## FIELD SAMPLES OF HOT MIX AS AN ACCEPTANCE PROCEDURE

Final Report

bу

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Research Report No. 167
Research Project No. 82-1B(B)

Conducted by
LOUISIANA DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT
Research and Development Section
In Cooperation with
U. S. Department of Transportation
FEDERAL HIGHWAY ADMINISTRATION

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DECEMBER 1983

### ABSTRACT

Shifting the sampling site of asphalt concrete from the plant to the roadway necessitates a modification of the Marshall procedure. The effect of such a modification on the Marshall properties and resultant process levels in a Statistically Oriented End-Result Specification requires a feasibility determination. The variation associated with a modified test procedure was examined in this study.

Loose mix samples from the roadway were secured from the same trucks sampled at the plant in four districts, which represented two mix types (low and high stability) and four different asphalt cement sources. These materials were tested at the district laboratories in duplicate and at the research laboratory where samples were compacted similarly to the district, by a means of compaction different from the district, and at a reduced compaction temperature. Marshall briquettes were tested and the Marshall properties were analyzed using standard statistical procedures.

It was found that the Marshall properties' statistical parameters of mean levels and variation were significantly different from the parameters basic to the current specifications. These differences create new process levels which would demand a revision of specifications upon implementation of the modified test procedure. In general, the data demonstrates within lab and between lab repeatability. Also, that manual and automatic compaction harmers will provide significantly different results.

### METRIC CONVERSION FACTORS\*

| To Convert from  | To   | Multiply by  |
|--|--|--|
|  | Length   |  |
| foot<br>inch<br>yard<br>mile (statute)   | <pre>meter (m) millimeter (mm) meter (m) kilometer (km)</pre>  | 0.3048<br>25.4<br>0.9144<br>1.609  |
|  | Area   |  |
| square foot<br>square inch<br>square yard  | square meter (m²)<br>square centimeter (cm²)<br>square meter (m²)  | 0.0929<br>6.451<br>0.8361  |
|  | Volume (Capacity)  |  |
| <pre>cubic foot gallon (U.S. liquid)** gallon (Can. liquid)** ounce (U.S. liquid)</pre>                      | cubic meter (m³)<br>cubic meter (m³)<br>cubic meter (m³)<br>cubic centimeter (cm³)   | 0.02832<br>0.003785<br>0.004546<br>29.57   |
|  | Mass   |  |
| ounce-mass (avdp) pound-mass (avdp) ton (metric) ton (short, 2000 1bs)                                       | gram (g)<br>kilogram (kg)<br>kilogram (kg)<br>kilogram (kg)  | 28.35<br>0.4536<br>1000<br>907.2   |
|  | Mass per Volume  |  |
| <pre>pound-mass/cubic foot pound-mass/cubic yard pound-mass/gallon (U.S.)** pound-mass/gallon (Can.)**</pre> | kilogram/cubic meter (kg/m³)<br>kilogram/cubic meter (kg/m³)<br>kilogram/cubic meter (kg/m³)<br>kilogram/cubic meter (kg/m³) | 16.02<br>0.5933<br>119.8<br>99.78  |
|  | Temperature  |  |
| deg Celsius (C)<br>deg Fahrenheit (F)<br>deg Fahrenheit (F)  | kelvin (K)<br>kelvin (K)<br>deg Celsius (C)  | t <sub>k</sub> =(t <sub>c</sub> +273.15)<br>t <sub>k</sub> =(t <sub>F</sub> +459.67)/1.8<br>t <sub>c</sub> =(t <sub>F</sub> -32)/1.8 |

<sup>\*</sup>The reference source for information on SI units and more exact conversion factors is "Metric Practice Guide" ASTM E 380.

<sup>\*\*</sup>One U.S. gallon equals 0.8327 Canadian gallon.

### TABLE OF CONTENTS

| ABSTRACT  | - iii  |
|---|--|
| LIST OF CONVERSION FACTORS  | - iv   |
| LIST OF TABLES  | - vii  |
| LIST OF FIGURES   | - viii   |
| IMPLEMENTATION STATEMENT  | - ix   |
| INTRODUCTION  | - 1  |
| SCOPE   | - 3  |
| METHODOLOGY   | 5  |
| Sampling and Testing Program Test Procedure Data Analysis DISCUSSION OF RESULTS | - 6<br>- 7   |
| Variation - Prior Research  | - 11<br>- 13<br>- 22<br>- 26<br>- 27<br>- 29<br>- 30 |
| CONCLUSIONS   | _ 35   |
| RECOMMENDATIONS   | _ 37   |
| LIST OF REFERENCES  | _ 38   |
| APPENDIX A - TEST DATA  | _ 39   |
| APPENDIX B - STATISTICAL PARAMETERS   | - 49   |
| APPENDIX C - t-TEST ANALYSIS  | - 63   |

### LIST OF TABLES

| Table | No. |  | Page | No |
|-------|-----|--|------|----|
| 1     |     | Marshall Stability Statistical Parameters - Prior Research                   | 1:   | 3  |
| 2     |     | Marshall Stability Statistical Parameters - Plant, District, Research        | 1    | 4  |
| 3     |     | t-Test - Computer Output   | 16   | 3  |
| 4     |     | t-Test - Marshall Stability  | 1:   | 5  |
| 5     |     | Marshall Stability Correlation Output - Type 1 Mix                           | 18   | 8  |
| 6     |     | Marshall Stability Correlation Output - Type 3 Mix                           | 19   | 9  |
| 7     |     | Specific Gravity Statistical Parameters - Plant, District, Research          | 23   | 3  |
| 8     |     | Air Voids Statistical Parameters - Plant, District, Research                 | 24   | 1  |
| 9     |     | Voids Filled With Asphalt Statistical Parameters - Plant, District, Research | 25   | 5  |
| 10    |     | Statistical Parameters - Within Lab  | 27   | 7  |
| 11    |     | Statistical Parameters - Between Lab   | 28   | 3  |
| 12    |     | Statistical Parameters - Reduction of JMF Temperature                        | 28   | 3  |
| 13    |     | F-Statistic - Within Lab and Between Lab                                     | 31   |    |
| 14    |     | F-Statistic - Effect of Asphalt Cement on Plant Briquettes                   | 32   | 2  |
| 15    |     | Statistical Parameters - Automatic Versus Manual Compaction                  | 33   | }  |

### LIST OF FIGURES

| Figure No | Pa  | age No. |
|-----------|---|---------|
| 1         | Process Level Distributions                 | 12      |
| 2         | Marshall Stability Correlation - Type 1 Mix | 20      |
| 3         | Marshall Stability Correlation - Type 3 Mix | 21      |

### IMPLEMENTATION STATEMENT

Implementing a shift in sampling location from the plant site to the roadway is not deemed feasible at this time. Such a change would require a major rewriting of specifications and a subsequent retraining program. Consideration should be given to discontinue the use of manual compaction hammers.

### INTRODUCTION

In 1971 Louisiana initiated full implementation of a Statistically Oriented End-Result Specification for asphaltic concrete. This specification defined responsibilities for the contractor and the Department for control and/or acceptance testing, defined quality criteria for control and acceptance and structured price adjustments for non-conforming materials. Quality assurance under such a statistically oriented program is rooted in the randomness of sampling and testing.

