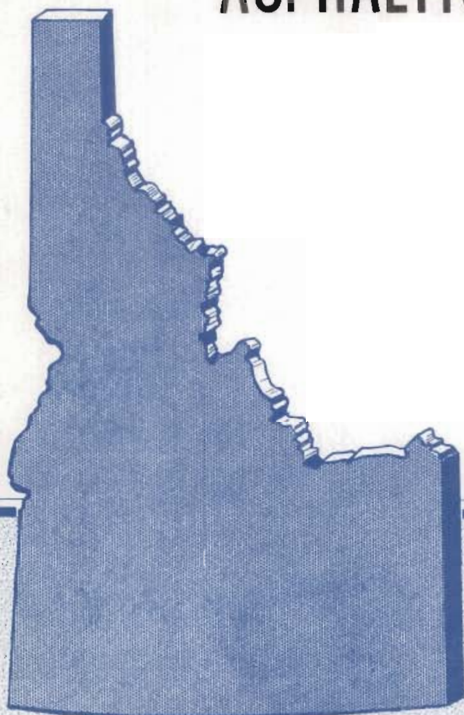
X-TRA

NON-DESTRUCTIVE TESTING AND COMPACTION CONTROL OF ASPHALTIC PAVEMENT CONSTRUCTION



AUGUST 1969

RESEARCH PROJECT NO. 24

IDH-RP024(5)

STATE OF IDAHO DEPARTMENT OF HIGHWAYS

NON-DESTRUCTIVE TESTING
AND
COMPACTION CONTROL
OF
ASPHALTIC PAVEMENT CONSTRUCTION

Research Project Number 24

by

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August 1969

IDAHO DEPARTMENT OF HIGHWAYS

Boise, Idaho

ACKNOWLEDGEMENTS

As E.I.T.'s, Gene Wortham and Jon Schierman conducted Phases I and II, respectively, of this project and wrote the preliminary reports from which this report was contracted; Mr. L. F. Erickson, Materials and Research Engr. gave encouragement and guidance to the project. Technicians from the Central Materials Laboratory cut the cores and did the testing on the cores

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INTRODUCTION

The failures of our plantmix pavements are receiving more attention in recent years, either because there are more of them or because of greater concern from engineers trying to provide maintenance-free pavements. In either case, it has become the purpose of much research and investigational work to determine the causes of these failures.

Much recent research elsewhere has pointed to insufficient compaction as a contributor to, if not the cause of, many failures, including stripping, cracking, ravelling, rutting, etc. The compaction of bituminous surfaces and bases "has probably been the subject of more studies and publications than any other facet of the paving operation. There seems to be no doubt in the engineer's mind that proper and adequate compaction is most essential in constructing a stable and durable pavement. In fact, no aggregate and asphalt mixture becomes a pavement until it is properly compacted." [1]

For many years highway departments, including the Idaho Department of Highways, have been spending a great deal of time and money in obtaining cores from the roadway for density determinations. When the density is finally determined the roadway is completed and it is too late to correct any deficiency. An ideal method of obtaining density for field control is non-destructive testing, which tells immediately the density of the asphaltic mixture being tested.

In 1965 and again in 1967, the Idaho Department of Highways conducted research projects using non-destructive methods for testing the compaction of plantmix pavements as they were being constructed. The first project (Phase I 1965) was conducted on the 0.1' plantmix overlay of the Interstate highway between Burley (I.C. of I-80N & SH-27) and the Salt Lake Interchange (Jct. I-80N & I-15W). The second project (Phase II 1967) was conducted on six different paving projects in southern Idaho. Both phases had as their purpose, not only to determine the practicality of using non-destructive methods of test, but to evaluate different methods and to determine a sequence of rolling which would give the desirable minimum density to

the plantmix pavement surface.

The need for these projects was emphasized in a report in March 1966. This report concerning pavement cracking showed a very real correlation between compaction, air voids, and pavement performance; i.e. as percent compaction decreased, air voids increased and cracking, ravelling, etc. became visible earlier in the life of the pavement. Table 1 is part of a table from the aforementioned report showing this relationship. Goode & Lufsey[2] recommend that for best results the air voids should exceed 3% by volume of the mix but not exceed 6%.

As stated earlier it was the objective of these projects to determine whether it was practical to use these methods of non-destructive testing for control of pavement compaction.

Another objective was to determine the types of rollers and the sequence in which they should be used to obtain the degree of compaction required to present a good riding surface and to give a long service life to the asphaltic pavement. The temperature of the mix at the time of rolling is an important consideration and determination of its effect upon the final density was another objective of the projects.

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PROCEDURES

Phase I - I-80N-3(27)206 - Burley to Jct. I-15W

This was an overlay project of 0.1' plantmix pavement. Three rollers were used for compaction; a two-axle tandem, 17,700 lb. steel wheel roller; a 3-axle tandem 27,350 lb. steel wheel roller; and a 25,000 lb. eleven wheel pneumatic tire roller with 9.00 x 20 tires with 55 psi pressure.

Density testing was done with three different types of instruments. The Air Permeameter or Asphalt Paving Meter, measures the flow of air through the voids in the pavement relating rate of flow to volume of air voids and thus to degree of compaction.

The water permeability test operates on the same principle as the air permeameter, relating voids to density. Water permeability tests were run in accordance with California Test Method No. 341-A.

Nuclear density testing was by a Troxler Model SC 120H Surface Density gage in accordance with the manufacturer's instructions.

In order to have a base for comparison, cores were obtained from the pavement and tested for field density and air voids. However, these were not obtained until 7 days after the pavement was laid. Since the pavement was in service, the additional compaction may have upset the correlation with the instrument tests, especially in the wheelpaths.

During the construction of the pavement, air flow tests were performed after breakdown, intermediate and final rolling. Water permeability and nuclear testing was done only after final rolling. Air and pavement mix temperatures were taken following each phase of rolling. Table 2 describes the rolling sequences used during the study. A coverage as used in the table, is the number of passes necessary to completely roll a width of pavement at any point, excluding the overlap between passes.

Seven rolling patterns were used to determine a pattern which would give the best results for this type of paving project as indicated in Table 2.

RESULTS

Phase I

The results of the testing for this project are depicted by the graphs of Figures 1 to 14 in Appendix A. These charts show that in general there was a progressive increase in density from the breakdown to intermediate and final phases of rolling as indicated by the general decrease in rate of air flow.

Figures 15 thru 18 show interesting comparisons of data. Figure 15 shows a plot of the final air flow for each rolling pattern, with the breakdown rolling temperature for comparison purposes. These seem to show that higher pavement densities are obtained with higher breakdown temperatures. Figure 18 compares the 3 methods of testing. The air permeameter and the nuclear gage appear to relate, but the water permeability test did not appear to follow the pattern of the other two methods.

A comparison of breakdown temperature and field (core) densities is shown by the plot of Figure 19. The scatter is so great as to suggest many other variables which affect the final density such as roller pattern, thickness of pavement course, temperature of subsequent rolling, etc.

Tables 3 - 10 give the results of laboratory tests on the Class "D" plantmix from the various test sites on this project. It will be noted that the rolling temperatures are rather low at the time of testing with the air permeameter. Whereas the Standard Specifications require the intermediate rolling be completed while the plantmix temperature is above 140°F, some of the temperatures taken after the breakdown phase were much lower, and most of the temperatures taken following the intermediate rolling phase were very low. Since the testing was done several minutes after the rolling phase was completed, the pavement lost several degrees of temperature before the tests were performed. However, the extremely low temperatures would indicate that the rolling temperatures were low.

It is known that better pavement densities are obtained by rolling at higher temperatures and it is recommended that on all future projects efforts be made to meet the minimum specification and preferably to exceed it.

Table 11 gives the data from the cores taken from the project and relates the core densities to the lab densities. The figures next to the plotted points in Figure 19 are the percent of the lab densities obtained by the given rolling pattern as an average for the section.

CONCLUSIONS

Phase I

With the number of variables and test sites involved in this type of project it is difficult to arrive at any specific conclusions. Pavement course thickness, rolling temperatures, gradation of the mix, asphalt content, etc. appear to have their affect on the final results.

In Figures 15 & 17 the air permeameter test and the nuclear test appear to show roller patterns A,B,E and F to be the best compacted, while Figure 20 shows A,D & F to be the best compacted.

Pattern "A" had a high percent density with low percent air voids, being below 3.0% voids in one area of the section. This "tight" mat was accompanied with flushing.

Pattern "B" was erratic in air flow readings during testing but looked fairly good after final rolling. This pattern had a good percent air voids value.

In rolling Pattern "C" the breakdown density does not appear as good as for the three-axle tandem and not much better than the two-axle roller. The 180°F breakdown temperature was the lowest of all sections tested. The air flow values also are higher in comparison with Patterns "A" and "B".

Pattern "D" had high final air flow values but was third most dense from the percent of optimum density standpoint. This may be due to the traffic compaction it received before the core was removed.

The air flow and percent air voids for Pattern "E" look very good. Optimum density appear to be a little low by comparison.

Although roller Pattern "F" had a high breakdown temperature of 240°F it had a high air flow rate (1058 ml/min.) after breakdown compared with Pattern"E" (380 ml/min.) with a temperature of 255°F. The final air flow and percent laboratory density values look good.

The breakdown temperature for roller Pattern "G" was only 195°F, which probably contributed to the low density. It had the highest air flow rate of all sections tested. There evidently was not enough compactive effort applied with this pattern.

The data presented in this report appear to warrant the following conclusions:

1. The air permeameter could be used for the compaction control of plantmix pavements.
2. The water permeability test does not appear to be suitable for this type of testing.
3. Rolling Pattern "B" and "E" give the best, most uniform results.
4. Not enough data were obtained using the nuclear density gage to justify its use without additional testing.
5. Conclusions made on this project may not be applicable to other than thin course plantmix paving projects.

RECOMMENDATIONS

Phase I

It is recommended that:

1. Three-axle tandem rollers be used for breakdown rolling.
2. The following roller patterns be used on thin plantmix overlays:

   Three-axle tandem - 2 coverages
   Pneumatic Tired Roller - 2-3 coverages
   Two-axle tandem - 1-2 coverages

   or

   Three-axle tandem roller - 2 coverages
   Two-axle tandem roller - 2-3 coverages
3. Additional evaluation testing of both the air permeameter and the nuclear gage before using them for compaction control of plantmix paving projects; especially projects other than thin lift pavements.
4. Testing of standard and thick lift plantmix projects be made before specifying the above rolling patterns for these types of projects.
5. Rolling be accomplished at as high temperatures as possible.

PROCEDURES

Phase II

To obtain the information desired for this project it was necessary and desirable to conduct tests on several projects.

Nuclear density readings were made on all projects. Cores were obtained from the roadways at the locations of the nuclear reading so that densities determined by the nuclear gages could be compared with the actual densities of the cores. Air permeameter readings were taken on several projects in an effort to compare or correlate the results with actual air voids as obtained from conventional tests on the cores. Because of the grease ring left by the air permeameter this test could not be conducted on the spot where the nuclear test and the cores were taken. However, the air permeameter tests were performed as near as possible to these test sites to eliminate as much as possible differences in gradation, handling or compaction.

On the I-80N-3(34)196 project nuclear density readings were made at various stages of rolling to try to establish the affect of rolling upon density. The number of passes per roller were also varied and nuclear density readings taken at various stages. This allowed comparison of the affect of a given roller on the density at any given number of passes. The mix temperature was recorded at the time of each nuclear reading to show the effect of rolling temperature on the final density. Temperatures were taken with a dial thermometer thrust into the edge of the pavement at approximately the mid-point of the course.

On the I-15-2(17)72 project which was receiving the final plantmix surfacing, nuclear density testing was done on the existing plantmix pavement to determine, if possible, the effect of the underlying material on the readings of the nuclear gages. To give a uniform surface across the full width of roadway 0.2 foot of plantmix was being placed on the shoulders while adding only 0.1 foot over the travelway of the existing plantmix. Readings with the nuclear gages were made at designated locations on the travelway prior to laydown of the new plantmix. None was made on the shoulders because the coarse chips made it impossible to seat the gage properly. After laydown, readings on both the shoulder and travelway were made at the initial site after the breakdown roller and after the 3rd pass with the pneumatic tired roller. Readings were taken after the 5th and 7th passes with the pneumatic tired roller at sites approximately 25 feet and 50 feet ahead respectively. All six sites were tested after the final pneumatic tired roller and after the finish roller, making it possible to compare the effect of the finish roller on the final compaction at sites with different coverages with the pneumatic tired roller. Air permeameter tests were performed on six of the sites after final rolling but were unusually high and were discarded as being invalid.

Another test performed on this particular project was the determination of the transverse effect of a normal rolling pattern ie, to determine the density variations across the pavement resulting from the rolling pattern followed by the contractor without the introduction of variations by the engineer. This was accomplished by taking nuclear density readings at 1 foot intervals across the entire pavement width prior to laydown and following the finish rolling. The distance from the pavement shoulder to the roller was measured on each roller pass. Temperatures were recorded at all phases of the rolling test to help determine the effect of rolling temperature upon the different phases of rolling.

To determine the effects of different mixes on the nuclear gages nuclear density readings were made with the Troxler gage, along with cores, beside record sample sites on two projects, FL-25(4) and I-15-2(17)72, and density readings were taken with the Seaman gage on project S-3712(3). Cores were also taken and tested for density and air voids.

RESULTS

Phase II

The data obtained from testing on the project are contained in the Appendixes. Table 12, Appendix B, lists the results of testing on Project S-3804(3) Mountain Home to SH-51. The results were very erratic, possibly due to the inexperience of the operator in the use of the nuclear gages and the air permeameter.

In Table 13 of Appendix B are listed the data obtained on the I-80N-4(1)220 project, a 0.1' overlay project from Cotterell to Salt Lake I.C. at the Jct. with I-15W. Only seven cores were taken from the pavement. This was not enough to establish any kind of correlation with either nuclear gage. Because of the traffic seal on the pavement surface the air permeameter readings registered so low that the results had no meaning.

Tables 14, 15 & 16, Appendix B, are a tabulation of the results of testing on the I-80N-3(34)196 project from Greenwood I.C. to SH-25 I.C. Here the data from the nuclear gages and the air permeameter are compared with core data. It is apparent that the two nuclear gages do not give the same results but they do follow the same trend. Neither nuclear gage gave the same results as the cores nor can it be said that they were consistent in their variation. The Troxler varied in its relationship to the core densities from -13#/cu.ft. to +4.2 #/cu.ft. and the Seamans gage varied with the core densities from +8.2 #/cu.ft. to -3.5 #/cu.ft.

Test results pertaining to the effect of underlying material on the density gages were inconclusive as there were too many other variables which affected these results.

In comparing core densities and air void values with the air permeameter readings no apparent trends or correlations were apparent.

Figures 22 and 23 show the relationship of density to compactive effort. Both figures show an apparent loss of density during certain of the pneumatic roller stages, probably due to the effect of ridges left in the pavement by the pneumatic roller during the early rolling stages. With average final densities for both sequences of 128.4 #/cu.ft. it appears that the additional pneumatic rolling passes of Figure 23 were unnecessary.

The final temperatures for each roller were plotted against the corresponding final core density to determine the effect of temperature upon density. These results are shown in the graphs of Figures 26 & 27 in Appendix B. No definite trends appear in these relationships.

Tables 17-21 in Appendix B show the results of the rolling sequence tests. These results reflect the influrnce of many variables. First there is undoubtedly an effect from the underlying material, but how it influences the gage readings is not readily apparent. The ridges left by the pneumatic tired roller influenced the readings following these rolling phases. And since the readings following the 5th and 7th pneumatic roller passes were taken 25 and 50 feet respectively, ahead of the original site, differences in material no doubt had a great influence upon the nuclear gage readings. The results of the final nuclear readings taken at each of the six different locations for each test section indicate a fairly good correlation between the two nuclear gages; in fact, better than between either gage and the conventional core method of testing. This may be partly due to the cores being taken one month after the rolling data were taken. Changes in density could well have occurred due to the traffic on the roadway.

