUMBER	PERCENT OF 5990	AC TYPE	TRUCK NUMBER	MIX TEMPERATURE	COMMENTS	PAVER TEMPERATURES	COMMENTS
#14	3%	10	#1	395°F	Mixed too long. Had the wrong AC type for #19 so used for Sec. 14 truck waited till its section came up		
#19	3%	5	#1	385°F		330°F	
#18	0%	5	#1	385°F	1 full 1-1/2 truck loads	370°F	
#17	9%	5	#1	390°F		320°F	
#16	6%	5	#1	336°F	2nd dump in the truck was 20 sec. early	230°F	
#15	0%	5	#1 #2 #3	272°F 340°F ---	2 full 1-1/2 truck loads sample taken shut down after truck #3	265°F 305°F 280°F	
#14	3%	10			Refer to 1st mix made		
#13	6%	10	#1	383°F		360°F	
#12	9%	10	#1	395°F		330°F	
#11	0%	10	#1	376°F		360°F	
#10	0%	20	#1 #2	395°F 340°F	Sample taken 2 full 1-1/2 truck loads	230°F 300°F 250°F	
=9	9%	5	#1	380°F		330°F	

SECTION NUMBER	PERCENT OF 5990	AC TYPE	TRUCK NUMBER	MIX TEMPERATURE	COMMENTS	PAVER TEMPERATURES	COMMENTS
#13	6%	10			Had a short load, had to put out more mix		
#8	3%	5				355°F 345°F	
#7	0%	5	#1	395°F		355°F	
#6	6%	5			Shut down between #6 & #5	330°F	
#5	0%	10	#1 #2	315°F 290°F	Sample taken. 3 full truck loads	285°F 230°F 255°F 220°F	
#8	3%	5			Needed more mix. Mixed 20 sec. too long		
#4	6%	10	#1	375°F		330°F	Paver breakdown (15 min.)
#3	3%	10	#1	--		355°F	
#2	0%	10	#1	385°F		350°F	
#1	9%	10	#1			300°F	