Currently, asphaltic concrete is sampled and tested at the asphalt plant. Random number tables have been generated for use in determining sampling times. However, it is believed that familiarity with plant operations can, at times, lead to a biasing of sampling time. It is further believed that sampling in the field at the laydown site could remove this bias. With this in mind, it was felt that sampling at the field site should be investigated.

Changing the sampling site necessarily causes problems in the Marshall design procedure, as the mix will subsequently lose temperature when transported back to the plant lab for testing. Questions arise concerning the method of reheating the mixture and the resultant Marshall properties. How should the mix be reheated? How long? Are Marshall properties the same? If not, can they be correlated? Can acceptance limits be modified to accommodate field sampling?

This study was initiated to determine the feasibility of changing the point of acceptance from the plant to the roadway. This report contains the results of this study.

### SCOPE

The scope of this evaluation was to determine, both in a selected number of district laboratories and in the research laboratory, the relationship and variation to be expected between plant and roadway test results with respect to Marshall properties (stability, air voids, voids filled with asphalt) on different Louisiana mix types and composition. As part of this effort, the effect of manual versus automatic compaction upon resulting Marshall properties was examined.

The study encompassed the selection of two mix types (or stability levels) in each of four districts for a total of eight projects with twenty samples collected per project at the roadway.

### METHODOLOGY

### Sampling and Testing Program

Each of four districts with different asphalt cement sources were requested to select two ongoing hot-mix construction projects representing a Type 1 (low stability) wearing course mix and a Type 3 (high stability) wearing course mix from which loose mix samples could be secured. From each of the selected projects 20 sets of duplicate loose mix samples (a total of 40 samples per project) were taken at the roadway, each set (2 one-gallon cans) coming from the identical transport previously sampled for acceptance at the plant. One gallon of each set was retained at the district for testing and the other gallon was forwarded to the research section.

At the district laboratory each sample was reheated to obtain a mix at the job mix formula temperature, followed by compaction (manual or automatic) by identical means as was used at the plant. Two specimens labelled D1 and D2 were prepared from each gallon can according to the procedure provided below. Marshall properties were then determined.

Three Marshall briquettes were fabricated from each gallon can shipped to the research laboratory. Two of these specimens were compacted by identical means as the district and the plant (one being heated to the job mix formula temperature—R1, the second being reheated to a temperature 25°F cooler—R3). The third specimen—R2—was reheated to the job mix formula temperature but compacted (manual or automatic) by means different from what was used at the plant. The fabrication of briquettes and subsequent testing was identical to the district laboratory.

A primary concern in shifting the sampling site was the effect of binder viscosity on the Marshall properties of the specimens formed after reheating the mix. Generally, an increased binder viscosity will provide a tougher mix which will increase stability but will resist compaction, thus lowering the specific gravity and voids filled with asphalt (VFA) of a mix and increasing air voids. Binder viscosities normally increase to some extent due to plant processing and the inherent properties of the particular asphalt cement utilized (measured by an asphalt's viscosity index). effect upon viscosity of allowing the mix to cool to ambient and then reheating in order to compact the specimen was unknown. this in mind two assumptions were made: (1) with the field samples cooling to ambient temperature prior to reheating, any increase in binder viscosity would be similar within each asphalt type; and (2) that the binder viscosity would not significantly increase once the sample had cooled so that a time lapse between sampling and testing would not affect the results.

### Test Procedure

Preliminary work in the district and research laboratories resulted in the following standardized procedure utilized for this study:

- 1. Allow gallon can to cool to ambient temperature.
- 2. Place uncovered can into preheated oven (set at 5°F above the job mix formula temperature) for 40 minutes.
- 3. Remove can from oven and split and quarter mix into two approximately 1200-gram samples.
- 4. Place each split sample into a pan and return to oven, along with a conical mixing bowl, for two hours.
- 5. Remove one sample pan from the oven, empty mix into bowl and stir, add mix to Marshall mold and compact, returning mixing bowl to oven.

- 6. Immediately upon completion of Step 5, remove second sample pan and mixing bowl from oven and make second briquette.
- 7. Test briquettes for all Marshall design properties—specific gravities, stability, flow and voids filled with asphalt.

If more than one gallon can of mix was to be tested, the split samples from these cans were placed into the oven (Step 4) at 10-minute intervals such that the 2-hour oven exposure was maintained, allowing 10 minutes to complete Steps 5 and 6 for the two briquettes made from each gallon can.

The following nomenclature will be used in this analysis:

P = Plant data

D1 = District data: compacted same method as plant at

JMF temperature

D2 = Replicate district data

R1 = Research data: compacted same method as plant at

JMF temperature

R2 = Research data: compacted by different method from

plant at JMF temperature

R3 = Research data: compacted same method as plant at

JMF temperature minus 25°F.

### Data Analysis

Each reheated and compacted briquette was tested for apparent specific gravity and Marshall stability, and then the percent air voids based on a theoretically voidless mixture and voids filled with asphalt were calculated. This raw data was compiled and is presented in Appendix A (page 39). The data is arranged by source (plant: P; district: D1, D2; research: R1, R2, R3) within each project (defined by the mix type and the asphalt cement utilized). It should be noted that one project included only 13 samples.

one project had 15 samples and two projects had 21 samples. This variation with the sampling plan was due to plant production schedules and the study time constraints.

Louisiana's current acceptance and control limits for Marshall properties were developed from known process levels with respect to the mean and variability of the material and/or test. These levels were determined from historical sources. As such, there exists a definite relationship between the specifications and the statistical parameters of the associated properties. Any change in test procedure which would cause the values of the statistical parameters to change must necessarily be examined to determine the validity of the statistically oriented specifications.

Specifically, the specifications were developed so that the contractor would maintain process control; that is, he would maintain his operations to achieve a specified mean level and also keep his variability within a prescribed limit. These actions would be rewarded with 100% pay and the state would be statistically assured of a quality controlled mix. A change in the mean or variability due to the test procedure under consideration must therefore be examined to assure compatibility with the specifications.

The Department's Statistical Analysis System (SAS) computer program was used to analyze the data. Number of samples, means, standard deviations, minimum values, maximum values and coefficients of variation are presented in Appendix B (page 49). This data was used to examine the variability of the test data within the testing program for consistency and to examine its validity with respect to the statistical parameters used to develop the specfications.

A t-statistic was used to compare the Marshall properties determined for the field samples with those found at the plant. This statistic tests the hypothesis at some preselected significance

level that samples from two populations have the same mean. The t-statistic is based upon the means, variance (dispersion about the mean) and the degrees of freedom of the two sets of samples examined and assumes that the data is normally distributed. The calculated t-statistic\* is then compared to the tabulated t value. If the calculated value is larger than the tabulated t at the preselected probability or significance level, then it is concluded that the tested means are not equal. For this study a significance level of 0.05 was chosen.

Another statistical technique used to evaluate the field and plant data was analysis of variance (ANOVA). The ANOVA technique differs from the t-statistic in that more than two means can be tested at the same time. This increased utility allows several influential factors or effects to be studied simultaneously. The basis for this analysis rests on the premise that if the means of data groups are greatly different, then the variance of the combined groups is larger than the variance of the separate groups. ANOVA separates the variance of all observations into parts with each part measuring the variability due to some specific effect. The hypothesis of equal means is accepted if the observed data means are close. ANOVA uses the F-statistic which, similar to the t-statistic, depends on the mean, variance and the degrees of freedom of the various populations examined. A significant F value would indicate that the hypothesis is false, or that the means are not equal. The significance level used for this evaluation was 0.05.