The final test on this project suggests why there may be so little correlation between tests taken under seemingly similar conditions of mix, temperature and rolling. In this test the variations in density were determined at 1 foot intervals across the pavement for a normal rolling pattern. Due to the overlapping of the roller it was found that there was a great differential in actual compactive effort across the width of the roadway. This is shown in Figure 24

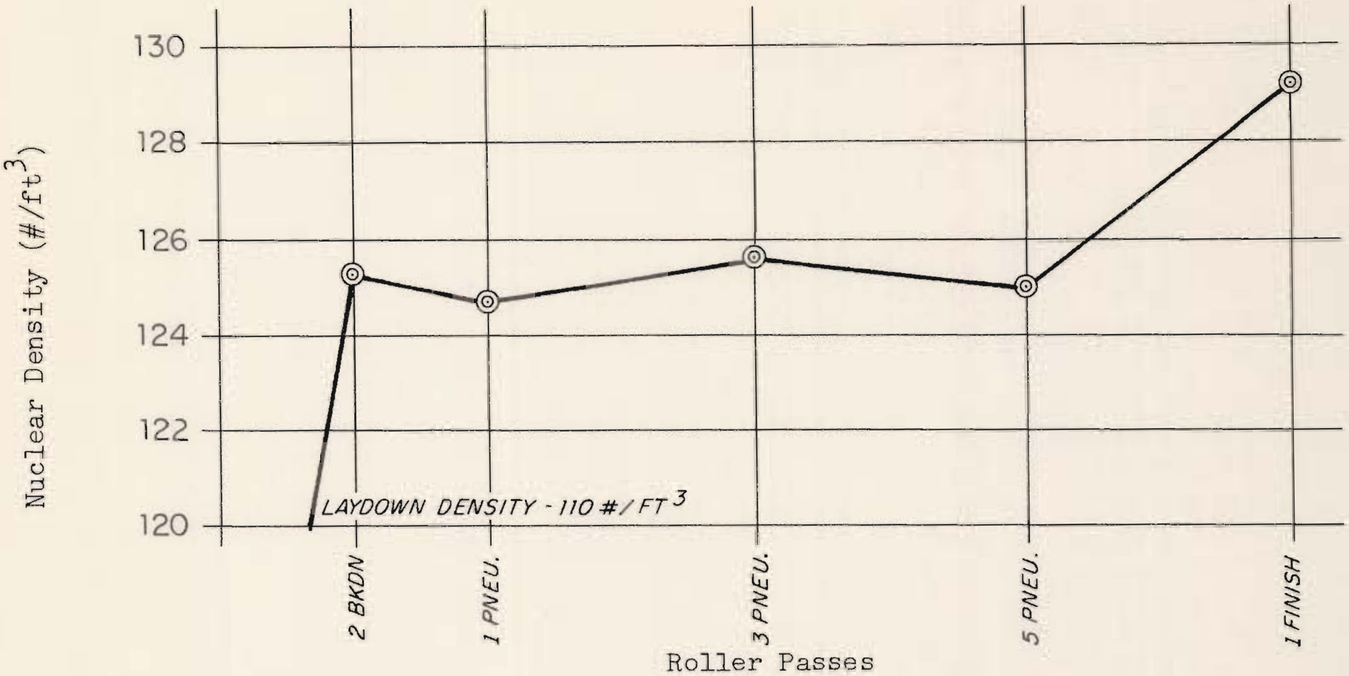

Figure 22 - Nuclear Density vs. Roller Passes

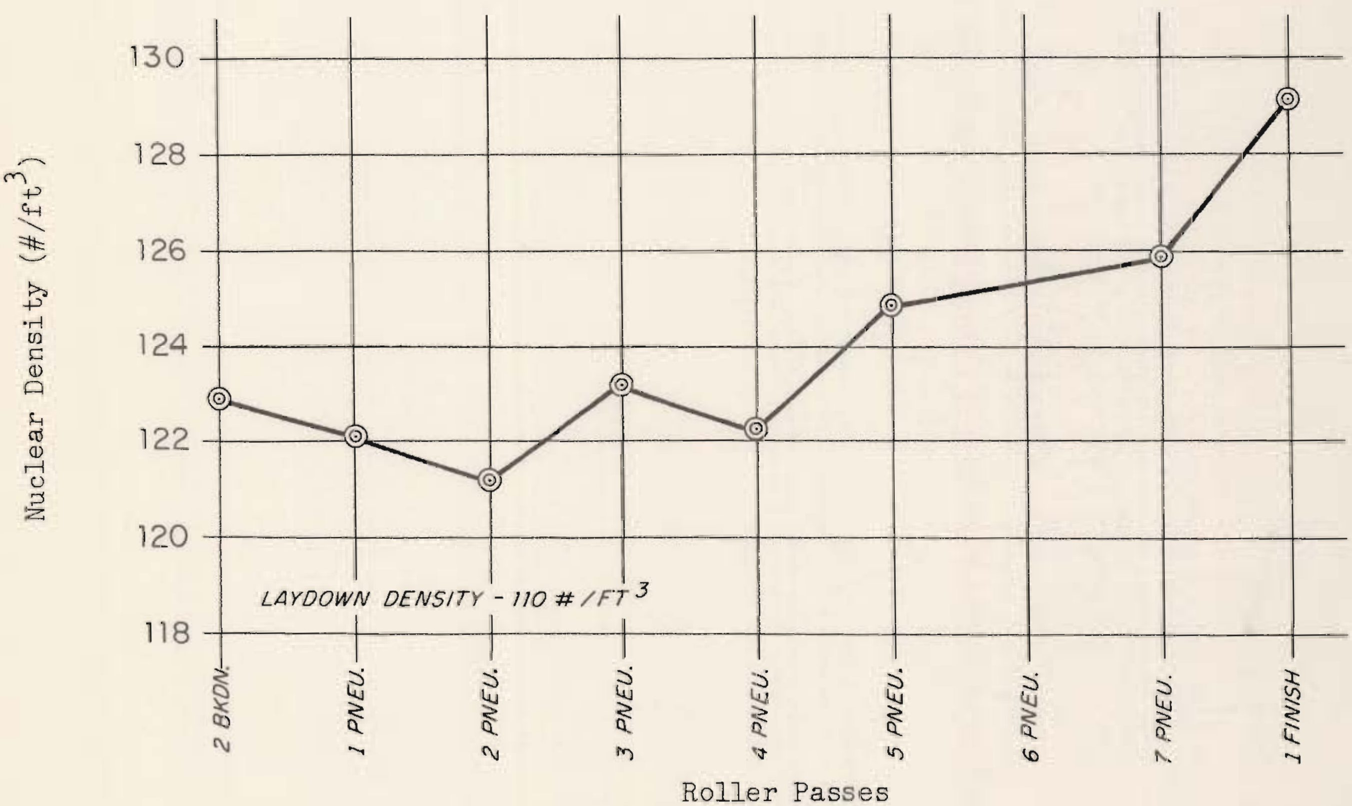

Figure 23 - Nuclear Density vs. Rolling Passes

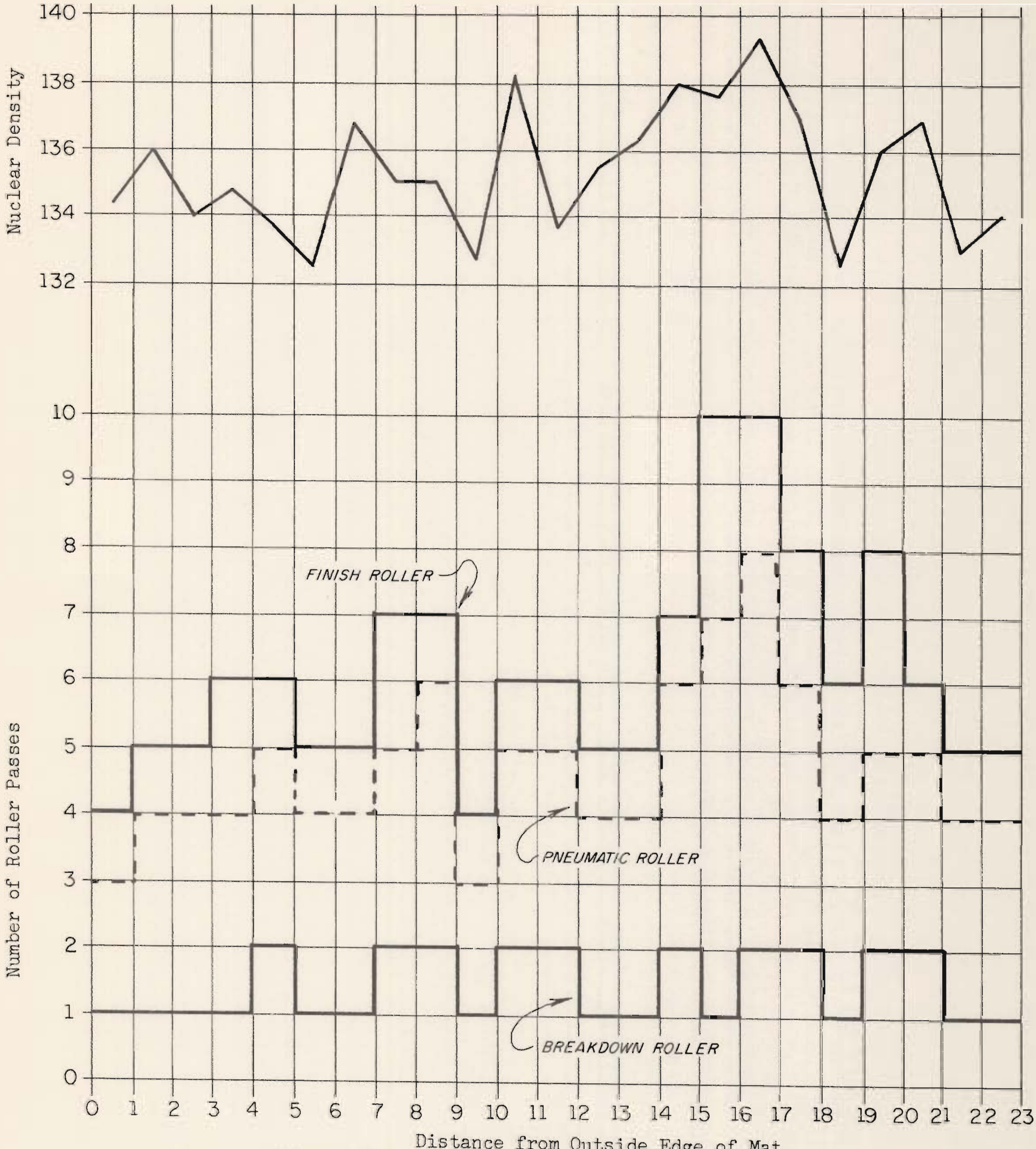

Figure 24 - Nuclear Density and Roller Passes
vs
Distance on Mat

where the distance from the edge of the pavement in 1 foot increments is plotted against the number of roller passes at that point. This is also compared with the nuclear density at each point. There is a very definite correlation between the number of roller passes and the density obtained. It can be seen that during a rolling sequence consisting of one pass with the breakdown roller, two passes with the pneumatic, and one pass with the finish the actual coverages range from four to eight at any given point. The two additional passes between fifteen and seventeen feet was due to the necessity of erasing a mark in the asphalt left by the roller on an earlier coverage. Figure 25 is a plot of the nuclear density versus number of roller passes and shows a very good relationship.

The above information tends to explain differences in results of tests taken randomly on a given project. In order to correlate results it would be necessary to know the number of coverages with the rollers at each test site.

Tables 22,23 & 24 are tabulations of data collected on the FL-25(4) project near Stanley, the I-15-2(17)72 project near Blackfoot and the S-3712(3) project on SH-19 near Nampa, to try to determine the effect of different plantmixes on the nuclear gages. These nuclear readings and cores were taken beside the record sample sites on these projects. The data in Table II for the FL-25(4) project, when compared with the data obtained with the Troxler gage on other projects, indicate that the Troxler gage should be calibrated for each individual project. The average difference between the core densities and the Troxler nuclear densities on the FL-25(4) project was -3.5 pcf, while on the I-80N-3(34)196 and I-15-2(17)72 projects the difference was approximately -4.7 pcf.

For the Seaman gage the mean difference between the gage densities and the core densities on the S-3712(3) project were -0.8 #/cu.ft. while on the I-80N-3(34)196 project they were +1.0 #/cu.ft. These differences can be explained by the fact that the Seaman gage was recalibrated between these two projects. It appears that the Seaman gage does not need to be calibrated for each different plantmix project.

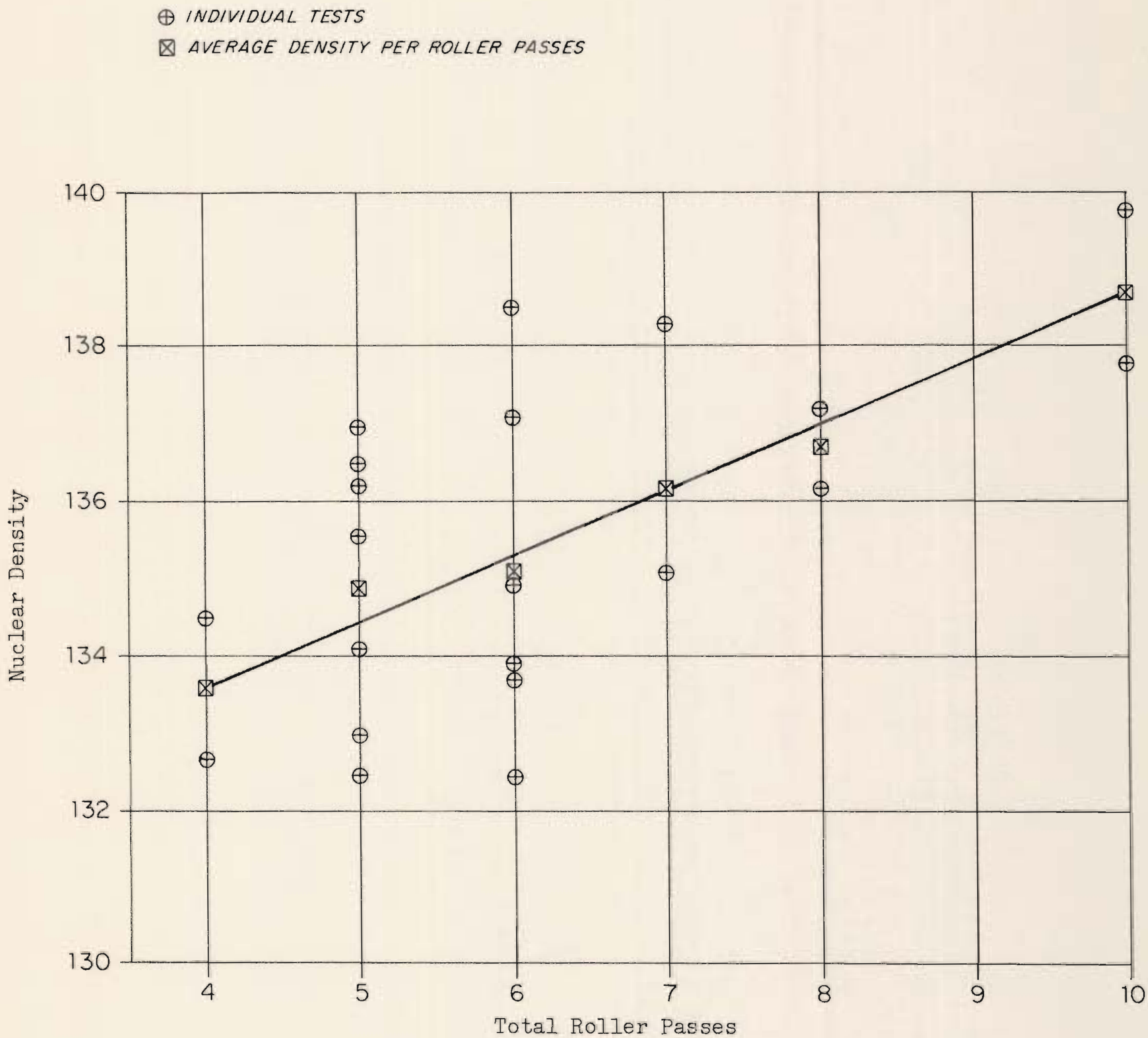

Figure 25 - Nuclear Density vs. Roller Passes
I-15-2(17)72 B
Across Pavement - One Test Site

CONCLUSIONS

Phase II

1. Training and experience in the use of the equipment is necessary to obtain meaningful results.

2. Insufficient data were obtained on the I-80N-4(1)220 project to establish relationships.

3. The air permeameter is ineffective for density or air voids testing on pavements having a traffic seal on the surface. It reflects surface texture more than density or air voids.

4. The two nuclear gages would give comparable results if calibrated upon the same material.

5. Nuclear gage densities deviated from core densities by significant amounts. However, with proper training and experience the deviation could be reduced to acceptable limits. Additional research would help in making clear cut decisions as to the use of these instruments in the control of plantmix compaction.

6. The nuclear gages do not give the desired accuracy in results on thin plantmix overlays.

7. For any given rolling operation the density will vary over a wide range at any given section of highway.

RECOMMENDATIONS

Phase II

It is recommended that: Additional experience be gained in the use of the nuclear gages for control of compaction of bituminous plantmix bases and pavements; especially the thicker lift construction. When other research projects are undertaken, care should be taken to design the projects to use statistical methods so that statistical analyses may be made of the data collected.

Prior to the use of any non-destructive testing the people who are going to use the equipment be thoroughly trained so that they will be able to detect errors in data.

The Troxler gage be calibrated for each change in mix unless later tests on thicker courses shows this to be unnecessary.

CONCLUSIONS - GENERAL

Each of the types of equipment used in these studies have their limitations and must be used with care and judgment. In order to obtain absolute values each needs to be calibrated with conventional type equipment or methods of determining pavement density.

The nuclear density gages appear to be the most practical method, of the three tested, of non-destructive testing for density of plantmix pavements. They are least sensitive to varying conditions and with an experienced operator can give good, repeatable results.

RECOMMENDATIONS - GENERAL

It is recommended that consideration be given to the use of nuclear gages in the control of compaction of asphalt treated bases, and plantmix pavements.