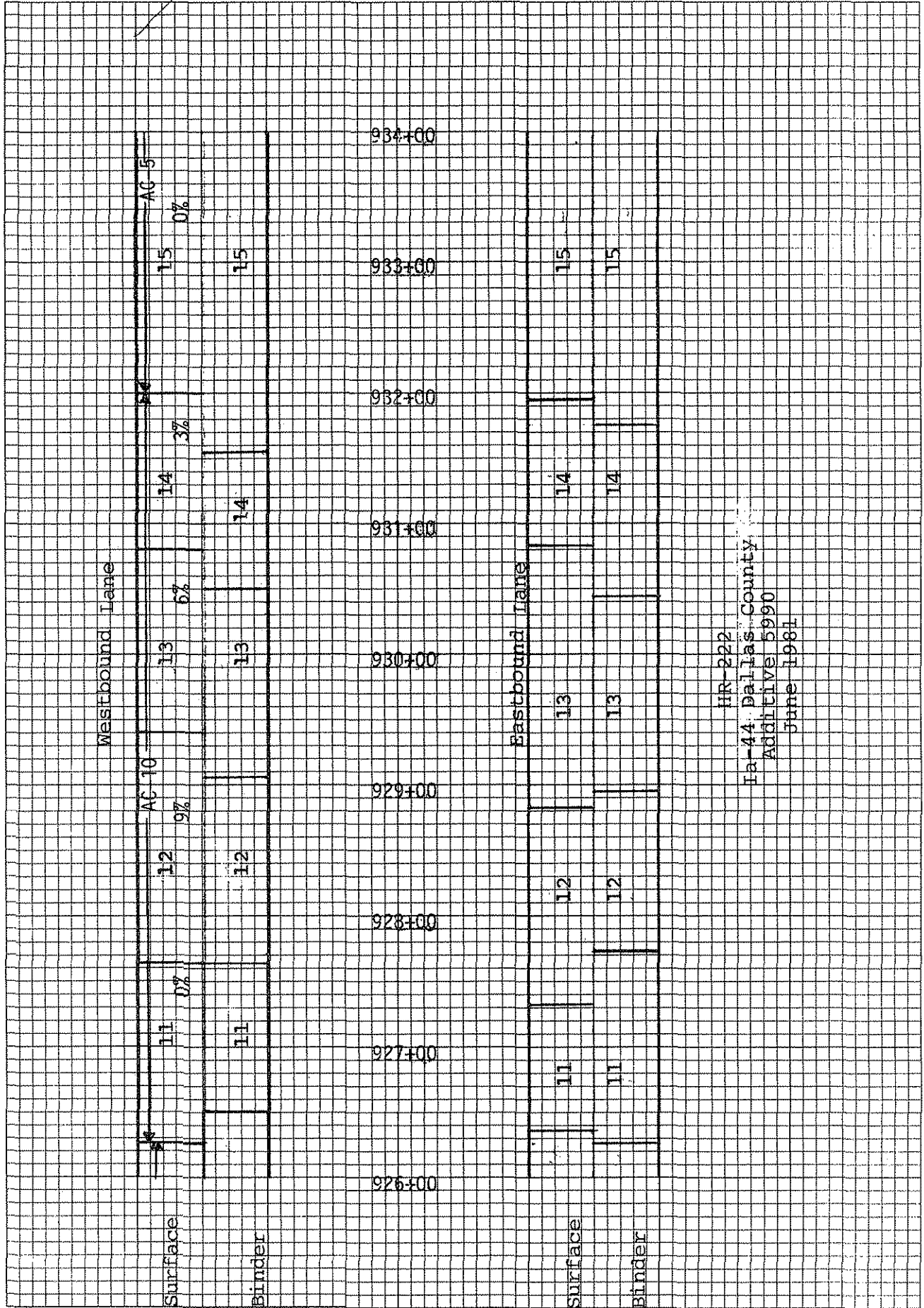




HR-222  
Ta-44 Dallas County  
Additive 5990  
June 1981



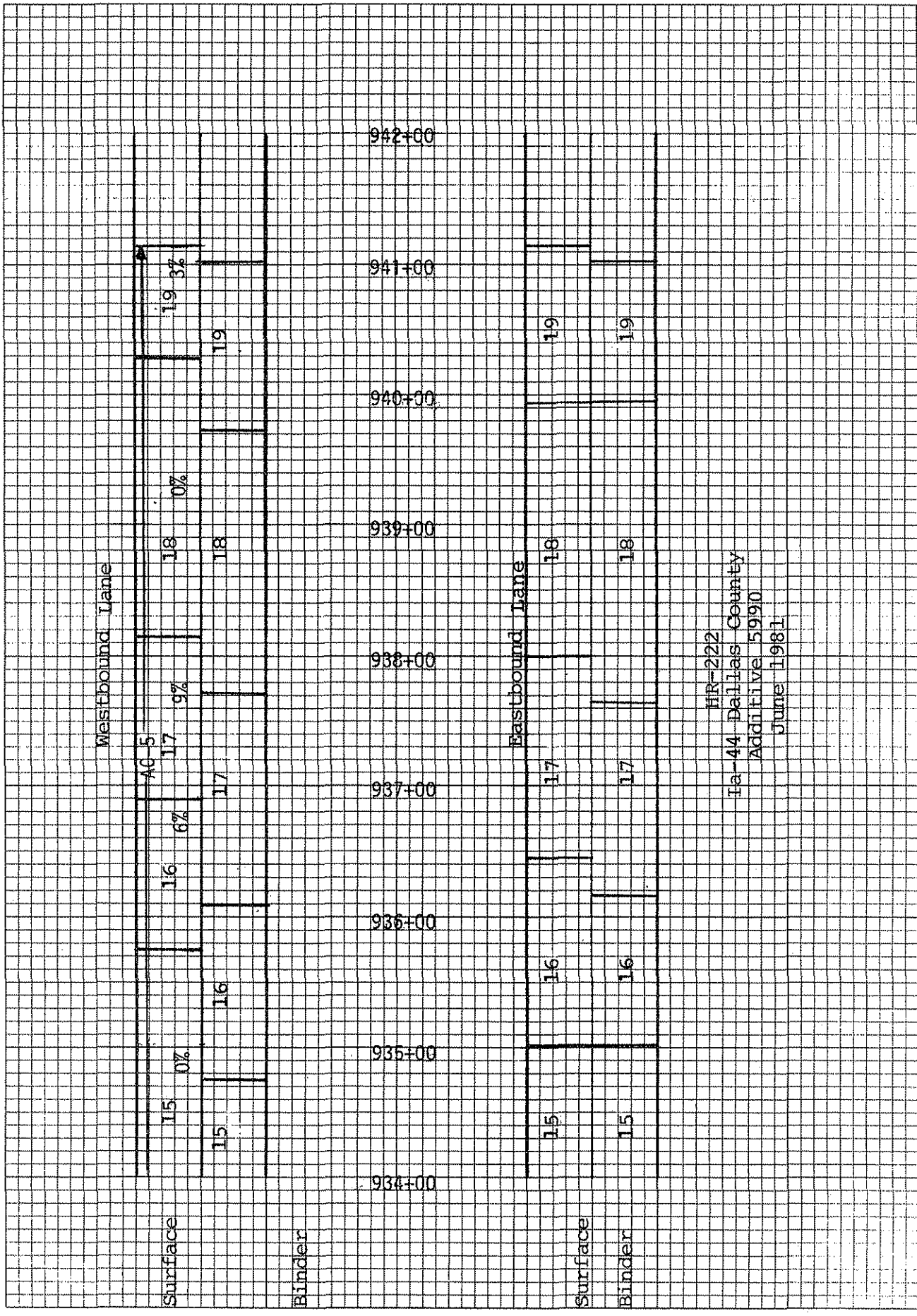
HR-222  
Ic-44 Dallas County  
Additive 5990  
June 1981



HR-222  
 La-44 Dallas County  
 Additive 5990  
 June 1981

46 0703

10 X 10 TO THE INCH • 7 X 10 INCHES  
KEUFFEL & ESSER CO. MADE IN U.S.A.



HR-222  
 Ia-44, Dallas County  
 Additive 5990  
 June 1981

APPENDIX E

Laboratory Test Results  
Surface Course

Sect.	AC Type	% 5990	Sp. G. (Ave. 3 Cores)	% Air	% A.C.	Marshall Stability	Viscosity Poises	Pen
1	10	9	2.27	6.7	5.1	2733	2810	65
2	10	0	2.27	7.4	---	----	----	--
3	10	3	2.32	5.1	5.5	2392	2830	61
4	10	6	2.34	4.3	5.5	2400	----	--
5	10	0	2.27	5.8	---	----	2000	72
11	10	0	2.34	4.4	5.7	2283	2250	69
12	10	9	2.33	4.1	5.6	2415	2530	70
13	10	6	2.33	4.7	5.4	2630	2170	71
14	10	3	2.36	3.7	5.6	2233	1800	79
6	5	6	2.30	6.1	6.4	2068	1280	94
7	5	0	2.36	4.1	---	----	----	--
8	5	3	2.35	3.8	5.4	2092	996	107
9	5	9	2.32	4.7	5.9	2320	1650	82
15	5	0	2.31	5.4	---	----	1220	93
16	5	6	2.31	5.2	6.3	2013	1300	93
17	5	9	2.29	6.1	6.4	2192	1180	99
18	5	0	2.36	3.8	5.4	2350	1440	88
19	5	3	2.36	3.4	5.8	1992	1230	95
10	20	0	2.25	7.9	---	----	4420	46