\*t = 
$$|\bar{x}_1 - \bar{x}_2| / \bar{s}(x) \sqrt{\frac{1}{n_1 + n_2}}$$

where  $\overline{x}_1$ ,  $\overline{x}_2$  = means from two independent samples  $\overline{s}$  = pooled variance of the two samples  $n_1$ ,  $n_2$  = number of values in each sample

These statistics were used to compare the plant-generated data with the data associated with the briquettes constructed using the developed test procedure. Direct comparisons were made between the plant (P) and the district (D1) and research (R1), which examined the possibility of differing means and their associated variances. Within lab (D1 versus D2) and between lab (R1 versus D1) variations were also evaluated along with the effect of compaction temperature (R3 versus P, R3 versus R1). Finally, the method of compaction (automatic versus manual) was studied.

### DISCUSSION OF RESULTS

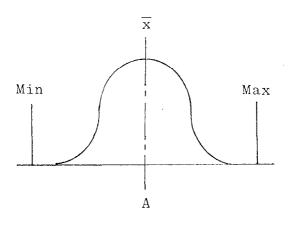
### Variation - Prior Research

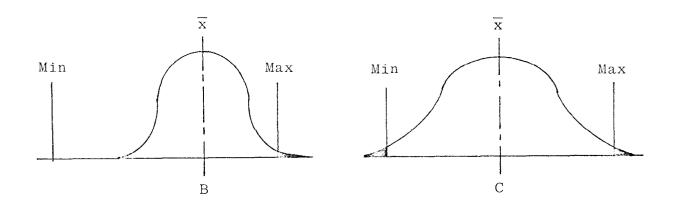
In the early 1960s Louisiana completed a study--Quality Control Analysis Part I - Asphaltic Concrete (1)\*--which established engineering tolerance limits for materials test properties such as Marshall stability, gradation, voids and asphalt cement content. The establishment of these limits based on the concept of process levels--statistically determined means and variation--marked the beginning of the state's Statistically Oriented End-Result Specifications.

Generally, in order to be assured that a test value is due to the randomness generated within a given process and not due to a loss of control in materials, production or sampling and testing, the process should maintain that test value at a certain mean and within some allowable set limits. Figure 1A depicts a proper level of control for a particular test value; the values are distributed normally about a mean within the prescribed limits so that all values can be assumed to occur by the randomness of the process. Figures 1B and 1C, however, show the situation when either the mean shifts while maintaining the same variability or the variability is increased while the mean remains stable. Either of these situations would occur from other than random causes and the material would be considered deficient.

A modification to a test procedure must necessarily produce test values which retain similar statistical parameters to the unmodified procedure or the specification limits become invalidated. New specifications must then be identified or the modification should be discarded.

<sup>\*</sup>Underlined numbers in parentheses refer to the list of references.





Process Level Distributions
FIGURE 1

Later studies (References 2 and 3) investigating the data generated by the introduction of Statistically Oriented End-Result Specifications provide a comparative base for the statistical parameters developed with the modified test procedure. This base is limited to Marshall stability as the emphasis in these studies was acceptance tests. Marshall properties of voids, specific gravity and VFAs used as control tests were not examined in these studies. Mean stabilities and standard deviations from these studies are presented in Table 1.

TABLE 1

MARSHALL STABILITY STATISTICAL PARAMETERS
PRIOR RESEARCH

| Source     | Refere         | nce 2       | Referen                 | ice 3 |
|------------|----------------|-------------|-------------------------|-------|
| Parameters | $\overline{x}$ | S           | $\overline{\mathbf{x}}$ | S     |
| Mix Type   |                |             |                         |       |
| 1          | 1676           | 271         | 1553                    | 290   |
| 3          | 1950           | 35 <i>6</i> | 1888                    | 303   |

### Marshall Stability Variation

The statistical parameters for the plant data, determined by the conventional procedure, and the district (D1) and research (R1) data generated with the modified procedure are presented in Table 2 for each mix type by project (identified by asphalt cement). This data has been extracted from Appendix B (page 49).

TABLE 2

MARSHALL STABILITY STATISTICAL PARAMETERS PLANT, DISTRICT, RESEARCH

| Sour          | ce           | Plant (1       | P)  | District       | (D1) | Research                | (R1) |
|---------------|--------------|----------------|-----|----------------|------|-------------------------|------|
| Para          | meters       | $\overline{X}$ | S   | $\overline{X}$ | S    | $\overline{\mathbf{x}}$ | S    |
| Mix '<br>Asph | Type/<br>alt |                |     |                |      |                         |      |
| Туре          | 1            |                |     |                |      |                         |      |
| :             | E            | 1528           | 156 | 1650           | 221  | 1661                    | 197  |
|               | L            | 1582           | 247 | 2219           | 404  | 1795                    | 184  |
|               | S            | 1968           | 299 | 2494           | 263  | 2650                    | 383  |
| ,             | Т            | 1692           | 212 | 2027           | 183  | 1967                    | 198  |
| A11           | Type 1       | 1702           | 290 | 2128           | 406  | 2040                    | 460  |
| Type          | 3            |                |     |                |      |                         |      |
|               | E            | 1935           | 249 | 2201           | 378  | 2452                    | 187  |
|               | L            | 2280           | 289 | 3668           | 549  | 2971                    | 183  |
|               | S            | 2282           | 331 | 2776           | 279  | 2441                    | 238  |
|               | Т            | 1730           | 133 | 2504           | 162  | 2276                    | 316  |
| A11 '         | Type 3       | 2071           | 356 | 2843           | 650  | 2542                    | 361  |

The plant samples for both Type 1 and Type 3 mixes maintained slightly higher mean stabilities, 1702 and 2071, respectively, than those obtained from prior research. Also, the sample standard deviations of 290 and 356 for the Type 1 and Type 3 mixes, respectively, were very similar, demonstrating that the mixes produced for this study were typical of those being produced under current specifications.

All mean stabilities for both mix types determined at either the district or at research were considerably higher than those found at the plant. Likewise, there was more variation with the new procedure as indicated by the standard deviations except for the Type 3 mix tested at the research lab.

The hypothesis that the mean plant samples and the mean district and research samples were not different was examined with the test. An example of the computer output for this test is presented in Table 3, which shows the results between the plant and research data for all Type 1 specimens. Appendix C (page 63) provides a summary of the t-test results for all of the Marshall properties. Those results in italics are significant at the 0.05 level. Table 4 repeats the t-test values for Marshall stability.

TABLE 4
t-TEST - MARSHALL STABILITY

| Source | Plant vs District<br>(P/D1) | Plant vs Research<br>(P/R1) |
|--------|-----------------------------|-----------------------------|
| Mix    |                             |                             |
| Type 1 | 7.4516*                     | 8.9484                      |
| Туре 3 | -5.3897                     | -7.9830                     |

It can be observed that, overall, the hypothesis of equal means cannot be accepted at the 0.05 significance level. Generally, this is also true for each individual project with the Type 1, E asphalt and the Type 3, S asphalt as exceptions (Appendix C, page 63).