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APPENDIX A

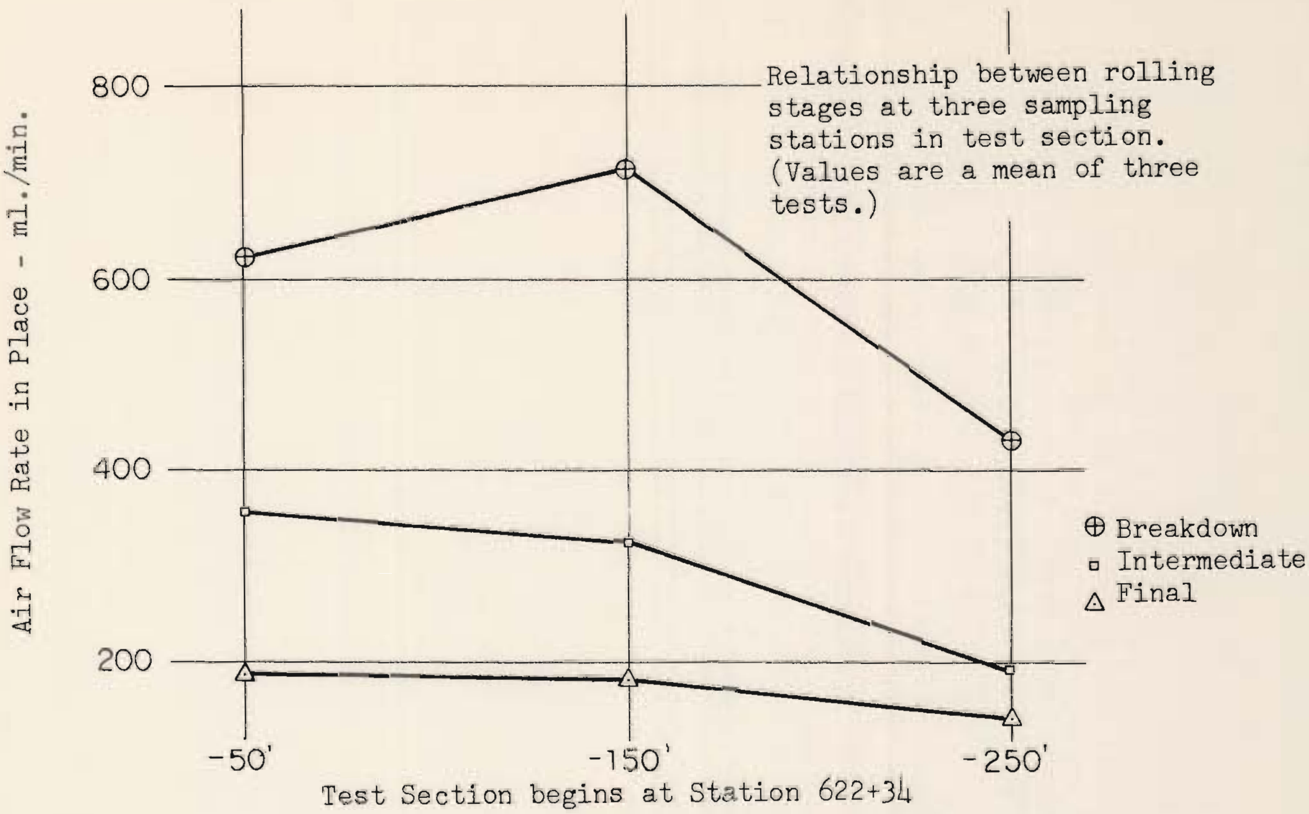


Figure 1 - Rolling Pattern "A"

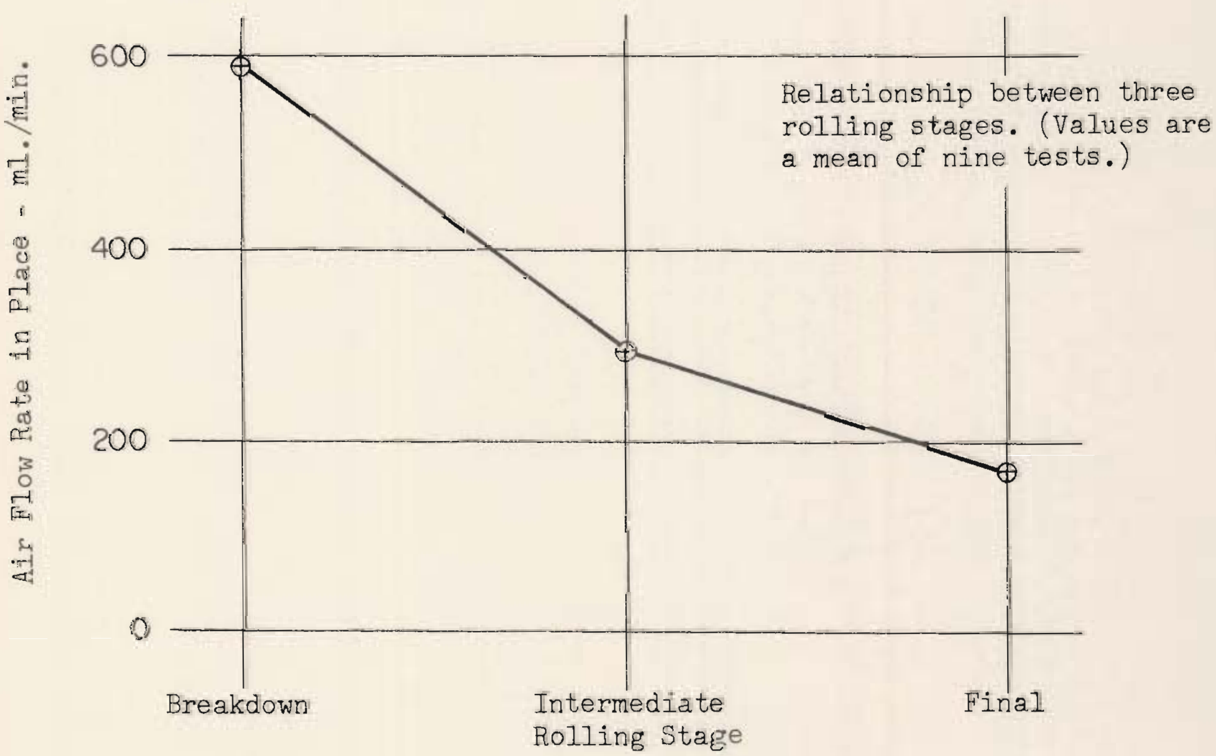


Figure 2 - Rolling Pattern "A"

I-80N-4(7)220

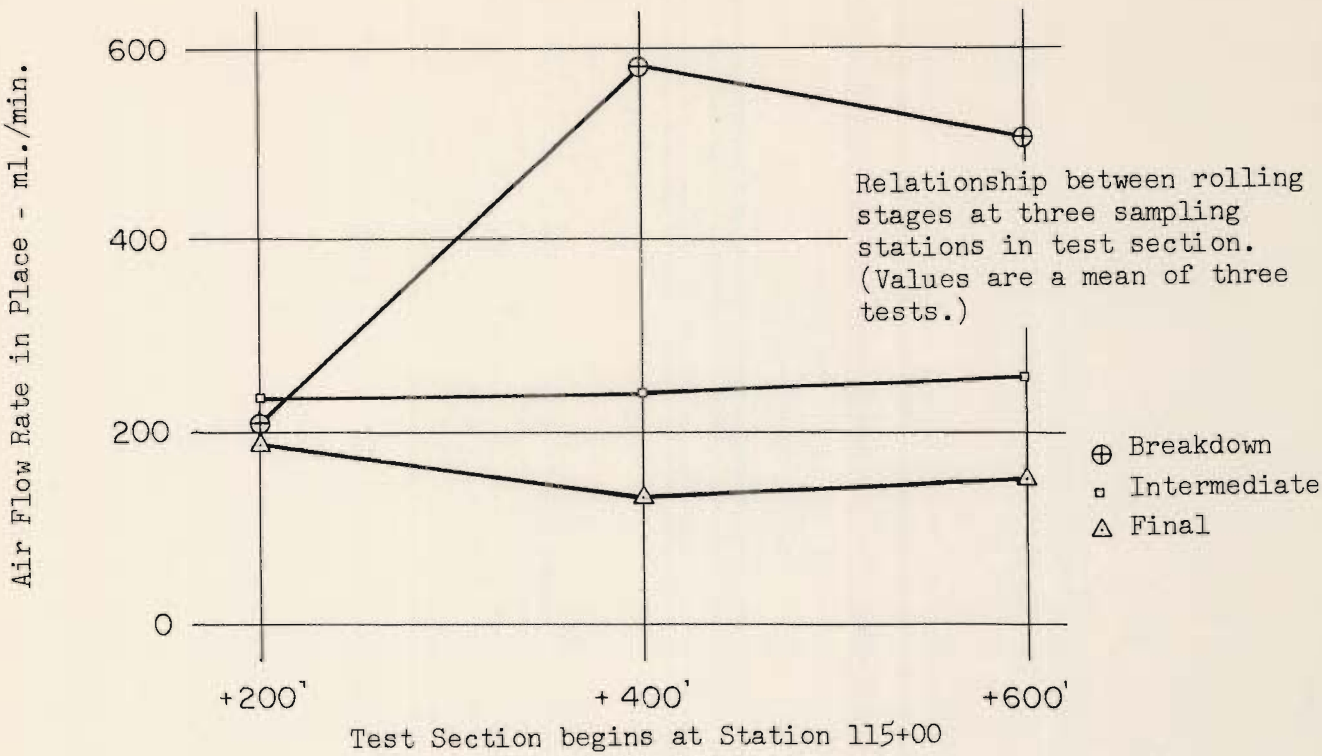


Figure 3 - Rolling Pattern "B"

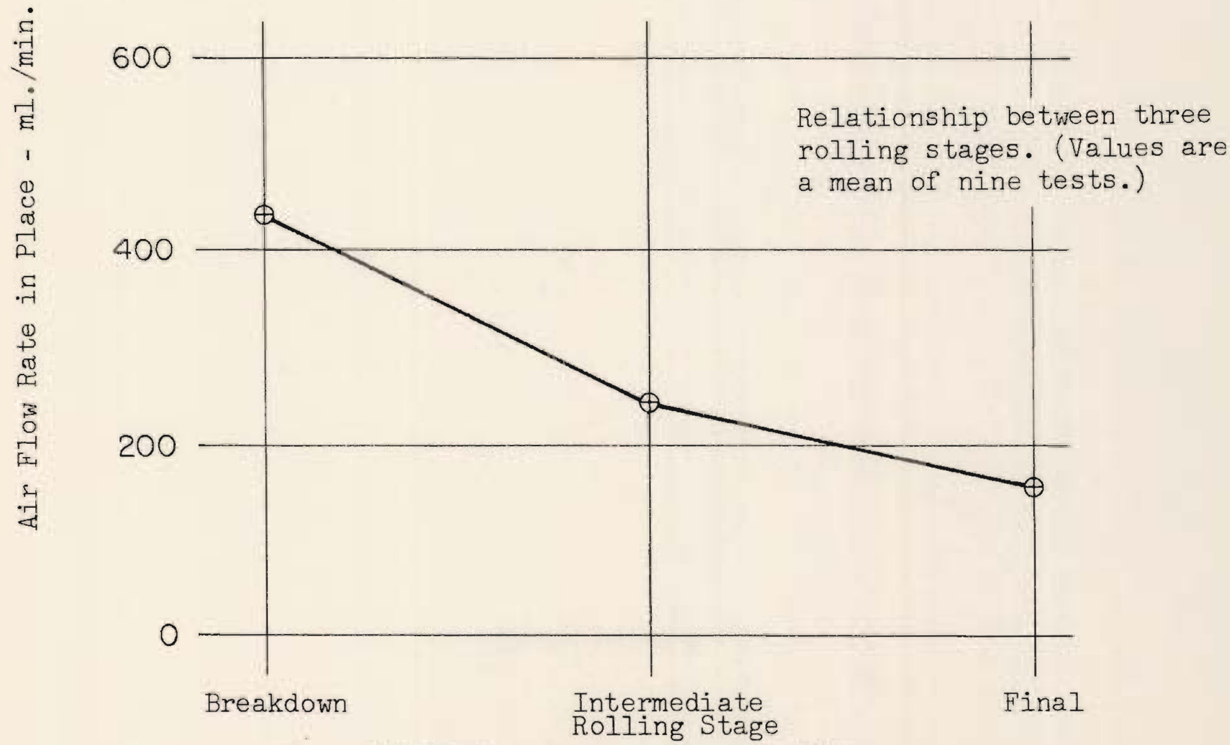
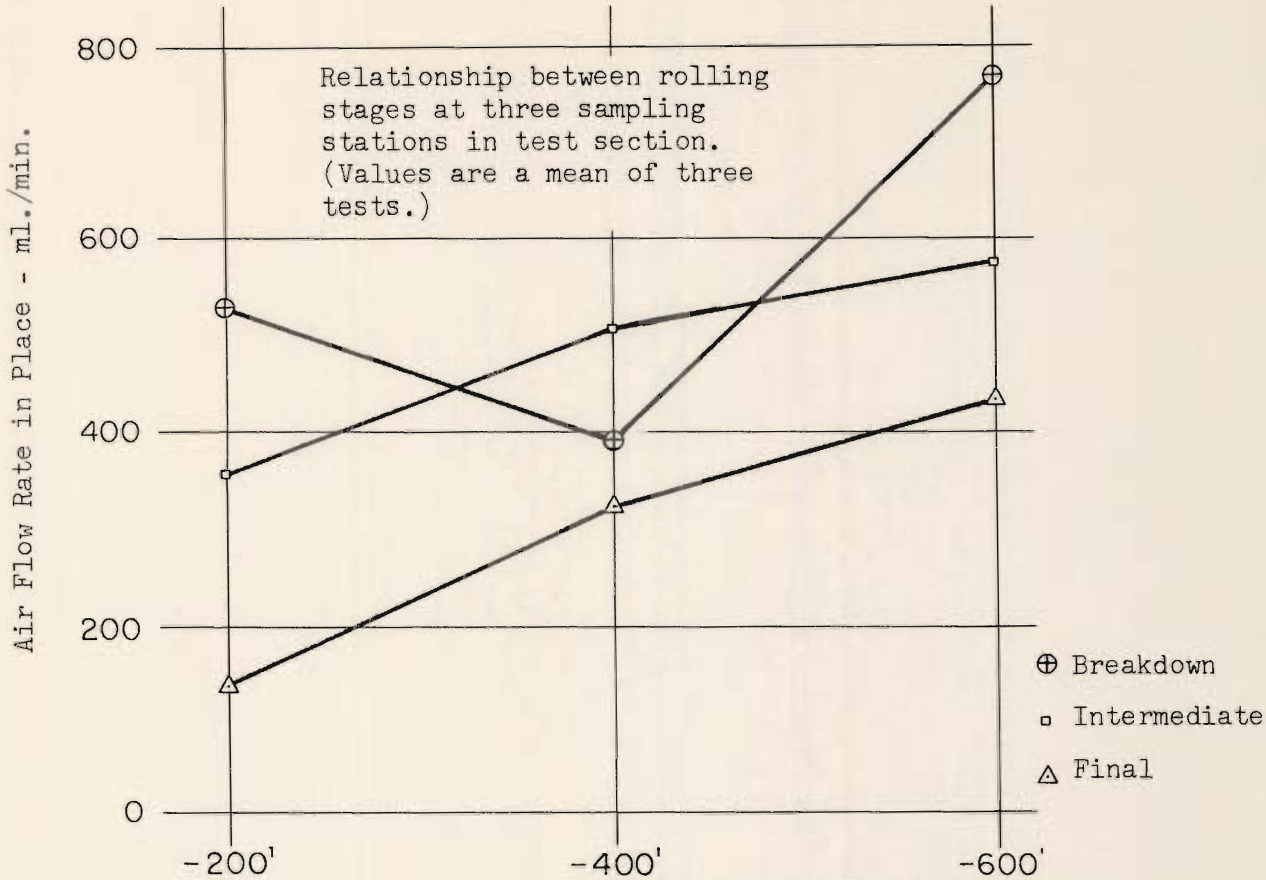


Figure 4 - Rolling Pattern "B"



Test Section begins at Station 581+50
Figure 5 - Rolling Pattern "C"

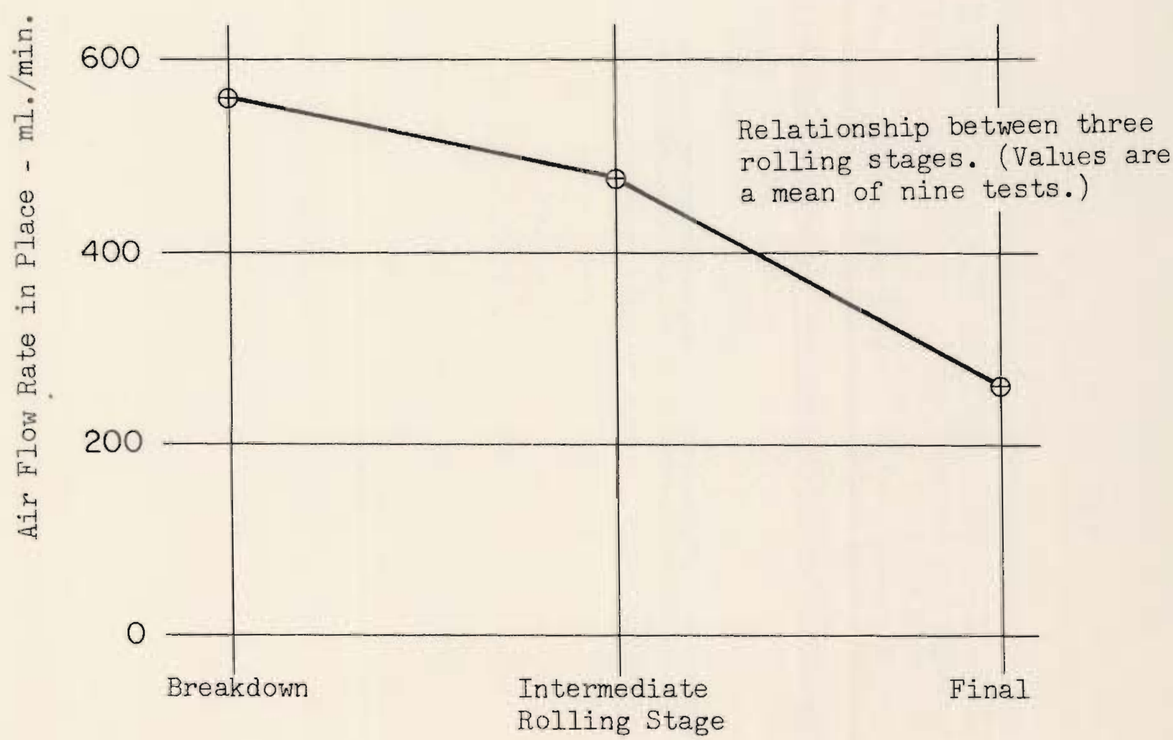


Figure 6 - Rolling Pattern "C"

I-80N-3(27)206

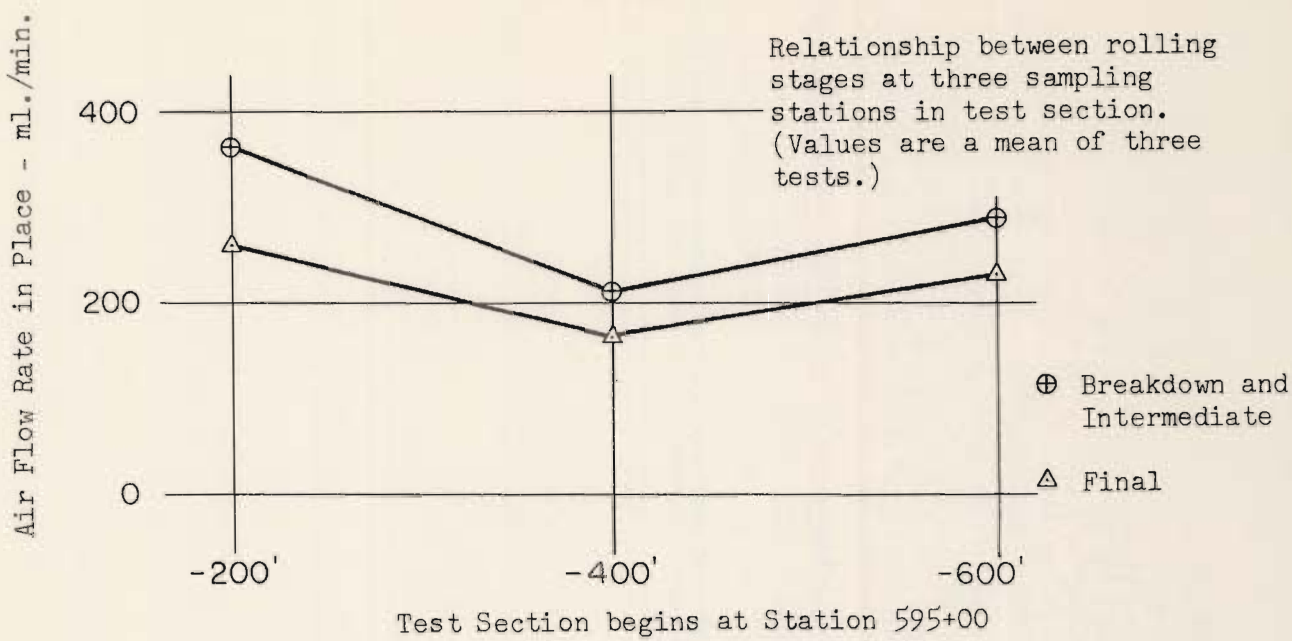


Figure 7 - Rolling Pattern "D"

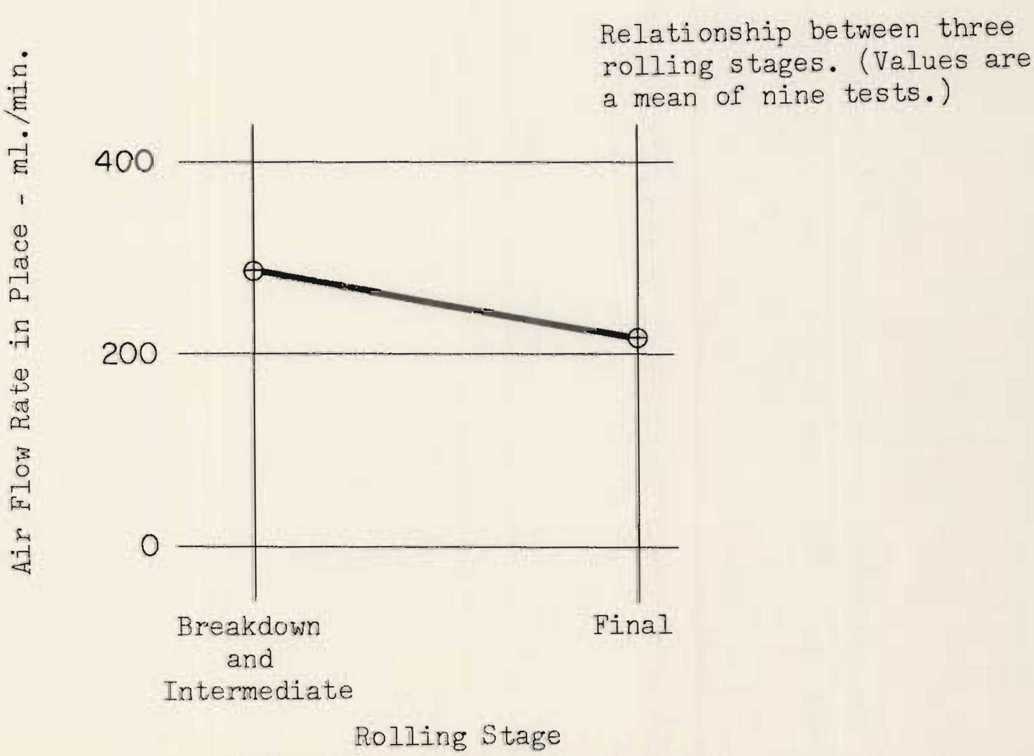
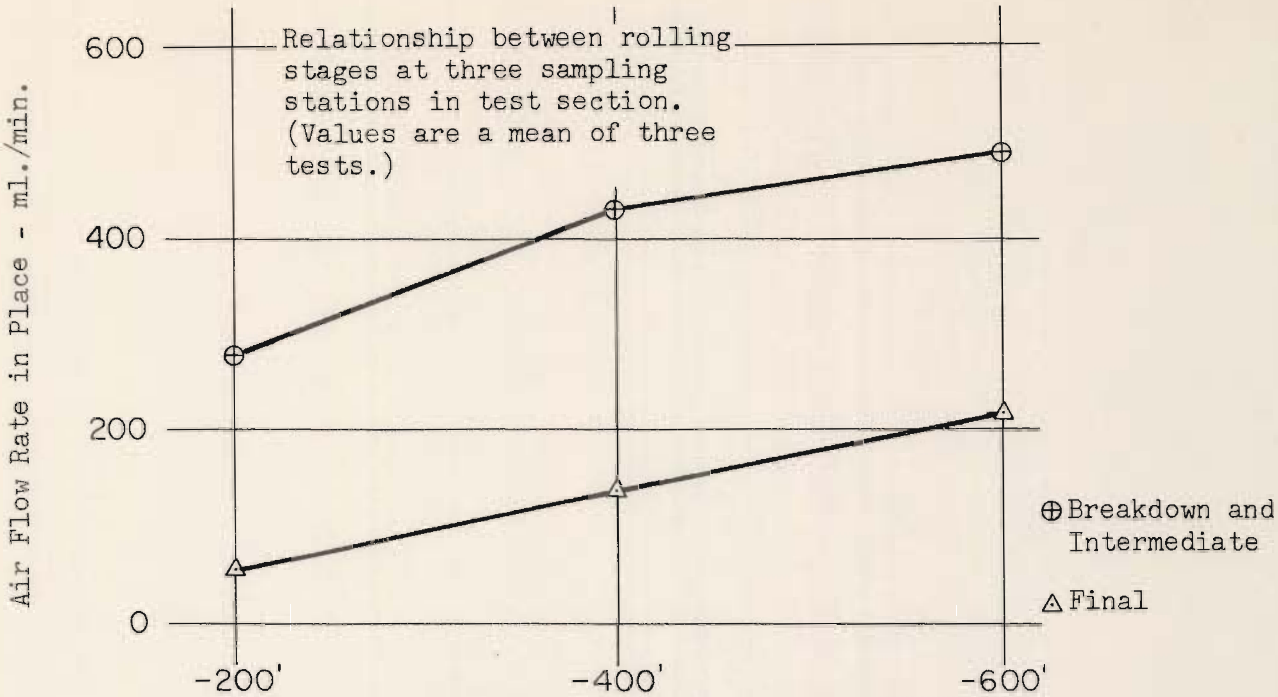


Figure 8 - Rolling Pattern "D"



Test Section begins at Station 549+00

Figure 9 - Rolling Pattern "E"

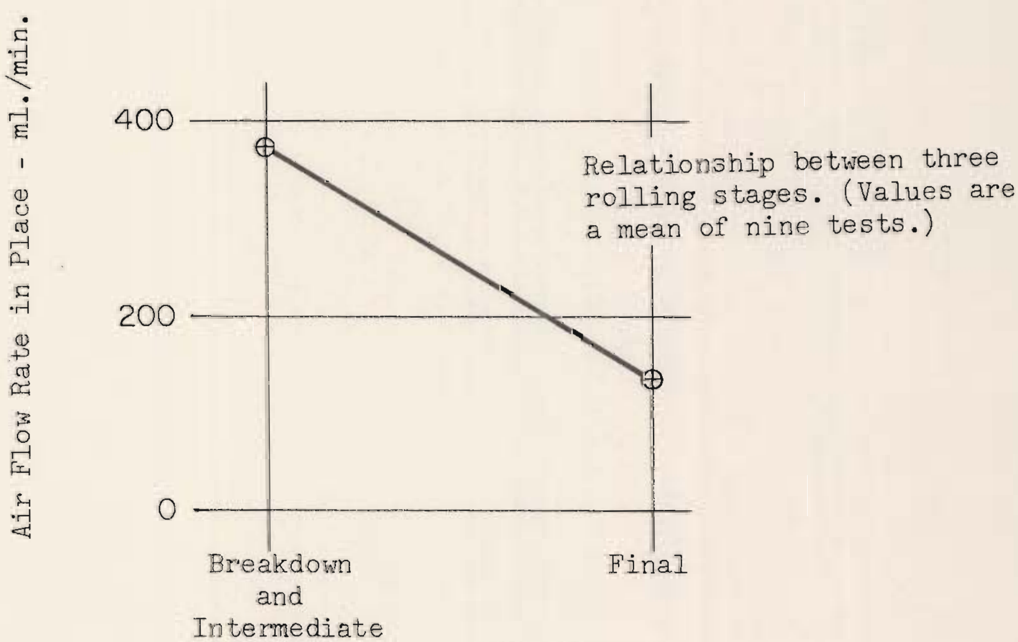
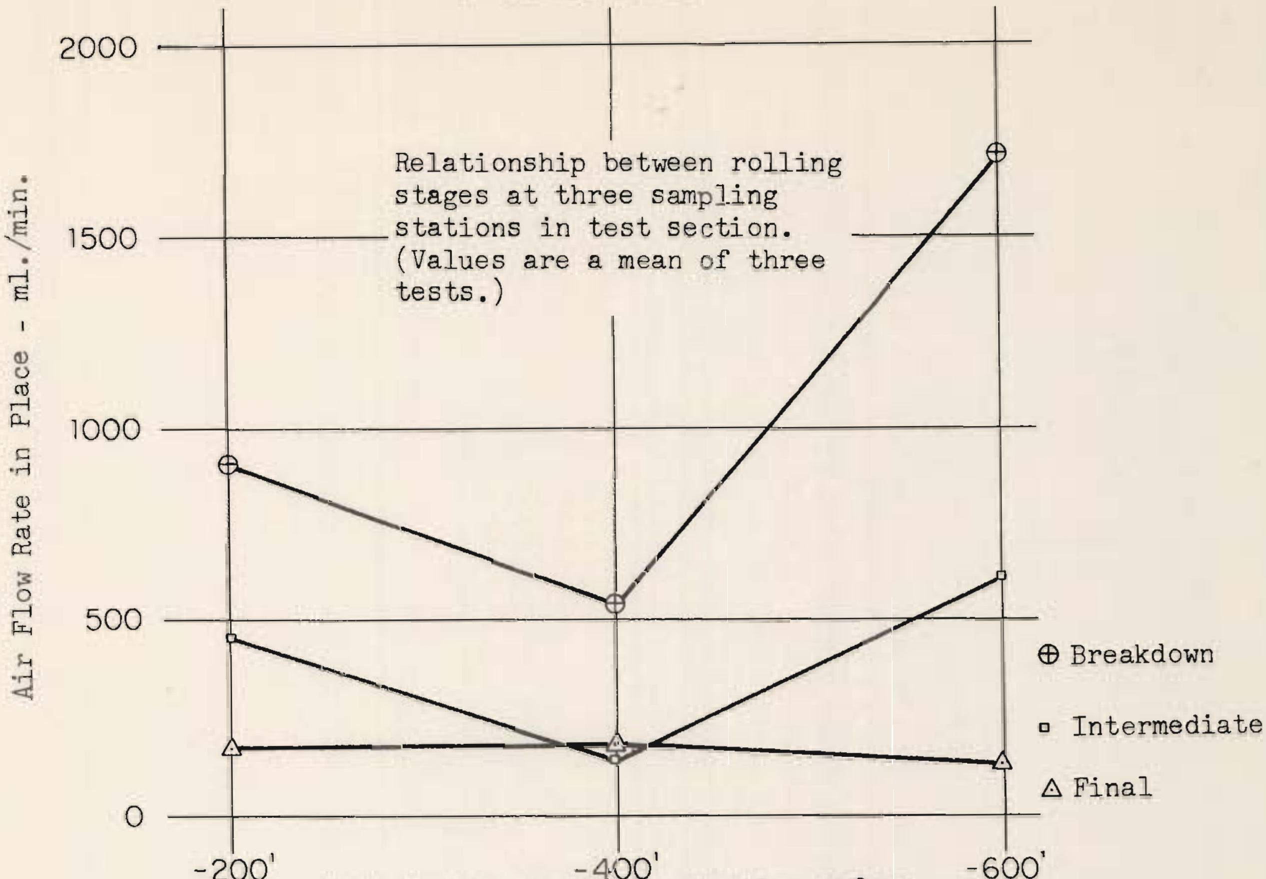


Figure 10 - Rolling Pattern "E"



Test Section begins at Station 378+00

Figure 11 - Rolling Pattern "F"

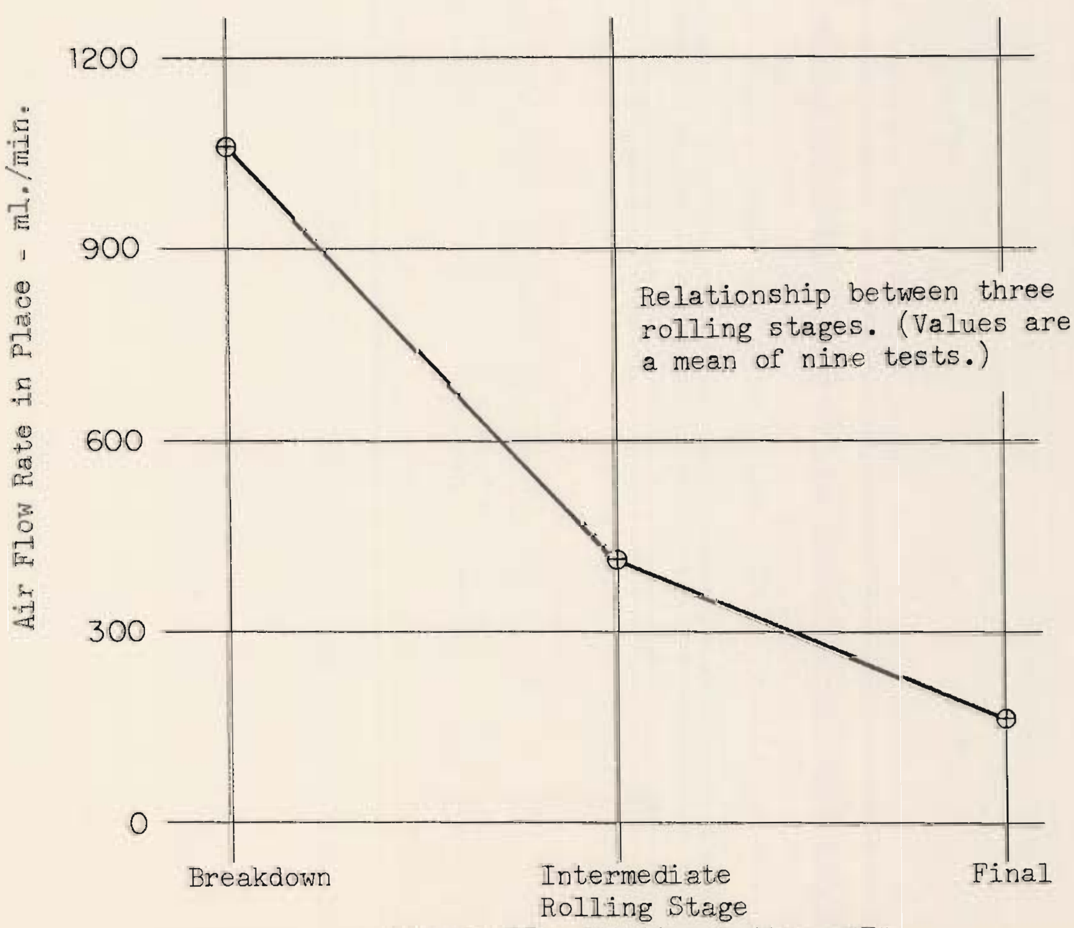
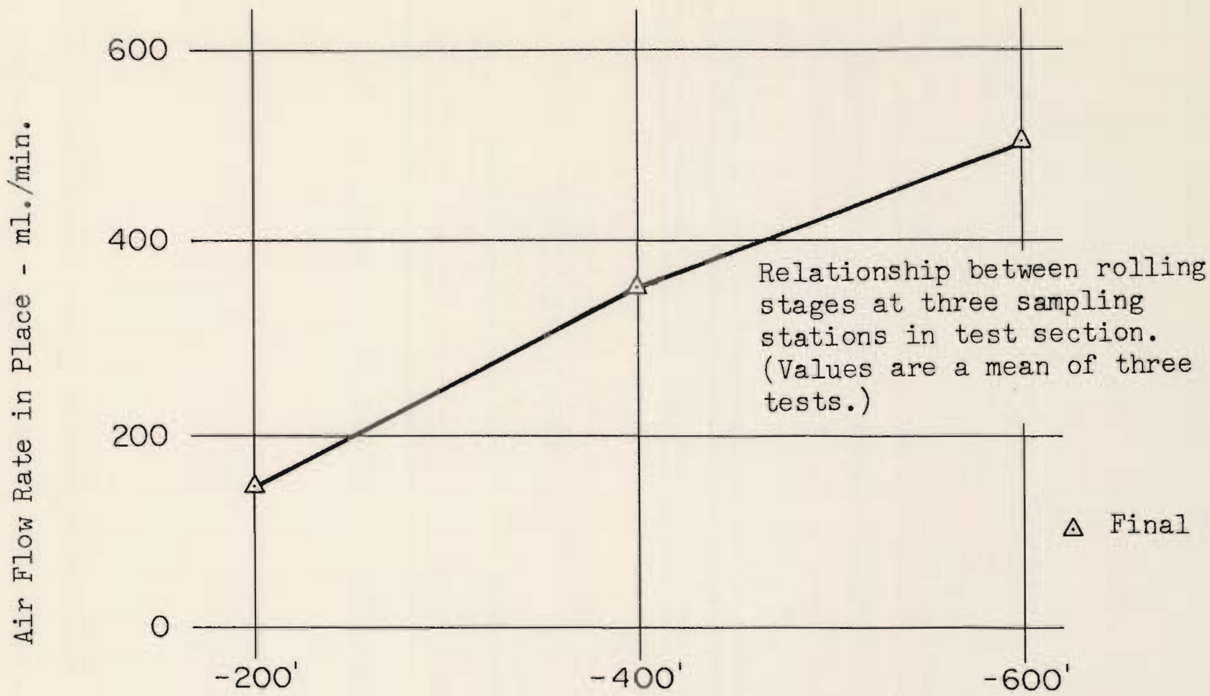