<sup>\*</sup>Italicized numbers are significant at 0.05 level.

TABLE 3

# t-TEST - COMPUTER OUTPUT

| Fig.      | VARIABLE:       | SPGR     |                                |                              |                            |               |                                 |   |                                      |                            |   |
|--|-----------------|----------|--------------------------------|------------------------------|----------------------------|---------------|---------------------------------|---|--------------------------------------|----------------------------|---|
| 147    | SOURCE          | z        | MEAN                           | STO DEV                      | STD ERROR                  | MINIMUM       | MAXIMUM                         | VARIANCES                                 | <b>-</b>                             | DF                         | PROB > [T]                              |
| NOTE NOTE ARE EQUAL, F'= 1.28 WITH 75 AND 75 DF PROB > F'= 0.2890  NOTE NOTE NOTE A 94342105 0.6892048 0.09957202 3.30000000 0.0000000 0.000001 7.4617 150.0  NOTE NOTE NOTE NOTE NOTE COUNTY, F'= 1.58 WITH 75 AND 75 DF PROB > F'= 0.0484  NOTE NOTE NOTE NOTE NOTE NOTE NOTE NOTE   | C 4             | 76       | 2.31000000                     | 0.02545584                   | 0.00291999                 | 2.25000000    | 2.36000000                      | UNEQUAL<br>EQUAL                          | -5.9074<br>-5.9074                   | 147.8<br>150.0             | 0.0001                                  |
| 148   15   15   15   15   15   15   15   1   |                 | VARIANC  | ,                              | 1<br>                        | AND 75                     | 11 1          | . 2890                          | 1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 | 1<br>1<br>1<br>8<br>3<br>4<br>3<br>1 | ;<br>;<br>;<br>;<br>;<br>; | !<br>!<br>!<br>!<br>!<br>!<br>!         |
| NOTE   No.   MEAN   STD DEV   STD ERROR   MINIMUM   MAXIMUM   VARIANCES   T   DF PROBINE   | VARTABLE        | GIOV ::  |                                |                              |                            |               |                                 |   |                                      |                            |   |
| 76 4.94342105 0.86892048 0.09967202 3.30000000 6.2000000 FQUAL 7.4617 150.0 17.00000000 7.00000000 FQUAL 7.4617 150.0 150.0 0.07921402 2.50000000 6.20000000 FQUAL 7.4617 150.0 150. | SOURCE          | Z        | MEAN                           | STD DEV                      | STD ERROR                  | MINIMUM       | MAXIMUM                         | VARIANCES                                 | <b>j</b> -                           | DF                         | PROB > [T[                              |
| THE VARIANCES ARE EQUAL, F'= 1.58 WITH 75 AND 75 DF PROB > F'= 0.0484  FIRE TO STORD TO STD DEV STD ERROR MINIMUM MAXIMUM VARIANCES TO DF PROE TO STORD TO STD TO S | D 4             | 76       | 4,94342105                     | 0,86892048                   | 0.09967202                 | 3.30000000    | 7.00000000                      | UNEQUAL<br>EQUAL                          | 7.4617                               | 142.7                      | 0.0001                                  |
| STABLE: VFA  The maximum maximum maximum variances T DEP PROB  The model of the model of the model of the model of the maximum variances T DEP PROB  The model of |                 |          | ARE EQUAL,                     |                              | AND 75                     | !!<br>`L      | .0484                           |   | ,                                    |                            |   |
| PRGE   | VARIABLE        | : VFA    |                                |                              |                            |               |                                 |   |                                      |                            |   |
| 76 70.63157895 3.52455049 0.40429367 64.00000000 79.00000000 EQUAL -8.6202 142.6 75.07894737 2.79410407 0.32050572 65.00000000 82.00000000 EQUAL -8.6202 150.0  2 HD: VARIANCES ARE EQUAL, F'= 1.59 WITH 75 AND 75 DF PROB > F'= 0.0460  31.23647893 4 1316.00000000 3203.0000000 UNEQUAL 7.4516 150.0  2 HD: VARIANCES ARE EQUAL, F'= 1.97 WITH 75 AND 75 DF PROB > F'= 0.0039  | SOURCE          | Z        | MEAN                           | STD DEV                      |                            | MINIMUM       | MAXIMUM                         | VARIANCES                                 | <b>}</b>                             | ш.<br>О                    | PROB >  T                               |
| REABLE: STAB  STABLE: STAB  TO 2128.47368421 406.19008600 46.59319834 1316.00000000 3203.0000000 EQUAL  TO 2128.47368421 406.19008600 46.59319834 1316.00000000 2506.00000000 EQUAL  TO 21028.47368421 406.19008600 289.74890279 33.23647859 1118.00000000 2506.00000000 EQUAL  TO 200000000 289.74890279 33.23647859 1118.000000000 2506.00000000 EQUAL  TO 200000000 289.74890279 33.23647859 1118.00000000 2506.00000000 EQUAL  TO 200000000 289.74890279 33.23647859 1118.000000000 2506.00000000 EQUAL  TO 200000000 289.74890279 33.23647859 1118.000000000 2506.00000000 EQUAL  TO 2000000000 289.74890279 33.23647859 1118.000000000 2506.00000000 EQUAL  TO 2000000000 289.74890279 33.23647859 1118.000000000 2506.00000000 EQUAL  TO 2000000000 289.74890279 33.23647859 1118.0000000000 2506.00000000 EQUAL  TO 2000000000 289.74890279 33.23647859 1118.000000000 2506.000000000 EQUAL  TO 20000000000 289.74890279 33.23647859 1118.0000000000 2506.000000000 EQUAL  TO 20000000000 289.74890279 33.23647859 1118.000000000 2506.000000000 EQUAL  TO 200000000000 289.74890279 33.23647859 1118.0000000000 2506.0000000000000 EQUAL  TO 2000000000000000000000000000000000000   | 1 O A           | 76       | 70.63157895<br>75.07894737     | 3.52455049<br>2.79410407     | 0.40429367                 | 64.00000000   | 79.00000000                     | UNEQUAL<br>EQUAL                          | -8.6202<br>-8.6202                   | 142.6<br>150.0             | 0.0001                                  |
| RIABLE: STAB  JECE N MEAN STD DEV STD ERROR MINIMUM MAXIMUM VARIANCES T DF PROF  76 2128.47368421 406.19008600 46.59319834 1316.00000000 3203.00000000 UNEQUAL 7.4516 135.6  76 1702.00000000 289.74890279 33.23647859 1118.00000000 2506.00000000 EQUAL 7.4516 150.0  8 HO: VARIANCES ARE EQUAL, F'= 1.97 WITH 75 AND 75 DF PROB > F'= 0.0039   | FOR HO:         | VARIANC  | 1                              | 1.59                         | AND 75                     | V T I         | .0460                           | 1<br>1<br>1<br>1<br>2<br>3<br>1<br>1<br>1 | 1<br>!<br>!<br>!<br>!<br>!           | 1                          | 1 |
| JRCE N MEAN STD DEV STD ERROR MINIMUM MAXIMUM VARIANCES T DF PROB<br>76 2128.47368421 406.18008600 46.59319834 1316.000000000 3203.00000000 UNEQUAL 7.4516 135.6<br>76 1702.00000000 289.74890279 33.23647859 1118.00000000 2506.00000000 EQUAL 7.4516 150.0<br>8 HO: VARIANCES ARE EQUAL, F'= 1.97 WITH 75 AND 75 DF PROB > F'= 0.0039  | VARIABLE        |          |                                |                              |                            |               |                                 |   |                                      |                            |   |
| 76 2128.47368421 406.19008600 46.59319834 1316.00000000 3203.00000000 UNEQUAL 7.4516 135.6 76 1702.00000000 289.74890279 33.23647859 1118.00000000 2506.00000000 EQUAL 7.4516 150.0 3 HO: VARIANCES ARE EQUAL, F'= 1.97 WITH 75 AND 75 DF PROB > F'= 0.0039  | SOURCE          | z        | MEAN                           | STD DEV                      | STO ERROR                  | MINIMUM       | MAXIMUM                         | VARIANCES                                 | <b>-</b>                             | OF                         | PROE >  T                               |
| 1.97 WITH 75 AND 75 DF   | <u>.</u><br>2 a | 76<br>76 | 2128.47368421<br>1702.00000000 | 406.19008600<br>289.74890279 | 46.59319834<br>33.23647859 | 1316.00000000 | 3203.000000000<br>2506.00000000 | UNEQUAL<br>EQUAL                          | 7.4516                               | 135.6<br>150.0             | 0.0001                                  |
|  | FOR HO:         | VARIANC  | SES ARE EQUAL, F'              |                              |                            | PROB > F'= 0  | .0039                           |   |                                      |                            |   |