Figure 12 - Rolling Pattern "F"

I-80N-3(27)206



Test Section begins at Station 534+00

Figure 13 - Rolling Pattern "G"

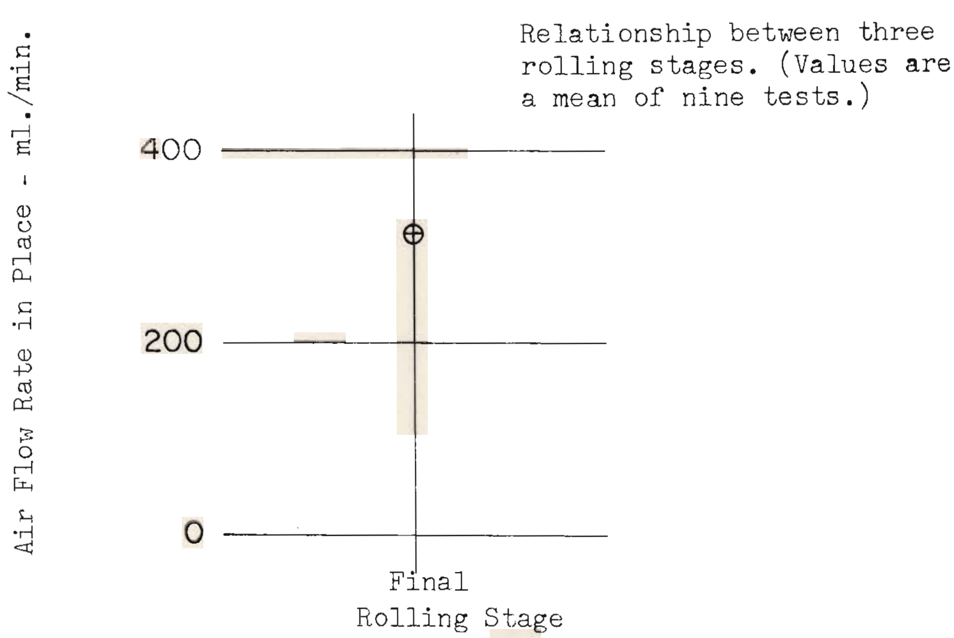


Figure 14 - Rolling Pattern "G"

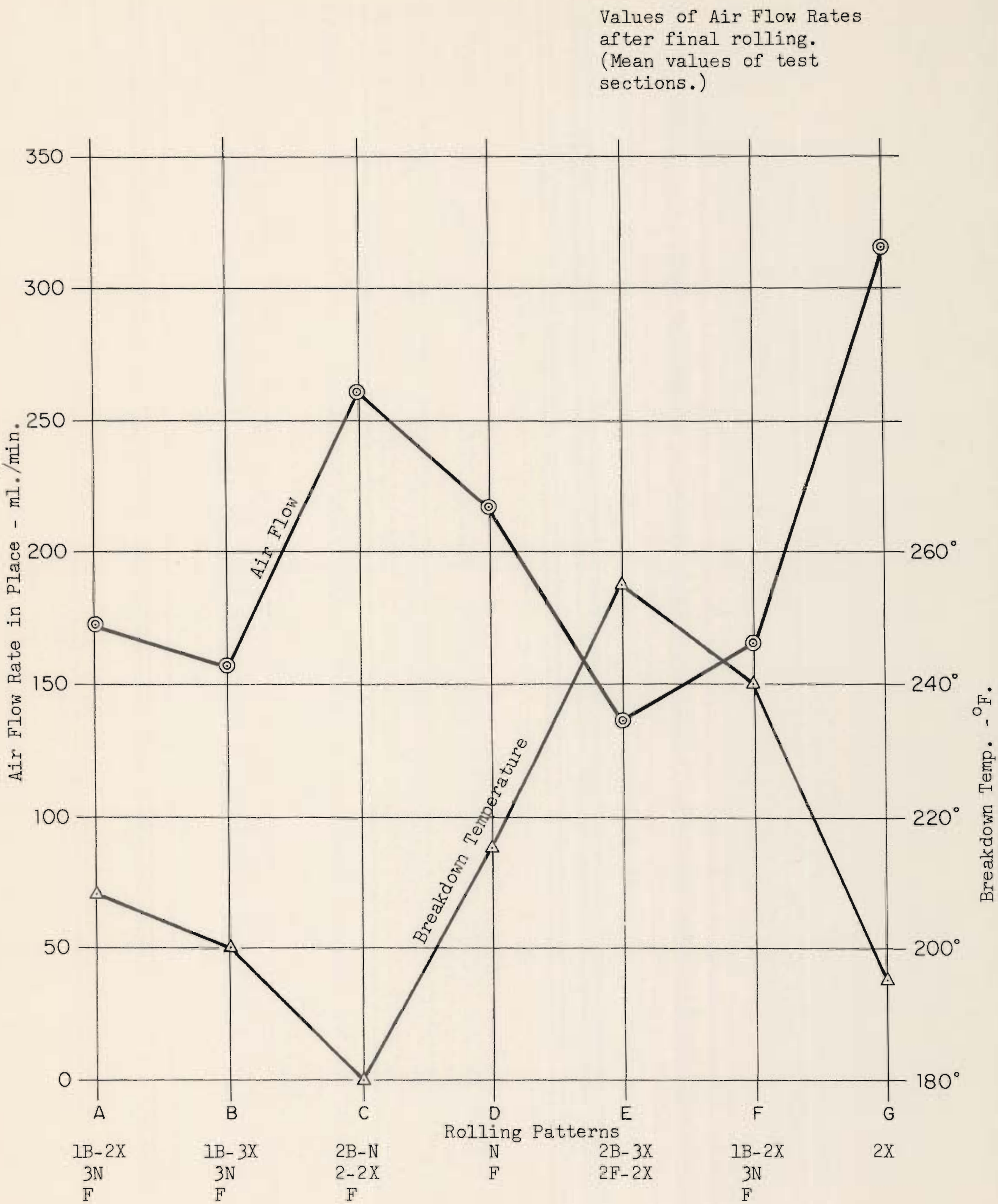


Figure 15 - Comparison of Air Flow Rates and Breakdown Temperature.

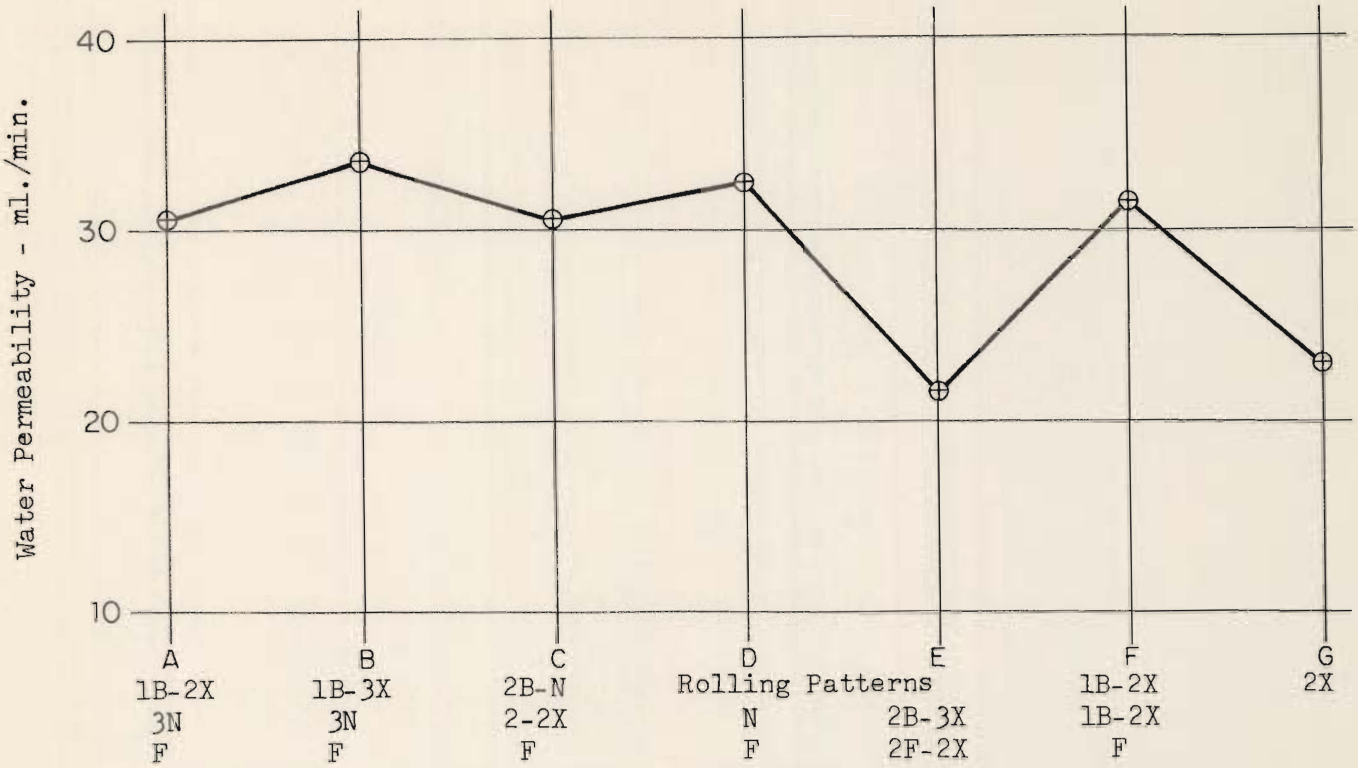


Figure 16 - Mean Values of Water Permeability After Final Rolling.

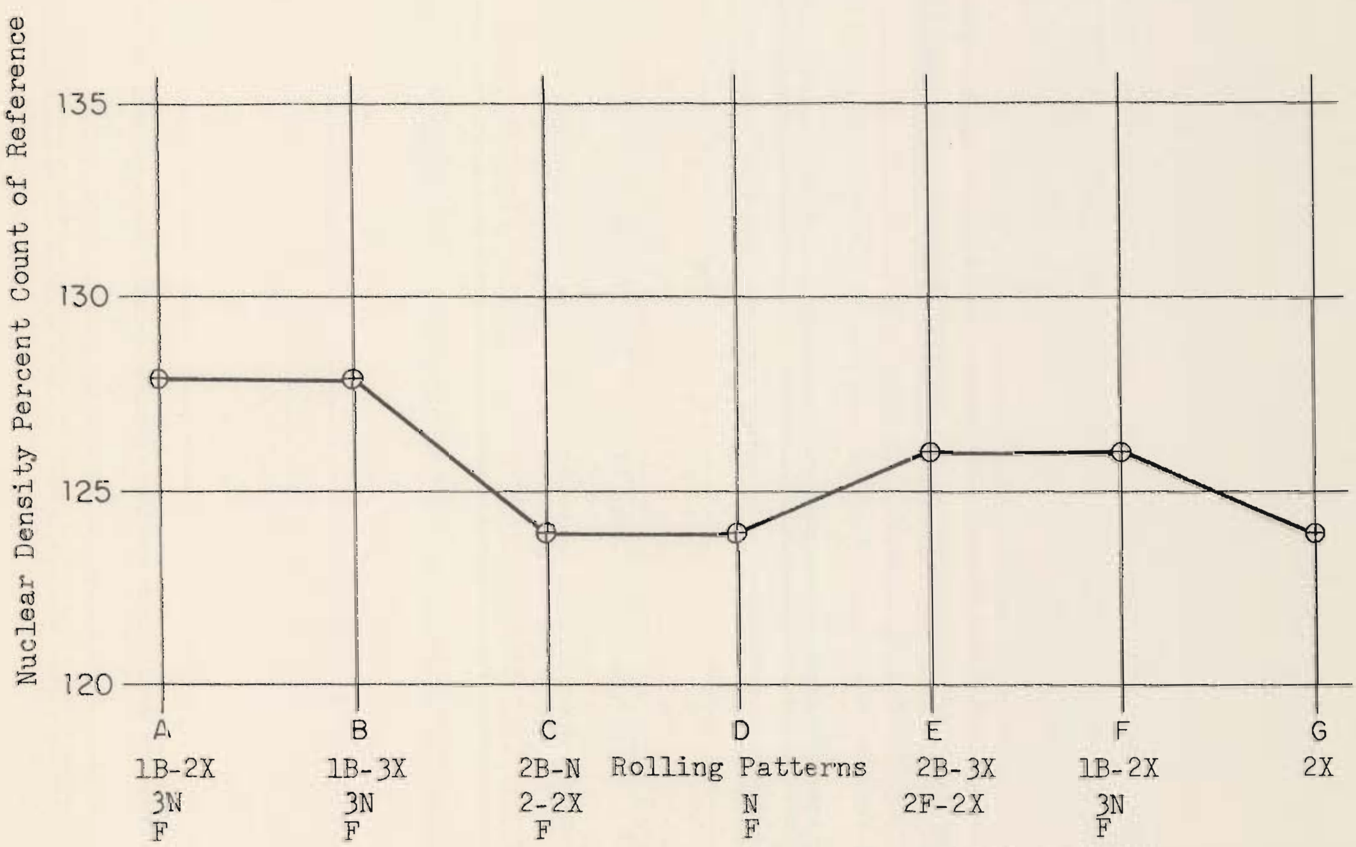


Figure 17 - Mean Values of Nuclear Density After Final Rolling.

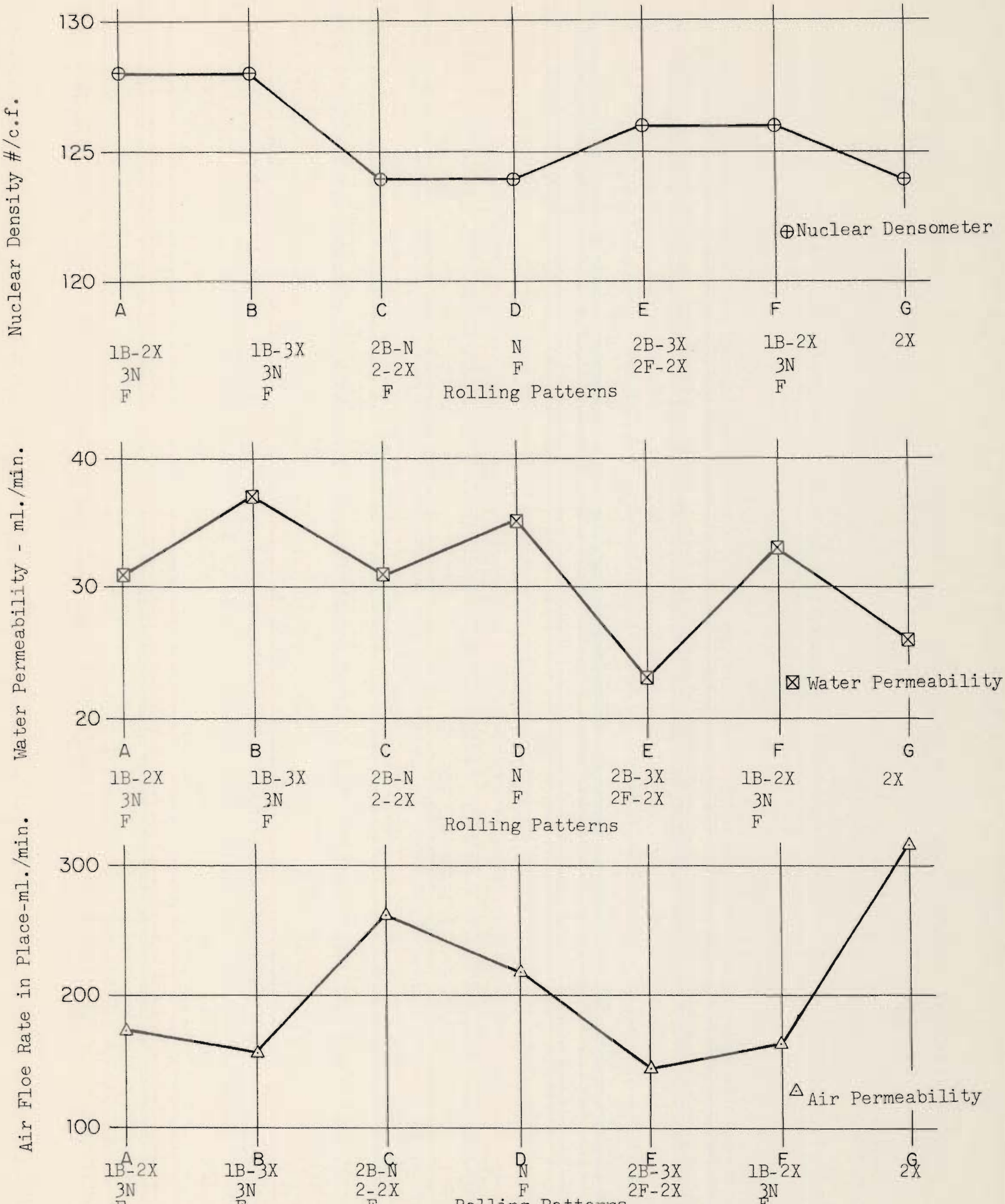


Figure 18 - Relationship between Various Test Methods for Field Density Control.