The difference in stability level observed between the plant results and the results based on the new procedure was anticipated, as it was believed that the reheated samples would have a more viscous asphalt cement due to plant aging and the reheating process. An attempt was made to correlate these results. A SAS General Linear Models procedure which is composed of ANOVA and a regression analysis was used for this purpose. Tables 5 and 6 report the analysis for Type 1 and Type 3 mixes, respectively, and correspond to Figures 2 and 3. These figures reflect both plant versus research (identified as 1 in the figure) and plant versus district (identified as 2 in the figure) data along with the estimated correlation lines (identified as R and D in the figure). tables demonstrate very good correlation as indicated by the high R<sup>2</sup> values. For Type 1 mix there is similarity between the district and research sample correlation, generally showing an increase of stability of approximately 20 percent in the specimens fabricated with the new procedure. The Type 3 mix also displays this 20 percent increase for the research specimens but is considerably higher (36 percent) for the district specimens. This disparity in correlation would pose problems in establishing minimum stability requirements for Type 3 mix and therefore would require further study. Perhaps most distressing, though, is the large spread of data evidenced in Figures 2 and 3. This graphic depiction reiterates the high standard deviations reported in Table 2. Standard deviations of 406 (district) and 460 (research) are much higher than the sample standard deviation of 290 from prior research for the Type 1 mix. Also, while the Type 3 deviations at research of 361 seem comparable to the 356 found in prior research, the district specimens were almost double at 650. From the perspective of process levels, then, a much higher mean value would have to be maintained in order to be assured that variation was due to randomness and not a change in the quality of the mix. Such a mean would be higher than the values found in this study.

TABLE 5

MARSHALL STABILITY CORRELATION OUTPUT - TYPE 1 MIX

|         | DEPENDENT VARIABLE | : R1STAB   |                          |               |        |                |                    |          |            |
|---------|--------------------|------------|--------------------------|---------------|--------|----------------|--------------------|----------|------------|
|         | SOURCE             | DF         | SUM OF SQUARES           | MEAN S        | QUARE  | F VALUE        | PR > F             | R-SQUARE | С.У.       |
|         | MODEL              | 1          | 327675607.78674512       | 327675607.786 | 74512  | 2063.05        | 0.0001             | 0.963119 | 19.8200    |
|         | ERROR              | 79         | 12547602.21325487        | 158830.407    | 76272  |                | STD DEV            | R        | 1STAB MEAN |
|         | UNCORRECTED TOTAL  | 80         | 340223210.00000000       |               |        |                | 398.53532812       | 2010     | 0.77500000 |
|         | SOURCE             | DF         | TYPE I SS                | F VALUE       | PR > F | DF             | TYPE IV SS         | F VALUE  | PR > F     |
|         | PSTAB              | 1          | 327675607.78674512       | 2063.05       | 0.0001 | 1              | 327675607.78674518 | 2063.05  | 0.0001     |
|         | PARAMETER          | ESTIMATE   | T FOR HO:<br>PARAMETER=O | PR >  T       |        | ROR OF<br>MATE |                    |          |            |
| X)<br>T | PSTAB              | 1.17983457 | 45.42                    | 0.0001        | 0.02   | 597562         |                    |          |            |
|         |                    |            |                          |               |        |                |                    |          |            |
|         |                    |            |                          |               |        |                |                    |          |            |
|         | DEPENDENT VARIABLE | : DISTAB   |                          |               |        |                |                    |          |            |
|         | SOURCE             | DF         | SUM OF SQUARES           | MEAN S        | QUARE  | F VALUE        | PR > F             | R-SQUARE | C.V.       |
|         | MODEL              | 1          | 359468768.00317674       | 359468768.003 | 17674  | 2755.74        | 0.0001             | 0.971789 | 17.2216    |
|         | ERROR              | 80         | 10435473.99682325        | 130443.424    | 96029  |                | STD DEV            | D        | ISTAB MEAN |
|         | UNCORRECTED TOTAL  | 81         | 369904242.00000000       |               |        |                | 361.16952385       | 2091     | 7.18518519 |
|         | SOURCE             | DF         | TYPE I SS                | F VALUE       | PR > F | DF             | TYPE IV SS         | F VALUE  | PR > F     |
|         | PSTAB              | . 1        | 359468768.00317674       | 2755.74       | 0.0001 | 1              | 359468768.00317668 | 2755.74  | 0.0001     |
|         | PARAMETER          | ESTIMATE   | T FOR HO:<br>PARAMETER=O | PR >  T       |        | ROR OF<br>MATE |                    |          |            |