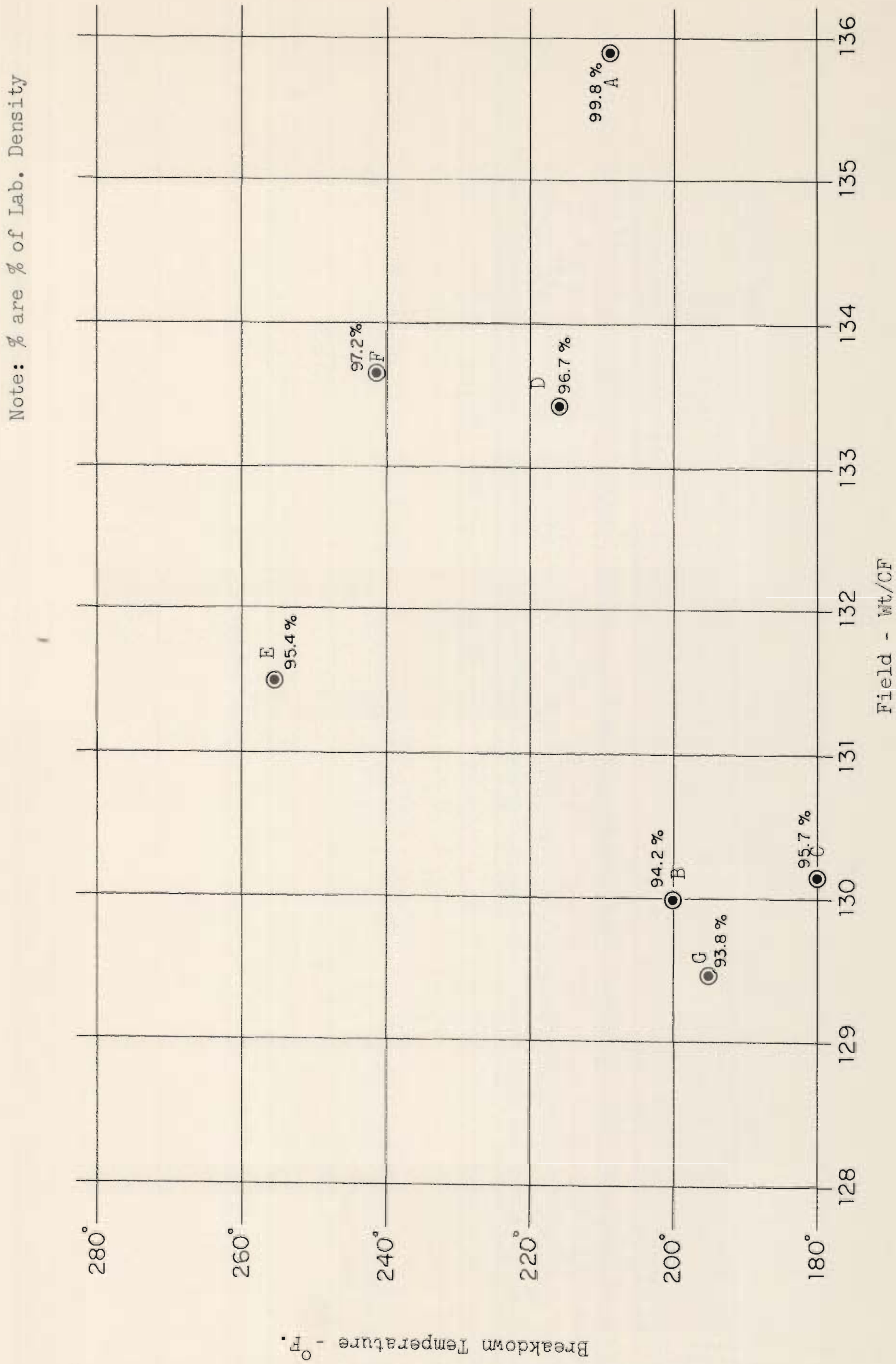


Figure 19 - Relationship Between Breakdown Temperature and Field Wt/C.F.

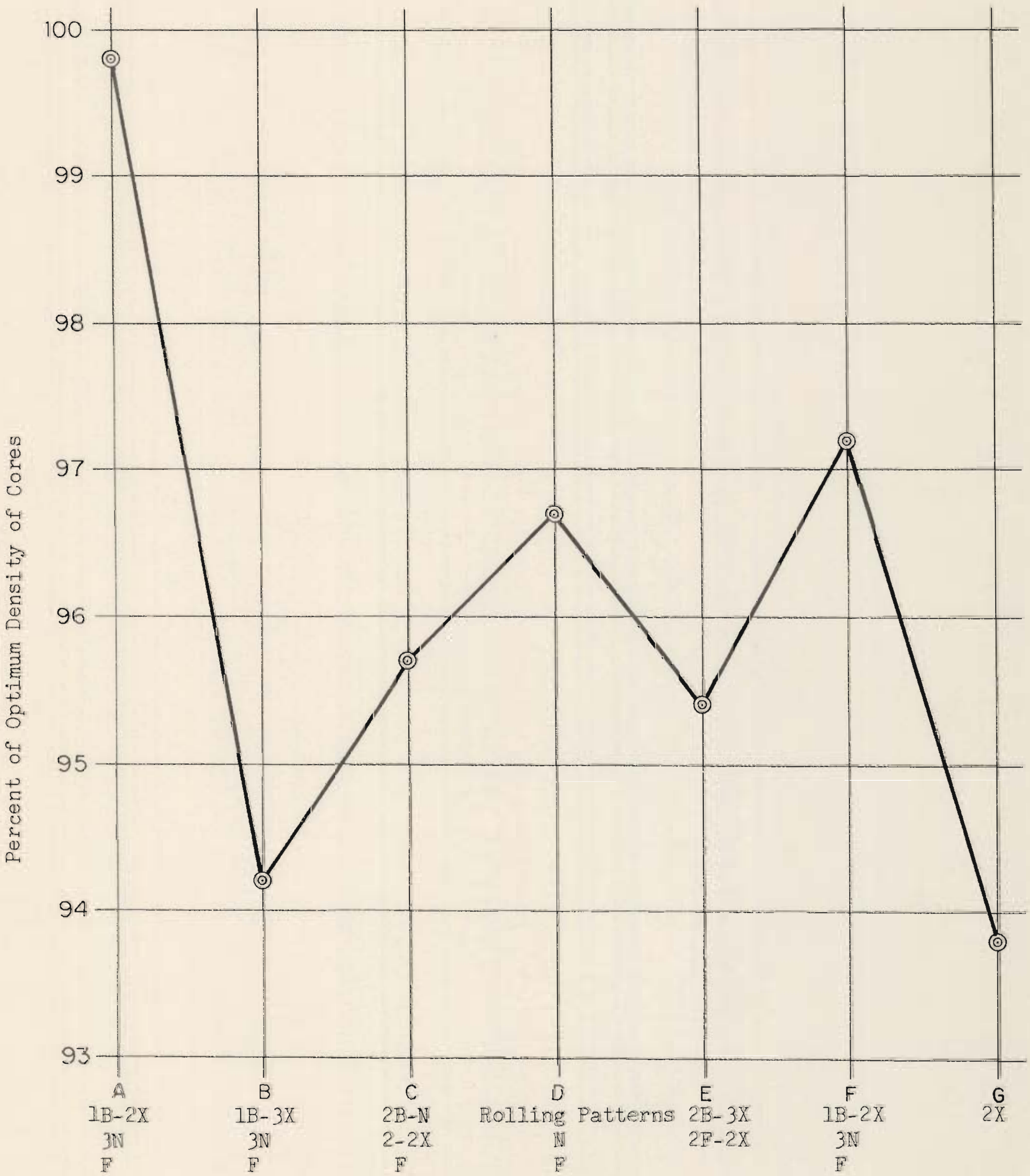


Figure 20 - Percent of Optimum Density for Cores Taken 7 Days After Laydown. (Mean value for test sections.)

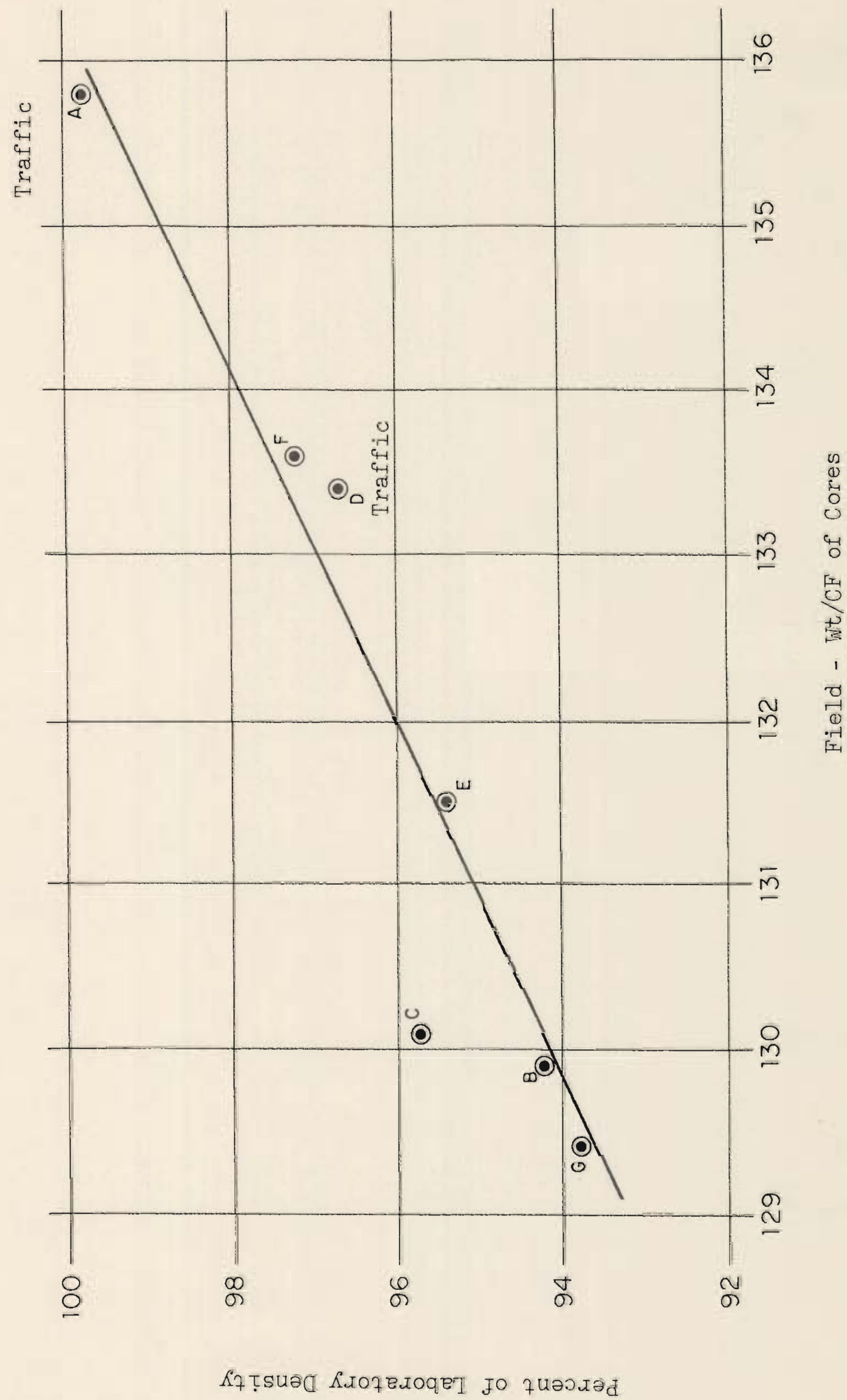


Figure 21 - Relationship Between Percent Laboratory Density of Cores and Field Wt/C.F. of Cores.

Project	Performance: Long. Crack	Performance: Wheel Path Crack	Performance: Ravel	Age	Voids: Field Cores	Voids: Lab. Comp.	Comp. % Lab.	Voids/Bit.Index: Field Cores	Voids/Bit.Index: Lab. Comp.	Probable Cause
F-1381(10)	Some		Severe	1	9.5 15.4	2.9 7.7	91.5 95.4	6.2 9.0	3.4 3.8	Lack of Compaction
I-15-1(5)17	Some	Some	None	2	7.0 11.3	5.6 6.0	94.5 98.4	4.6 10.1	3.3 5.2	Lack Compaction in Part Lack Asphalt in Part.
I-15-2(9)88 A	Few	Few	Flush	3	2.2	2.9	101.1	1.1	1.4	Too much Asphalt used.
I-15-2(11)96	V. Few	None	None	3	2.5 6.7	2.1 3.4	95 100	2.6	1.7	Excellent Job
I-15-2(8)104 I-15-2(11)96 B	Many	Serious	Slight	3	2.2 8.7	0.3 3.7	94.8 99.6	1.4 6.5	0.2 2.8	Compaction in Part Possibly Asphalt
I-15-3(7)111	None	Serious	Slight	3	9.8	6.0	99.6	7.6	4.6	Lack Asphalt
I-15-3(5)117	None	None	None	3	8.0	5.4	96.1 100.0	5.7	3.8	Excellent Job
I-15W-5(4)118 EBL	Many	Serious	Slight	2	7.0 9.9	7.7 12.4	98.8 101.0	5.4 9.1	6.9 9.1	Lack Asphalt
I-15W-5(4)118 WBL	Few	None	None	4	8.0 8.7	6.8 7.4	98.7 99.2	6.3	5.6	Excellent Job
I-80N-3(3)206 Unused Highway	Few		None	4	7.6 10.4	8.1 10.3	94.9 95.8	5.1	5.0	Portion under I.C. No traffic
I-80N-3(3)206	Few		None	4						Project sealed-too dry Performance good
I-90-1(7)11	Severe	Severe	Some	4	9.1 9.6	8.7 10.0	95.0 100.6	4.9	4.9	Lack of asphalt- Compaction
I-90-1(7)11	Many	Many	Slight	4	9.0 12.0	7.7 7.9	96.0 98.8	8.6	6.5	Lack of asphalt
I-80N-3( )3	Many	Many	Slight	4	7.6 10.4	8.1 10.3	96.8 99.9	5.1	5.0	Low Asphalt
Criteria					3+	3+	97+	+4	+4	

Table 1 - Project Performance vs Compaction

	Pattern	Coverage	Stage	Legend*	Remarks
"A"	1. 2 Axle Tandem	1	Breakdown	1B-2X	(Reg. Specs.)
	2. Pneumatic	3	Intermediate	3N	
	3. 3 Axle Tandem	as required	Final	F	
"B"	1. 3 Axle Tandem	1	Breakdown	1B-3X	(Reg. Specs.)
	2. Pneumatic	3	Intermediate	3N	
	3. 2 Axle Tandem	as required	Final	F	
"C"	1. Pneumatic	2	Breakdown	2B-N	
	2. 2 Axle Tandem	2	Intermediate	2-2X	
	3. 3 Axle Tandem	as required	Final	F	
"D"	1. Pneumatic	walk out(record)	Breakdown and Intermediate	N	
	2. 3 Axle Tandem	as required	Final	F	
"E"	1. 3 Axle Tandem	2	Breakdown	2B-3X	
	2. 2 Axle Tandem	2	Final	2F-2X	
"F"	1. 2 Axle Tandem	1	Breakdown	1B-2X	(Short Proj. Spec.)
	2. Pneumatic	3	Intermediate	3N	
	3. 2 Axle Tandem	as required	Final	F	
"G"	1. 2 Axle Tandem	as required	Breakdown, Intermediate and Final	2X	

*Notations used to identify rolling patterns on charts Figures 15,-18 & 20.

Table 2 - Rolling Sequences

Starts at Station 622+34 - I-80N-3(27)206

Air Temp. at Beginning, °F.	78
Old Pave. Temp. Before New Lift, °F.	108
Plant Mix Temp.	265
Plant Mix Temp. before Breakdown, °F.	208

Weather - partly cloudy, windy

	Station									Mean Value
	-50 ft.			-150 ft.			-250 ft.			
Rolling Stages	OWP	BWP	IWP	OWP	BWP	IWP	OWP	BWP	IWP	
After Breakdown										
Air Temp. °F.	78	78	78	78	78	78	78-	78	78	
* Pave. Temp. °F.	164	155	170	130	130	130	115	115	115	
Air Flow, ml/min	734	638	500	638	909	588	268	414	615	589
After Intermediate										
Air Temp. °F.	75	75	75	75	75	75	75	75	75	
* Pave. Temp. °F.	115	112	110	100	100	100	100	100	100	
Air Flow, ml/min	400	308	370	185	437	353	162	172	261	294
After Final										
Air Temp. °F.	67	67	67	67	67	67	67	67	67	
* Pave. Temp. °F.	80	80	80	80	80	80	80	80	80	
Air Flow, ml/min	214	250	107	100	293	158	111	162	150	172
Water Permeability ml/min	32	35	28	31	50	28	18	26	30	31
Air Temp. °F. 66										
Pave. Temp. °F. 88										
Nuclear Density**	133	124	128	133	124	128	130	130	126	128

* These temperatures were recorded at the time of air permeability testing.

** These are apparent densities only. The nuclear gage was not calibrated for this material. Values determined from Troxler Laboratories Surface Density Gage backscatter curve.

Table 3 - Rolling Pattern "A" Field Test Data

Starts at Station 115+00 - I-80N-4(7)220

Air Temp. at Beginning, °F.	78
Old Pave. Temp. Before New Lift, °F.	96
Plant Mix Temp. °F.	265
Plant Mix Temp. Before Breakdown, °F.	200

Weather - clear, slight breeze

	Station									
	+200 ft.			+400 ft.			+600 ft.			Mean Value
Rolling Stages	OWP	BWP	IWP	OWP	BWP	IWP	OWP	BWP	IWP	
After Breakdown										
Air Temp. °F.	83	83	83	80	80	80	80	80	80	
* Pave. Temp. °F.	160	160	160	160	160	160	150	150	150	
Air Flow, ml/min	155	120	333	100	1380	261	947	333	250	431
After Intermediate										
Air Temp. °F.	82	82	82	84	84	84	80	80	80	
* Pave. Temp. °F.	135	135	135	140	140	140	140	140	140	
Air Flow, m./min	36	500	161	222	454	40	333	176	261	243
After Final										
Air Temp. °F.	80	80	80	80	80	80	80	80	80	
* Pave. Temp. °F.	120	120	120	125	125	125	120	120	120	
Air Flow, ml/min	94	351	125	136	214	41	100	115	240	157
Water Permeability ml/min	28	85	27	30	31	27	34	31	41	37
Air Temp. °F. 82										
Pave. Temp. °F. 120										
Nuclear Density**	128	130	126	130	128	133	126	130	126	128

* These temperatures were recorded at the time of air permeability testing.

** These are apparent densities only. The nuclear gage was not calibrated for this material. Values determined from Troxler Laboratories Surface Density Gage backscatter curve.

Table 4 - Rolling Pattern "B" Field Test Data

Starts at Station 581+50 - I-80N-4(7)220

Air Temp. at Beginning, °F.	74
Old Pave. Temp. Before New Lift, °F.	87
Plant Mix Temp. °F.	265
Plant Mix Temp. Before Breakdown, °F.	180

Weather - light overcast, stiff breeze

	Station									Mean Value
	-200 ft.			-400 ft.			-600 ft.			
Rolling Stages	OWP	BWP	IWP	OWP	BWP	IWP	OWP	BWP	IWP	
After Breakdown										
Air Temp. °F.	74	74	74	75	75	75	74	74	74	
* Pave. Temp. °F.	150	160	160	160	170	175	170	175	180	
Air Flow, ml/min	706	415	462	462	343	375	500	900	900	563
After Intermediate										
Air Temp. °F.	74	74	74	76	76	76	75	75	75	
* Pave. Temp. °F.	110	115	115	115	115	115	130	130	135	
Air Flow, ml/min	214	377	462	667	215	632	390	643	693	477
After Final										
Air Temp. °F.	84	84	84	86	86	86	83	83	83	
* Pave. Temp. °F.	115	115	115	115	115	115	115	115	115	
Air Flow, ml/min	136	89	179	546	205	205	170	320	500	261
Water Permeability ml/min	20	25	22	43	36	30	30	30	47	31
Air Temp. °F. 83										
Pave. Temp. °F. 114										
Nuclear Density**	123	128	126	124	126	126	126	128	118	124

* These temperatures were recorded at the time of air permeability testing.

** These are apparent densities only. The nuclear gage was not calibrated for this material. Values determined from Troxler Laboratories Surface Density Gage backscatter curve.

Table 5 - Rolling Pattern "C" Field Test Data

Starts at Station 595+00 - I-80N-3(27)206

Air Temp. at Beginning, °F.	81
Old Pave. Temp. Before New Lift, °F.	110
Plant Mix Temp. °F.	275
Plant Mix Temp. Before Breakdown, °F.	215

Weather - partly cloudy, stiff breeze

	Station									
	-200 ft.			-400 ft.			-600 ft.			Mean Value
Rolling Stages	OWP	BWP	IWP	OWP	BWP	IWP	OWP	BWP	IWP	
After Breakdown and Intermediate										
Air Temp. °F.	81	81	81	83	83	83	80	80	80	
* Pave. Temp. °F.	150	150	150	155	155	155	130	130	130	
Air Flow, ml/min	316	353	415	182	240	182	222	333	308	283
After Final										
Air Temp. °F.	80	80	80	80	80	80	80	80	80	
* Pave. Temp. °F.	112	112	112	112	112	112	110	110	110	
Air Flow, ml/min	286	286	205	214	180	103	180	260	248	217
Water Permeability ml/min.	38	34	26	32	36	36	34	42	33	35
Air Temp. °F. 82										
Pave. Temp. °F. 105										
Nuclear Density**	124	124	123	123	124	130	123	123	120	124

* These temperatures were recorded at the time of air permeability testing.

** These are apparent densities only. The nuclear gage was not calibrated for this material. Values determined from Troxler Laboratories Surface Density Gage backscatter curve.

Table 6 - Rolling Pattern "D" Field Test Data

Starts at Station 549+00 - I-80N-3(27)206

Air Temp. at Beginning, °F.	66
Pavement Temp. Before New Lift, °F.	80
Plant Mix Temp. Before Breakdown, °F.	255

Weather - slight breeze

	Station									Mean Value
	-200 ft.			-400 ft.			-600 ft.			
Rolling Stages	OWP	BWP	IWP	OWP	BWP	IWP	OWP	BWP	IWP	
After Breakdown and Intermediate										
Air Temp. °F.	64	64	64	66	66	66	66	66	66	
* Pave. Temp. °F.	130	125	125	130	130	130	130	130	130	
Air Flow, ml/min	264	222	353	480	364	445	573	167	720	380
After Final										
Air Temp. °F.	77	77	77	74	74	74	76	76	76	
* Pave. Temp. °F.	124	125	125	125	125	125	120	120	120	
Air Flow, ml/min	63	86	10	107	72	240	329	182	136	136
Water Permeability ml/min	15	31	15	20	17	21	34	27	23	23
Air Temp. °F. 77										
Pave. Temp. °F. 125										
Nuclear Density**	130	126	126	124	128	124	123	128	128	126

* These temperatures were recorded at the time of air permeability testing.

**These are apparent densities only. The nuclear gage was not calibrated for this material. Values determined from Troxler Laboratories Surface Density Gage backscatter curve.

Table 7 - Rolling Pattern "E" Field Test Data

Starts at Station 378+00 - I-80N-3(27)206

Air Temp. at Beginning, °F.	86
Pavement Temp. Before Lift, °F.	118
Plant Mix Temperature Before Breakdown, °F.	240

Weather - cloudy, slight breeze

	Station									
	-200 ft.			-400 ft.			-600 ft.			Mean Value
Rolling Stages	OWP	BWP	IWP	OWP	BWP	IWP	OWP	BWP	IWP	
After Breakdown										
Air Temp. °F.	86	86	86	86	86	86	86	86	86	
* Pave. Temp. °F.	180	180	180	175	175	175	150	150	150	
Air Flow, ml/min	1030	720	1000	572	480	572	1875	1636	1636	1058
After Intermediate										
Air Temp. °F.	86	86	86	86	86	86	86	86	86	
* Pave. Temp. °F.	135	135	135	135	135	135	135	135	135	
Air Flow, ml/min	667	343	353	120	111	231	622	480	762	413
After Final										
Air Temp. °F.	88	88	88	86	86	86	86	86	86	
* Pave. Temp. °F.	125	125	125	125	125	125	125	125	125	
Air Flow, ml/min	222	222	125	120	182	207	100	107	196	165
Water Permeability										
ml/min	28	28	49	28	25	36	34	29	38	33
Air Temp. °F. 86										
Pave. Temp. °F. 125										
Nuclear Density**	125	123	128	126	130	126	126	128	123	126

* These temperatures were recorded at the time of air permeability testing.

** These are apparent densities only. The nuclear gage was not calibrated for this material. Values determined from Troxler Laboratories Surface Density Gage backscatter curve.

Table 8 - Rolling Pattern "F" Field Test Data

Starts at Station 534+00 - I-80N-3(27)206

Air Temp. at Beginning, °F.	70
Pavement Temp. Before Lift, °F.	93
Plant Mix Temperature, °F.	260
Plant Mix Temp. Before Breakdown, °F.	195

Weather - slight breeze

	Station									Mean Value
	-200 ft.			-400 ft.			-600 ft.			
Rolling Stages	OWP	BWP	IWP	OWP	BWP	IWP	OWP	BWP	IWP	
After Breakdown, Intermediate and Final										
Air Temp. °F.	80	80	80	82	82	82	80	80	80	
* Pave. Temp. °F.	128	128	128	130	130	130	130	130	130	
Air Flow, ml/min	167	250	26	334	375	250	667	470	380	316
Water Permeability ml/min	21	22	15	35	24	27	35	26	30	26
Air Temp. °F. 80										
Pave. Temp. °F. 126										
Nuclear Density**	128	126	130	120	120	123	117	126	126	124

* These temperatures were recorded at the time of air permeability testing.

** These are apparent densities only. The nuclear gage was not calibrated for this material. Values determined from Troxler Laboratories Surface Density Gage backscatter curve.

Table 9 - Rolling Pattern "G" Field Test Data

Rolling Section*	"A"	"B"	"C"	"D"	"E"	"F"	"G"
Station	622+34	115+00	581+50	595+00	549+00	378+00	534+00
Gradation Sieve							
1/2 in.	94	96	92	95	93	95	91
No. 4	56	62	60	54	55	59	53
No. 8	41	44	45	39	41	41	40
No. 50	17	14	18	16	17	14	17
No. 200	6	5	7	6	7	5	6
% Asphalt (Wt./Agg.)	6.06	5.91	6.15	5.65	5.18	6.08	5.19
% Moisture (Wt./Agg.)	0.30	0.00	0.29	0.09	0.18	0.00	0.17
% Asphalt (Wt./Mix)	5.73	5.58	5.81	5.35	4.93	5.73	4.94
Stability	28	**	20	31	16	**	19
Wt./cu. ft.-Lab.	136.0	137.9	136.0	137.9	137.9	137.5	137.9
% Air Voids	5.7	2.5	4.4	3.4	2.0	1.4	2.3
Penetration	47	--	64	45	57	--	48
Ductility	140+	--	140+	138	134	--	131

* The alphabetical letter also refers to the rolling pattern, station nos. are at the beginning of test section

** Too low to record

Table 10 - Laboratory Results of Class "D" Plantmix Used in 0.1' Overlay

Rolling Section*

	"A" Traffic Lane 622+34		"B" Passing Lane 115+00		"C" Passing Lane 581+50		"D" Traffic Lane 595+00		"E" Passing Lane 549+00		"F" Passing Lane 378+00		"G" Passing Lane 534+00	
	OWP	IWP	OWP	IWP	OWP	IWP	OWP	IWP	OWP	IWP	OWP	IWP_	OWP	IWP
Interval														
Core Density, Lb./Cu. Ft. and Air Voids, % — 200 ft.	134.8	134.8	130.3	126.4	130.4	128.5	132.2	134.8	133.2	132.9	132.5	135.5	131.2	131.2
	4.5	3.5	7.3	9.5	6.8	9.3	7.2	4.1	6.8	5.5	5.0	5.3	6.8	6.0
400 ft.	136.7	134.9	129.4	132.4	131.1	130.5	132.9	134.2	130.5	131.9	132.4	135.0	127.9	130.0
	4.2	4.4	8.4	6.3	6.5	6.6	7.5	3.5	7.3	5.7	6.1	3.4	9.4	7.5
600 ft.	137.3	136.0	130.7	130.3	131.8	128.5	133.5	132.9	129.5	131.0	133.3	134.7	127.1	128.9
	2.5	2.7	7.4	7.6	6.2	8.5	5.4	4.8	6.9	6.3	5.6	4.5	9.0	8.3
Comp. Test Sect.														
Mean Wt/cu ft.	135.8		129.9		130.1		133.4		131.5		133.6		129.4	
Mean Air Voids,%	3.6		7.8		7.3		5.4		6.4		5.0		7.8	
% of Optimum Lab. Density	99.8		94.2		95.7		96.7		95.4		97.2		93.8	

* Alphabetical letter also designation of rolling pattern

Station Nos. indicate the beginning of test section

Table 11 - Field Density of Cores

APPENDIX B

S-3804(3)
TROXLER, SEAMAN, AND PERMEAMETER READINGS
VS
CORE DENSITY AND AIR VOIDS

Core No.	Core Density	Core Air Voids	Troxler Density	Seaman Density	Permeameter Readings
1	124.0	13.2	114.5		2419
2	127.0	11.1	118.3		1339
3	130.3	9.2	118.3	123.0	1245
4	131.5	7.6	128.5		554
5	130.4	9.1	125.8	130.0	564
6	129.5	9.4	121.0		583
7	129.2	9.2	129.5		826
8	130.4	7.9	128.5		759
9	127.3	10.9	117.2		1232
11	129.8	9.2	124.8		469
12	130.4	9.1	120.0		776
13	128.5	10.5	122.0	123.0	923
14	127.9	10.9	127.5	128.0	1296
15	129.8		124.8		
16	128.5		127.5	125.0	
17	126.7		124.8	125.0	
601-R	130.3		127.5	129.5	
602-R	129.3		123.8	130.0	
603-R	132.5		129.5	129.0	
604-R	130.1		128.5	129.5	
605-R	130.4		127.5	129.5	
606-R	127.5		127.5	127.0	

Table 12

I-80N-4(1)220
NUCLEAR DENSITY EQUIPMENT
AND
CORE DENSITY COMPARISON

Core No.	Actual Core Density	Troxler Density	Seaman Density
1	138.9	136.0	139.5
2	139.2	135.0	144.0
3	139.8	135.2	141.5
4	135.1	135.5	132.0
5	140.3	131.7	137.5
6	139.3	124.5	134.0
7	138.0		127.5

Table 13

I-80N-3(34)196
CLASS "B" PLANT MIX
TEST SITES
CORE RESULTS VS NUCLEAR DENSITY
READINGS

Test Site	Station	Core Density	Air Voids	Troxler Density	Seanans Density
1	714	133.0	6.5%	123.6	131.2
2	690	131.3	8.5%	124.3	127.5
3	666	132.7	7.1%	130.2	135.0
4	641	132.0	7.6%	126.6	130.3
5	610	131.8	7.8%	124.6	130.5
6	581	134.4	6.3%	125.3	130.3
7	557	135.4	7.5%	125.8	135.0
8	533	131.3	9.1%	123.0	135.0
9	508	133.2	7.6%	127.1	135.5
10	474	134.5	5.9%	121.5	131.0
11	449	127.9	10.5%	120.3	131.8
12	425	133.0	7.7%	127.0	
13	419	133.7	6.3%	129.4	
14	444	133.0	6.1%	129.0	
15	468	broken core		127.5	
16	494	134.0	5.3%	128.0	
17	520	135.0	6.8%	130.2	
18	546	134.6	5.4%	129.5	
19	572	135.0	5.5%	126.4	
20	599	130.2	9.3%	126.2	
21	625	broken core		127.2	
22	651	134.9	6.8%	121.0	
23	678	134.3	6.4%	129.3	
24	706	133.7	6.4%	126.6	133.0

Table 14

I-80N-3(34)196
CLASS "D" PLANT MIX
TEST SITES
CORE RESULTS VS NUCLEAR DENSITY
AND
AIR PERMEAMETER READINGS

Test Site	Station	Core Density	Air Voids	Troxler Density	Seamans Density	Permeability Readings
1	714	127.2	10.6%	121.6	127.0	534
2	690	125.7	11.7%	122.5	129.0	768
3	666	127.9	10.5%	127.5	128.0	237
4	641	136.9	4.8%	131.5	133.5	
5	610	128.1	9.5%	127.0	132.5	365
6	581	134.0	5.0%	128.5	134.0	101
7	557	127.8	11.0%	133.0	136.0	72
8	533	broken core		129.0	132.0	161
9	508	131.7	7.5%	130.5	133.2	
10	474	134.6	7.0%	128.4	132.0	186
11	449	130.5	8.7%	127.0	132.5	166
12	425	129.0	9.8%	124.5	129.5	114
13	419	131.1	7.0%	127.5	133.5	137
14	444	134.0	6.2%	129.0	129.0	52
15	468	135.2	5.4%	129.9	136.2	54
16	494	132.6	6.4%	131.7	135.5	
17	520	133.6	7.2%	127.8	133.0	151
18	546	134.2	4.4%	129.5	133.5	
19	572	132.7	5.5%	128.0	133.2	
20	599	132.0	7.2%	132.0	135.0	
21	625	broken core		131.8	135.0	
22	651	134.9	5.4%	133.5	137.5	
23	678	133.7	6.4%	131.2	133.8	
24	706	134.0	5.8%	130.7	133.5	

Table 15

I-80N-3(34)196
ROLLING TESTS
CORE RESULTS VS NUCLEAR DENSITIES
PERMEABILITY READINGS

Rolling Test	Passes by Each Roller Bkdn	Pneu	Fin	Core Density	Core Air Voids	Troxler Density	Seamans Density	Permeability Readings
1	2	9	1	128.2	10.0	127.2	133.0	
2	2	7	1	132.1	7.3	132.0	137.0	
3	2	7	1	133.8	6.7	130.5	137.5	
4	2	7	1	130.5	8.7	125.2	132.2	
5	2	7	1	131.7	7.1	126.5	133.5	
6	2	7	2	137.0	2.9	131.2	141.2	
7	3	7	2	134.5	4.9	130.3	136.5	
8	4	7	1	132.9	6.5	130.0	132.0	171
9	2	7	1	132.8	7.0	129.0	136.0	178
10	2	7	1	131.1	7.1	127.3	135.8	85
11	2	7	1	133.1	6.5	129.2	135.8	156
12	2	7	1	131.1	8.2	219.0	134.0	72
13	3	7	1	Broken Core		129.0	133.0	166
14	2	7	1	132.0	8.0	128.2	134.5	100
15	2	7	1	134.0	6.6	129.6	133.0	90
16	2	5	1	132.9	6.5	128.2	133.5	67
17	2	5	1	134.0	6.4	129.5	137.0	63
18	2	5	1	Broken Core		129.5	134.0	52
19	2	7	1	131.2	7.1	127.3	131.0	134
20	2	5	1	133.7	5.6	128.3	133.2	150
21	2	5	1	131.1	7.9	126.3	130.0	362
22	2	7	1	Broken Core		128.0	133.5	97
23	2	7	1	Broken Core		127.5	132.0	75
24	2	7	1	132.2	6.4	126.5	131.0	154

Table 16

ROLLING TESTS
I-15-2(17)72 Sec. B
STATION 1128
REFERENCE COUNT 57,782

	TIME	TEMP	POINT A		POINT B 25' Ahead of Point A		Point C 50' Ahead of Pt. B	
0.10' Pmx.			Troxler Density	Seaman Density	Troxler Density	Seaman Density	Troxler Density	Seaman Density
Old Pavement			135.8	140.0				
Laydown	9:11	225						
1 Breakdown	9:15	220	131.0					
2 Breakdown	9:18	217	134.8					
1 Pneu	9:22	210						
2 Pneu	9:22	210						
3 Pneu	9:22	210	134.2	139.5				
4 Pneu	9:48	165						
5 Pneu	9:50	165			124.5	132.0		
6 Pneu	9:51	165						
7 Pneu	9:52	165					125.2	133.0
Finish	10:16	135	134.8	140.5	124.5	131.5	127.0	134.0
(Core Densities - Air Voids, %)			(142.0-4.8)		(136.5-8.9)		(138.7-7.4)	
0.20' Pmx - Shoulder								
Laydown	9:04	240						
Breakdown	9:09	235	126.0	131.0				
1 Pneu	9:33	165						
2 Pneu	9:34	165						
3 Pneu	9:34	165	120.0	133.0				
4 Pneu	9:38	160						
5 Pneu	9:40	160			124.2	134.2		
6 Pneu	9:41	158						
7 Pneu	9:43	155					128.2	136.2
1 Finish	10:20	130						
2 Finish	10:22	130	130.2	136.0	128.2	136.0	132.0	140.5
(Core Densities - Air Voids, %)			(136.8 - 9.0)		(138.6- 8.2)		(137.8 - 8.7)	