PSTAE 1.23112329 52.50 0.0001 0.02345212

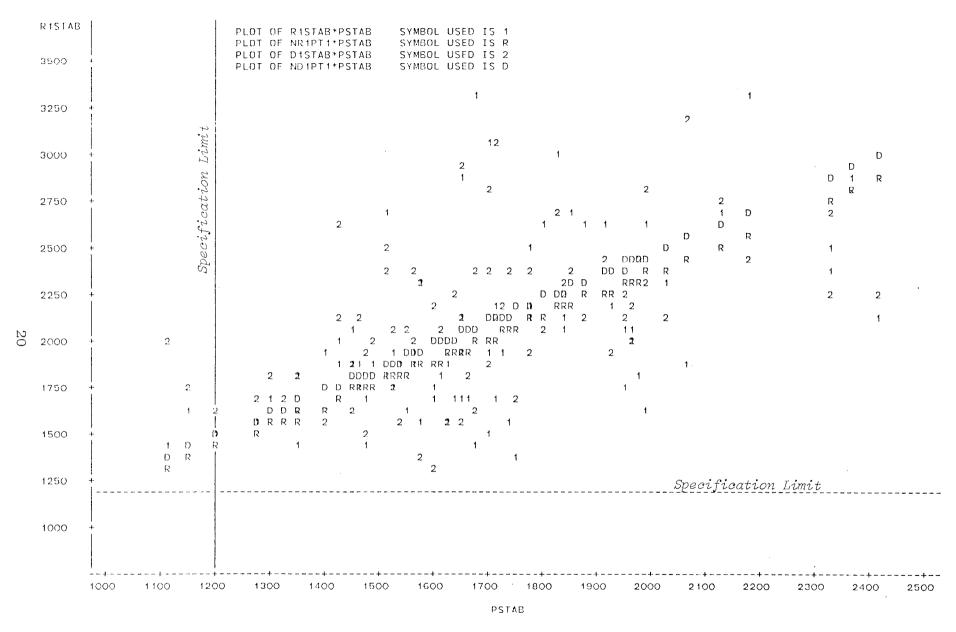
8

TABLE 6

MARSHALL STABILITY CORRELATION OUTPUT - TYPE 3 MIX

|                            | C. V.          | 17.3857            | RISTAB MEAN       | 2541.93243243      | JE PR > F  | 0.0001             |                          |            |
|----------------------------|----------------|--------------------|-------------------|--------------------|------------|--------------------|--------------------------|------------|
|                            | R-SQUARE       | 0.970764           |                   |                    | FVALUE     | 2423.95            |                          |            |
|                            | PR > F         | 0.0001             | STD DEV           | 441.93224797       | TYPE IV SS | 473407758.83922630 |                          |            |
|                            | F VALUE        | 2423.95            |                   |                    | DF         | -                  | SID ERROR OF<br>ESTIMATE | 0.02444811 |
|                            | MEAN SQUARE    | 3922640            | 1179142           |                    | PR > F     | 0.0001             | STD EI                   | 0.0        |
|                            | MEAN           | 473407758.83922640 | 195304.11179142   |                    | F VALUE    | 2423.95            | PR >  T                  | 0.0001     |
|                            | SUM OF SQUARES | 473407758.83922640 | 14257200.16077357 | 487664959.00000000 | TYPE I SS  | 473407758.83922640 | T FOR HO:<br>PARAMETER≖O | 49.23      |
| : R1STAB                   | DF             | <del></del>        | 73                | 74                 | DF         | <del></del>        | ESTIMATE                 | 1.20366949 |
| DEPENDENT VARIABLE: R1STAB | SOURCE         | MODEL              | ERROR             | UNCORRECTED TOTAL  | SOURCE     | PSTAB              | PARAMETER                | PSTAB      |

| DEPENDENT VARIABLE: D1STAB | : D1STAB   |                          |                    |                          |   |          |                 |
|----------------------------|------------|--------------------------|--------------------|--------------------------|---|----------|-----------------|
| SOURCE                     | DF         | SUM OF SQUARES           | MEAN SQUARE        | ARE F VALUE              | 유 사 가 가 가 가 가 가 가 가 가 가 가 가 가 가 가 가 가 가 | R-SQUARE | C . V .         |
| MODEL                      | +          | 603464973.27127450       | 603454973.27127450 | 450 1738.31              | 0.0001                                  | 0.959698 | 20.7277         |
| ERROR                      | 73         | 25342344.72872543        | 347155,40724281    | 281                      | STD DEV                                 | ٥        | D1STAB MEAN     |
| UNCORRECTED TOTAL          | 7.4        | 628807318.00000000       |                    |                          | 589,19895387                            | 284      | 2842.56756757   |
| च क्यां स                  | ži<br>Ži   | CO I Ediki               |                    |                          | TYPE IV 55                              | ר יאנטם  | ۱ــ<br>۱۲<br>۱۲ |
| PSTAB                      | <b>V</b>   | 603464973.27127450       | 1738.31            | 0.0001                   | 603464973.27127440                      | 1738.31  | 0.0001          |
| PARAMETER                  | ESTIMATE   | T FOR HO:<br>PARAMETER=O | PR >               | STD ERROR OF<br>ESTIMATE |   |          |                 |
| PSTAB                      | 1.35898794 | 41.69                    | 0.0001             | 0.03259504               |   |          |                 |



Marshall Stability Correlation - Type 1 Mix FIGURE 2

Marshall Stability Correlation - Type 3 Mix

FIGURE 3

# <u>Variation in Air Voids, Specific Gravities, Voids Filled</u> with Asphalt

These Marshall properties are interrelated and dependent upon aggregate/asphalt cement proportioning and the amount of compaction. Louisiana uses these properties to control mix types at the plant and partially to determine acceptance with respect to roadway density (95 percent minimum of plant specific gravity). Specific gravity is a tested property which is used to calculate the air void content of a mixture and along with asphalt cement content to determine voids filled with asphalt (VFA). Louisiana specifications require an air void content of 3-5 percent and a VFA of 70-80 for its Type 1 and Type 3 wearing course mixtures.

For reasoning similar to the expectation of higher stability values, it was also anticipated that the compaction of the specimens produced by the new procedure would be diminished. This is observed in the specific gravities presented in Table 7. In each case the mix gravities are less than those found in mix tested at the plant. The plant variation is generally less.

When consideration is given to a process level for air voids given the 3-5 specification limits, it is obvious that a mean level of 4 should be targeted. A standard deviation of 0.5 would then allow only 2.5 percent of all test values to be discarded as occurring from other than random effects. A summary of the statistical parameters for air voids is presented in Table 8. It is observed that the plant processes are being maintained at or near the mean of specification limits for both mix types. Further, the standard deviations are maintained near the 0.5 level. An increase in voids is indicated for the specimens fabricated at both research and the districts. Also, the variation is increased approximately 30 percent for the Type 1 mix and 100 percent for the Type 3 mix. The higher air void levels are consistent with the lower specific gravities of these specimens and as such would require both a change in specification mean and expanded limits.

TABLE 7

SPECIFIC GRAVITY STATISTICAL PARAMETERS PLANT, DISTRICT, RESEARCH

| Source               | P              | )     | D              | 1     | R              | 1     |
|----------------------|----------------|-------|----------------|-------|----------------|-------|
| Parameters           | $\overline{X}$ | S     | $\overline{x}$ | S     | $\overline{x}$ | S     |
| Mix Type/<br>Asphalt |                |       |                |       |                |       |
| Type 1               |                |       |                |       |                |       |
| E                    | 2.333          | 0.009 | 2.326          | 0.017 | 2.306          | 0.016 |
| L                    | 2.361          | 0.015 | 2.334          | 0.017 | 2.339          | 0.017 |
| S                    | 2.310          | 0.015 | 2.285          | 0.016 | 2.289          | 0.019 |
| ${f T}$              | 2.326          | 0.007 | 2,297          | 0.011 | 2.289          | 0.011 |
| All Type 1           | 2.333          | 0.023 | 2.310          | 0.025 | 2.306          | 0.026 |
| Type 3               |                |       |                |       |                |       |
| E                    | 2.312          | 0.006 | 2.288          | 0.018 | 2.282          | 0.018 |
| L                    | 2.347          | 0.008 | 2.327          | 0.011 | 2.331          | 0.013 |
| S                    | 2.331          | 0.009 | 2.293          | 0.009 | 2.293          | 0.010 |
| T                    | 2.347          | 0.009 | 2.311          | 0.016 | 2.294          | 0.012 |
| All Type 3           | 2.336          | 0.016 | 2.307          | 0.020 | 2.302          | 0.023 |