Table 17

ROLLING TESTS
I-15-2(17)72 Sec. B
STATION 1230
REFERENCE COUNT 57,782

	TIME	TEMP	POINT A		POINT B		POINT C	
0.1' Pmx.			Troxler Density	Seaman Density	Troxler Density	Seaman Density	Troxler Density	Seaman Density
Old Pavement			134.3	137.0				
Laydown	2:42	235						
Breakdown	2:43	234	127.5	133.0				
1 Pneu	3:01	218						
2 Pneu	3:01	218						
3 Pneu	3:02	217	128.0	136.0				
4 Pneu	3:03	215						
5 Pneu	3:04	215			129.2	137.2		
6 Pneu	3:04	214						
7 Pneu	3:04	214					127.5	134.2
Finish	4:00	150	129.0	136.5	131.0	139.0	130.0	140.5
0.20' Pmx. - Shoulder								
Laydown	2:26	235						
Breakdown	2:36	224	123.2	131.5				
1 Pneu	2:57	189						
2 Pneu	2:58	188						
3 Pneu	2:58	188	123.5	131.5				
4 Pneu	2:59	186						
5 Pneu	2:59	186			128.3	136.0		
6 Pneu	3:00	185						
7 Pneu	3:00	185					128.0	138.0
Finish	4:02	150	131.0	135.0	131.2	138.0	132.5	137.5

Table 18

ROLLING TESTS
I-15-2(17)72 Sec. B
STATION 1195
REFERENCE COUNT 58,118

	TIME	TEMP	POINT A		POINT B		POINT C	
0.1' Pmx.			Troxler Density	Seaman Density	Troxler Density	Seaman Density	Troxler Density	Seaman Density
Old Pavement			137.5	140.5				
Laydown	9:06	220						
Breakdown	9:17	180	124.2	131.2				
1 Pneu	9:32	155						
2 Pneu	9:32	155						
3 Pneu	9:33	153	125.0	128.0				
4 Pneu	9:34	153						
5 Pneu	9:34	153			129.0	135.2		
6 Pneu	9:35	150						
7 Pneu	9:35	150					127.2	134.5
Finish	10:03	135	128.7	131.0	130.0	136.0	131.5	136.2
0.1' Pmx. - Shoulder								
Laydown	8:56	220						
Breakdown	9:15	150	126.2	134.2				
1 Pneu	9:28	120						
2 Pneu	9:29	120						
3 Pneu	9:29	120	125.5	130.8				
4 Pneu	9:30	120						
5 Pneu	9:30	120			126.2	131.0		
6 Pneu	9:31	120						
7 Pneu	9:31	120					127.8	127.0
Finish	10:10	105	128.2	132.0	129.8	132.5	128.3	130.5

Table 19

ROLLING TESTS
I-15-2(17)72 Sec. B
STATION 702
REFERENCE COUNT 58,071

	TIME	TEMP	POINT A		POINT B		POINT C	
0.15' Pmx.			Troxler Density	Seaman Density	Troxler Density	Seaman Density	Troxler Density	Seaman Density
Old Pavement			142.0	146.5				
Laydown	11:04	230						
Breakdown	11:07	222	128.2	136.5				
1 Pneu	11:29	170						
2 Pneu	11:30	169						
3 Pneu	11:31	168	129.5	134.0				
4 Pneu	11:32	167						
5 Pneu	11:32	167			129.5	136.0		
6 Pneu	11:33	166						
7 Pneu	11:33	166					129.2	135.0
Finish	12:18	145	131.0	134.5	130.0	138.0	131.8	137.0
Core Densities and Air Voids			(140.6 - 6.1)		(141.1 - 6.6)		(139.8 - 7.0)	
0.15' Pmx. - Shoulder								
Old Pavement			137.5	140.5				
Laydown	10:58	230						
1 Breakdown	11:04	215						
2 Breakdown	11:07	202	126.0	133.0				
1 Pneu	11:25	167						
2 Pneu	11:26	166						
3 Pneu	11:27	166	127.5	136.0				
4 Pneu	11:28	165						
5 Pneu	11:28	165			129.5	134.0		
6 Pneu	11:29	165						
7 Pneu	11:29	165					128.0	135.0
Finish	12:25	145	131.7	134.5	130.3	136.2	131.0	135.2
Core Densities and Air Voids			(138.5 - 7.9)		(138.3 - 8.4)		(137.4 - 9.4)	

Table 21

ROLLING TESTS
I-15-2(17)72 Sec. B
STATION 1040
REFERENCE COUNT 58,248

	TIME	TEMP	POINT A		POINT B		POINT C	
0.1' Pmx.			Troxler Density	Seaman Density	Troxler Density	Seaman Density	Troxler Density	Seaman Density
Old Pavement			140.5					
Laydown	10:52	240						
Breakdown	11:06	210	127.5	132.3				
1 Pneu	11:16	195						
2 Pneu	11:17	195						
3 Pneu	11:18	195	127.0	135.0				
4 Pneu	11:20	190						
5 Pneu	11:20	190			127.5	133.0		
6 Pneu	11:21	188						
7 Pneu	11:21	188					128.5	136.0
Finish	1:03	140	130.0	137.2	127.8	136.0	131.0	136.0
Core Densities and Air Voids			(140.5 - 5.8)		(140.2 - 6.4)		(141.3 - 5.7)	
0.15' Pmx. - Shoulder								
Laydown	10:45	237						
Breakdown	11:01	211	123.7	133.0				
1 Pneu	11:12	193						
2 Pneu	11:13	192						
3 Pneu	11:13	192	124.3	131.8				
4 Pneu	11:14	191						
5 Pneu	11:14	191			128.0	133.2		
6 Pneu	11:15	190						
7 Pneu	11:15	190					127.0	133.2
Finish	1:08	140	128.0	135.0	129.0	136.0	129.0	134.0
Core Densities and Air Voids			(139.0 - 7.6)		(135.0 - 10.2)		(135.2 - 9.3)	

Table 20

FL-25(4)
TROXLER READINGS
VS
CORE DENSITY & AIR VOIDS
REFERENCE COUNT = 57,620

Core#	Count	Ratio	Density	Core Density	Core Air Voids
601cx	60,978	1.058	137.2	139.2	8.6
602cx	60,658	1.053	137.6	139.4	8.0
603cx	63,357	1.100	133.2	137.9	9.0
604cx	66,514	1.154	128.2	139.8	8.2
605cx	63,043	1.094	133.7	138.5	8.6
606cx	64,438	1.118	131.5	140.6	6.9
607cx	62,334	1.082	134.8	137.5	8.9
608cx	61,217	1.062	136.8	138.8	8.4
609cx	59,400	1.031	139.8	138.1	8.5
610cx	63,311	1.099	133.3	139.8	7.4
611cx	62,066	1.077	135.5	139.5	8.8
612cx	57,991	1.006	142.5	141.5	6.7
613cx	61,498	1.067	136.5	140.5	7.3
614cx	59,610	1.035	139.5	140.3	7.9
615cx	61,502	1.067	136.5	140.0	8.1
616cx	59,576	1.034	139.5	141.4	6.4
617cx	61,424	1.066	136.5	141.3	7.4
618cx	60,365	1.048	138.2	139.7	7.8
619cx	59,971	1.041	138.7	141.5	7.1
620cx	60,227	1.045	138.5	141.4	7.2

Table 22

I-15-2(17)72 Sec. B
TROXLER READINGS
VS
CORE DENSITY & AIR VOIDS
REFERENCE COUNT = 57,660

Core#	Count	Ratio	Density	Core Density	Core Air Voids
601cx	60,618	1.051	137.9	141.2	6.1
602cx	61,983	1.075	135.5	137.5	8.9
603cx	62,318	1.081	135.0	138.2	7.3
604cx	61,470	1.066	136.5	139.6	7.2
605cx	62,691	1.087	134.5	139.0	6.8
606cx	64,396	1.117	131.7	138.3	7.2
607cx	66,170	1.148	128.8	138.4	8.0
608cx	64,436	1.118	131.6	135.5	10.3
609cx	61,736	1.071	136.0	136.8	7.1
610cx	64,506	1.119	131.5	136.1	8.7
611cx	61,939	1.074	135.5	140.3	5.9
612cx	63,370	1.099	133.4	135.7	9.8
614cx	63,280	1.097	133.6	136.7	8.3
615cx	64,124	1.112	132.0	140.0	6.1
616cx	61,676	1.070	136.0	139.7	6.7
617cx	60,521	1.050	138.0	139.4	6.5
618cx	63,924	1.109	132.5	139.5	7.2
619cx	61,970	1.075	135.7	139.7	6.7
620cx**	62,756	1.094	133.7	139.2	7.4
621cx	61,481	1.072	135.9	141.8	6.1
622cx	63,425	1.105	132.8	139.8	7.4
623cx	61,588	1.073	135.8	140.1	6.8

* Cracked Core
** New Reference Count = 57,376

Table 23

S-3712(3)
NUCLEAR DENSITY READINGS
AND
CORE DENSITY & AIR VOIDS COMPARISON

Core #	Core Density	Core Air Voids	Seaman Density
1	133.5	10.9	134.8
2	137.3	8.3	134.7
3	136.7	8.7	134.9
4	134.8	9.6	134.9
5	134.8	9.2	131.2
6	135.4	9.9	133.6
7	134.1	9.7	135.1
8	137.3	8.4	141.7
9	135.4	9.6	134.3
10	135.4	9.6	136.6
11	137.3	7.9	136.7
12	135.4	9.6	133.1
13	134.1	12.3	133.9
14	133.5	10.5	132.5
15	134.8	10.4	132.1
16	136.1	8.1	134.0
17	137.3	8.3	136.8
18	135.4	8.9	134.0

Table 24

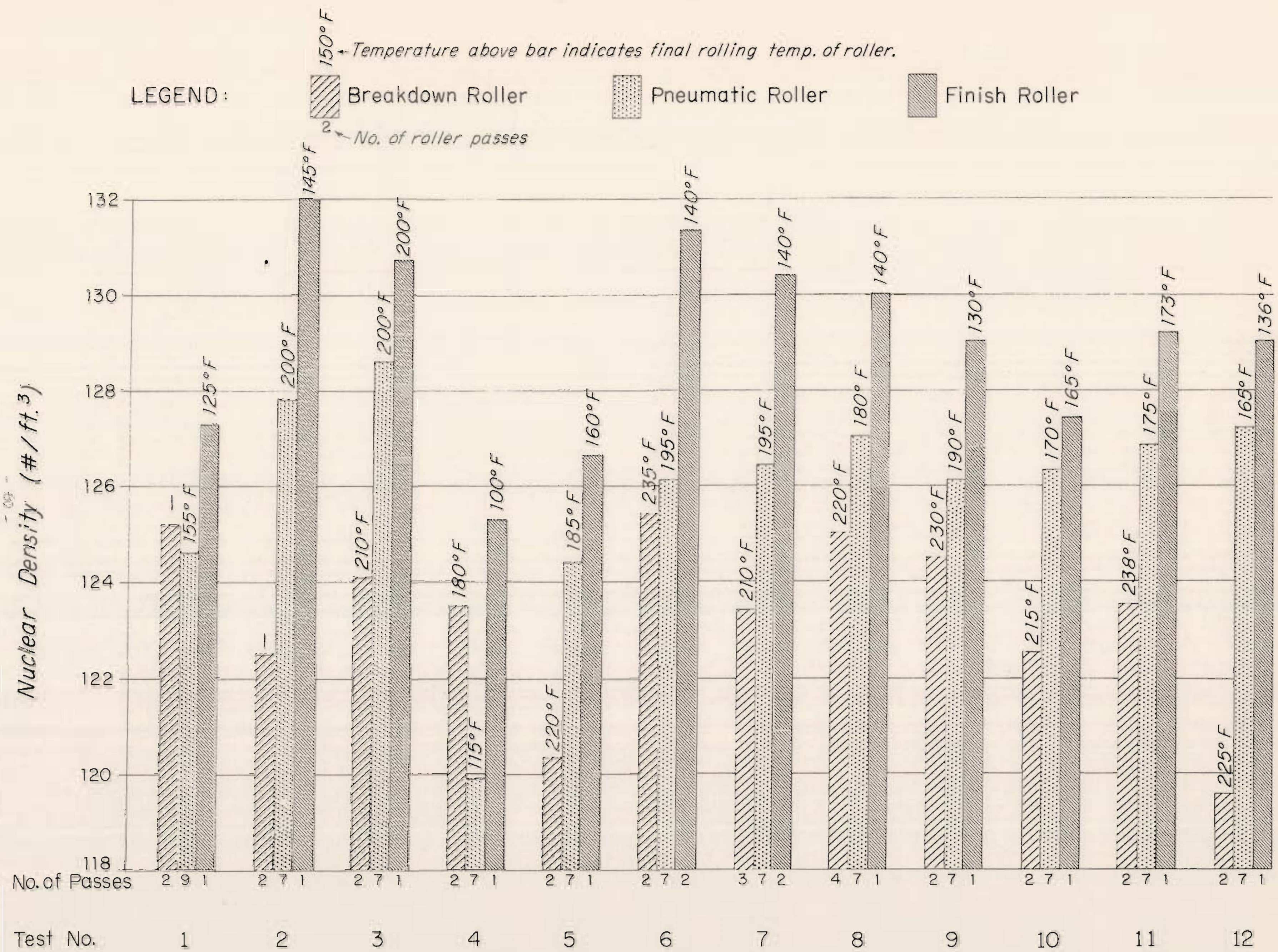


Figure 26 **Roller Test Vs. Nuclear Density**

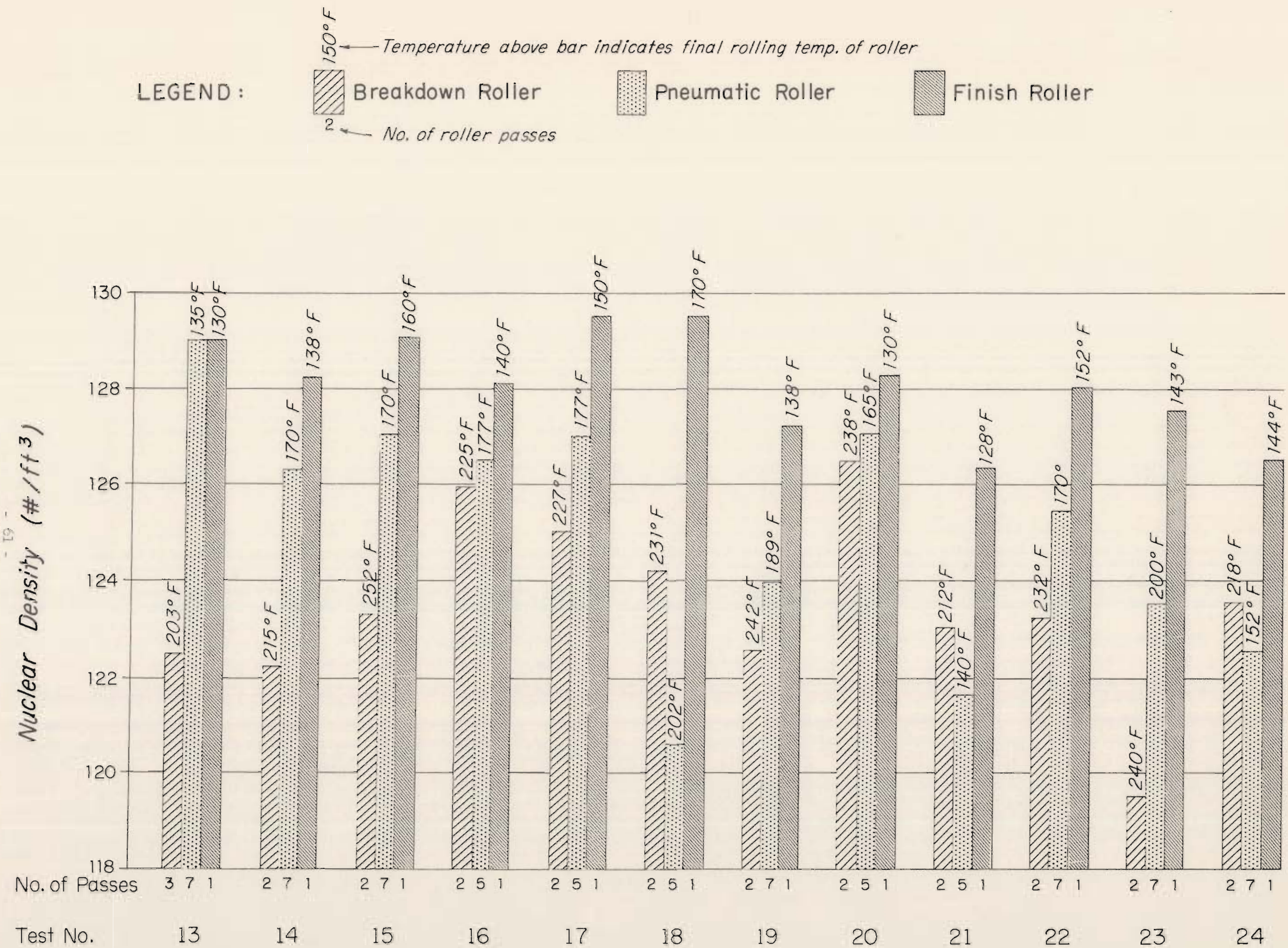


Figure 27 **Roller Test Vs. Nuclear Density**