TABLE 8

AIR VOIDS STATISTICAL PARAMETERS PLANT, DISTRICT, RESEARCH

| Source               | P              | )    | D1             |      | R1                      |      |
|----------------------|----------------|------|----------------|------|-------------------------|------|
| Parameters           | $\overline{x}$ | S    | $\overline{x}$ | S    | $\overline{\mathbf{x}}$ | S    |
| Mix Type/<br>Asphalt |                |      |                |      |                         |      |
| Type 1               |                |      |                |      |                         |      |
| E                    | 4.0            | 0.35 | 4.3            | 0.72 | 5.1                     | 0.66 |
| L                    | 3.3            | 0.59 | 4.3            | 0.66 | 4.2                     | 0.67 |
| S                    | 4.5            | 0.63 | 5.6            | 0.66 | 5.4                     | 0.79 |
| Т                    | 4.2            | 0.30 | 5.4            | 0.47 | 5.8                     | 0.50 |
| All Type 1           | 4.0            | 0.69 | 4.9            | 0.87 | 5.1                     | 0.91 |
| Type 3               |                |      |                |      |                         |      |
| E                    | 4.0            | 0.26 | 5.0            | 0.75 | 5.3                     | 0.72 |
| L                    | 3.4            | 0.32 | 4.2            | 0.43 | 4.0                     | 0.56 |
| S                    | 4.1            | 0.38 | 5.6            | 0.41 | 5.6                     | 0.45 |
| Т                    | 3.8            | 0.35 | 5.2            | 0.64 | 6.0                     | 0.53 |
| All Type 3           | 3.8            | 0.42 | 5.0            | 0.77 | 5.2                     | 0.94 |

TABLE 9

VOIDS FILLED WITH ASPHALT STATISTICAL PARAMETERS PLANT, DISTRICT, RESEARCH

| Source               | I              | P   | D              | 1   | R              | 1   |
|----------------------|----------------|-----|----------------|-----|----------------|-----|
| Parameters           | $\overline{x}$ | s   | $\overline{x}$ | s   | $\overline{x}$ | s   |
| Mix Type/<br>Asphalt |                |     |                |     |                |     |
| Type 1               |                |     |                |     |                |     |
| E                    | 75             | 1.5 | 74             | 3.2 | 70             | 3.0 |
| L                    | 77             | 3.1 | 72             | 3.3 | 73             | 3.4 |
| S                    | 73             | 2.8 | 69             | 2.8 | 70             | 3.3 |
| Т                    | 74             | 1.5 | 69             | 2.0 | 67             | 2.0 |
| All Type 1           | 75             | 2.8 | 70             | 3.5 | 70             | 3.5 |
| Type 3               |                |     |                |     |                |     |
| E                    | 75             | 1.2 | 71             | 3.1 | 70             | 3.0 |
| L                    | 78             | 1.6 | 74             | 2.0 | 74             | 2.5 |
| S                    | 74             | 1.9 | 67             | 1.6 | 68             | 1.8 |
| Т                    | 75             | 1.7 | 69             | 2.5 | 66             | 1.9 |
| All Type 3           | 76             | 2.1 | 70             | 3.4 | 69             | 3.9 |

Additionally, since roadway densities are based on plant specific gravities, refinements would have to be made with respect to the percent of compliance to plant gravity (currently 95 percent) and to the pay adjustment tables.

Similar to the process level for air voids, VFA should be maintained at 75 with a standard deviation of 2.5 (discarding of 2.5 percent of data for other than random effects). Table 9 reports that such process levels were generally maintained at the plant for both Type 1 ( $\overline{x}$  = 75, s = 2.8) and Type 3 ( $\overline{x}$  = 76, s = 2.1) mix. Again, consistent with the data found for specific gravity and air voids, the VFAs at research and the districts were lower than those found at the plant along with a higher level of variation. A change in the specification limits would be necessary.

A t-test was used to examine the hypothesis that there was no difference in the mean values of specific gravity, air voids and VFA for the plant versus research data and the plant versus district data (Appendix C, page 63). Large t-values were found indicating that the mean Marshall property values for both the research and district samples were not equal to the associated plant samples.

### Within Laboratory Variation

Two specimens were fabricated from each gallon can of loose mix at each district laboratory to examine within laboratory variation for the new test procedure. This data is labelled in the appendices and Table 10 as D1 and D2. Table 10 reports the statistical parameters and t-test values for the Marshall properties under consideration. The hypothesis of no difference in means for each of the properties examined was true for both mix types, indicating that within each laboratory the test procedure results are repeatable. This hypothesis is also true for each Marshall property when the data was examined by each project (Appendix C, page 63).

TABLE 10
STATISTICAL PARAMETERS - WITHIN LAB

| Source                | D              | )1    | D     | 2     |         |
|-----------------------|----------------|-------|-------|-------|---------|
| Statistical Parameter | $\overline{x}$ | S     | х     | S     | t-test  |
| Marshall Property     |                |       |       |       |         |
| Type 1                |                |       |       |       |         |
| Specific Gravity      | 2.310          | 0.025 | 2.313 | 0.025 | -0.5790 |
| Air Voids             | 4.9            | 0.87  | 4.9   | 0.83  | 0.6875  |
| VFA                   | 70             | 3.5   | 71    | 3.4   | -0.7278 |
| Stability             | 2128           | 406   | 2151  | 391   | -0.8287 |
| Type 3                |                |       |       |       |         |
| Specific Gravity      | 2.307          | 0.020 | 2.305 | 0.023 | 0.4919  |
| Air Voids             | 5.0            | 0.77  | 5.1   | 0.81  | -0.1666 |
| VFA                   | 70             | 3.4   | 70    | 3.7   | 0.0723  |
| Stability             | 2843           | 650   | 2966  | 753   | -1.0684 |

### Between Laboratory Variation

Research samples, R1, and district samples, D1, were used to examine variation between laboratories. Table 11 summarizes the statistical parameters found in Appendix B (page 49) and Appendix C (page 63). The t-test proved the hypothesis of equal means for most of the Marshall properties when the data for each mix type was considered. The exception was stability for Type 3 mix. This result reinforces the information obtained while attempting to correlate the research and district stabilities with those of the plant. When the t-test data is evaluated on a project basis it was found that: three Type 3

projects had equal means for specific gravity, air voids and VFA; no Type 3 projects had equal means for stability; two Type 1 projects had equal means for specific gravity, air voids and VFA; and, three Type 1 projects had equal means for stability. These results generally agree with the overall t-test evaluation by mix type, but show that there may be a need for further study of between-lab variation.

TABLE 11 STATISTICAL PARAMETERS - BETWEEN LAB

| Source                | Ι              | 01    | F              | R1    |         |
|-----------------------|----------------|-------|----------------|-------|---------|
| Statistical Parameter | $\overline{X}$ | S     | $\overline{x}$ | S     | t-test  |
| Marshall Property     |                |       |                |       |         |
| Type 1                |                |       |                |       |         |
| Specific Gravity      | 2.310          | 0.025 | 2.306          | 0.026 | 0.8532  |
| Air Voids             | 4.9            | 0.87  | 5.1            | 0.91  | -1.0154 |
| VFA                   | 70             | 3.5   | 70             | 3.5   | 1.0297  |
| Stability             | 2128           | 406   | 2040           | 460   | 1.2527  |
| Type 3                |                |       |                |       |         |
| Specific Gravity      | 2.307          | 0.020 | 2.302          | 0.023 | 1.3760  |
| Air Voids             | 5.0            | 0.77  | 5.2            | 0.94  | -1.4293 |
| VFA                   | 70             | 3.4   | 69             | 3.9   | 0.8661  |
| Stability             | 2843           | 650   | 2542           | 361   | 3.4767  |

### Variation with Reduction of Job Mix Formula (JMF) Temperature

With the anticipation of higher stabilities when reheating at the JMF temperature, it was decided that a reduction of temperature might lower stabilities to the current specification range. At the research lab, specimens denoted R3 were fabricated at a reheat tempeature of JMF minus 25°F. Statistical parameters for these samples along with the plant data are summarized in Table 12. The expected drop in stability and the mean stability and standard deviation is similar to the plant parameters. The t-test agrees in its acceptance of the hypothesis of equal means. The other Marshall properties do not show equality of means with the plant specimens. Similar to the earlier discussion of these properties, a modification would need to be effected in specifications to accommodate the change in mean value and greater variation in order to keep process levels equivalent to current specifications.

TABLE 12
STATISTICAL PARAMETERS - REDUCTION OF JMF TEMPERATURE

| Source                | Р              |       | R              | 3     |          |
|-----------------------|----------------|-------|----------------|-------|----------|
| Statistical Parameter | $\overline{x}$ | S     | $\overline{x}$ | S     | t-test   |
| Marshall Property     |                |       |                |       |          |
| Type 1                |                |       |                |       |          |
| Specific Gravity      | 2.333          | 0.023 | 2.299          | 0.028 | 8.2189   |
| Air Voids             | 4.0            | 0.69  | 5.4            | 0.94  | -10.3841 |
| VFA                   | 75             | 2.8   | 67             | 3.4   | 12.2498  |
| Stability             | 1702           | 290   | 1690           | 284   | 0.2556   |
| Type 3                |                |       |                |       |          |
| Specific Gravity      | 2.336          | 0.016 | 2.296          | 0.024 | 12.2780  |
| Air Voids             | 3.8            | 0.42  | 5.5            | 0.95  | -13.8673 |
| VFA                   | 76             | 2.1   | 68             | 3.9   | 14.1248  |
| Stability             | 2071           | 356   | 2150           | 390   | -1.2778  |

### Effect of Asphalt Cement on Marshall Properties

ANOVA was used to examine the influence of asphalt cement on the data from the within-lab evaluation, D1 versus D2, and the between-lab evaluation, R1 versus D1. Source (D1, D2, R1) and asphalt cement (E, L, S, T) were considered as primary effects along with the interactive effect of source and asphalt. Table 13 reports the F-values found in this analysis. Those F-values in italics represent significance; i.e., that the hypothesis of equal means is false.

For the within-lab data, the analysis shows that the effect of source and the interaction of source and asphalt cement exhibit little influence on the variation. The asphalt cement as an effect on the variation is highly significant. The between-lab data also shows that a significant amount of variation can be expected due to the asphalt cement utilized. Additionally, the source effect and interactive effect for the Type 3 mix and the interactive effect for the Type 1 mix contribute to the variation.

In spite of the high significance attributed to the asphalt cement in this analysis, it could not be determined whether this significance was due to the characteristics of each asphalt cement or was typical of some other influence such as job mix formula or laboratory technique. To examine the situation further, ANOVA was applied to the plant data which were not affected by the new test procedure (i.e., oxidation effects) to determine the influence of asphalt cement (such influence would be indicative of some influence other than oxidation of asphalt cement). Table 14 presents this data. As this data also shows a variation due to asphalt cement, the influence of asphalt cement on the data from the new test procedure cannot then be isolated to show an oxidation effect.

TABLE 13
F-STATISTIC - WITHIN LAB AND BETWEEN LAB

| Data Set                     | Within Lab |        | Betwe  | Between Lab |  |
|------------------------------|------------|--------|--------|-------------|--|
| Mix Type                     | Type 1     | Type 3 | Type 1 | Type 3      |  |
| Marshall Property/<br>Effect |            |        |        |             |  |
| Specific Gravity             |            |        |        |             |  |
| Source (S)                   | 0.94       | 0.61   | 2.00   | 4.98        |  |
| Asphalt (A)                  | 92.29      | 75.14  | 83.69  | 76.21       |  |
| Source X Asphalt (SXA)       | 0.36       | 0.96   | 4.85   | 5.04        |  |
| Air Voids                    |            |        |        |             |  |
| S                            | 0.90       | 0.07   | 1.96   | 4.92        |  |
| A                            | 47.36      | 70.45  | 41.81  | 65.62       |  |
| SXA                          | 0.35       | 0.75   | 4.68   | 4.86        |  |
| VFA                          |            |        |        |             |  |
| S                            | 0.80       | 0.02   | 1.55   | 1.98        |  |
| A                            | 27.18      | 93.89  | 20.32  | 76.45       |  |
| SXA                          | 0.43       | 0.91   | 4.60   | 5.65        |  |
| Stability                    |            |        |        |             |  |
| S                            | 1.37       | 3.95   | 3.99   | 34.42       |  |
| A                            | 51.27      | 118.86 | 69.99  | 79.54       |  |
| SXA                          | 0.17       | 2.72   | 8.36   | 12.40       |  |

TABLE 14

F-STATISTIC - EFFECT OF ASPHALT CEMENT ON PLANT BRIQUETTES

| Marshall Property | Specific<br>Gravity | Air<br>Voids | VFA   | Stability |
|-------------------|---------------------|--------------|-------|-----------|
| Mix Type          |                     |              |       |           |
| Type 1            | 61.85               | 24.03        | 9.63  | 12.72     |
| Type 3            | 62.52               | 15.69        | 13.94 | 21.04     |

# Automatic and Manual Compaction Variation

A t-test was used to examine the hypothesis of equal means for the Marshall properties of specimens compacted by automatic and manual hammers. The data was generated from the R1 and R2 samples compacted from the same loose mix can in the research laboratory. The statistical parameters extracted from Appendices B and C are reported in Table 15. It is observed that the hypothesis of equal means cannot be accepted with respect to any of the Marshall properties regardless of mix type. This result is also evident upon examination of the means. Clearly, the use of a manual hammer can change the outcome of the Marshall properties testing by increasing stability, specific gravity and VFA while decreasing the air void content.

TABLE 15

STATISTICAL PARAMETERS
AUTOMATIC VERSUS MANUAL COMPACTION

| Method                | Auton          | natic | Manı           | ıal   |         |
|-----------------------|----------------|-------|----------------|-------|---------|
| Statistical Parameter | $\overline{x}$ | S     | $\overline{x}$ | S     | t-test  |
| Marshall Property     |                |       |                |       |         |
| Type 1                |                |       |                |       |         |
| Specific Gravity      | 2.302          | 0.030 | 2.315          | 0.029 | -2.7665 |
| Air Voids             | 5.3            | 1.00  | 4.7            | 0.98  | 3.3995  |
| VFA                   | 69.3           | 3.73  | 71.8           | 3.84  | -4.0567 |
| Stability             | 1949           | 318   | 2181           | 412   | -3.8579 |
| Type 3                |                |       |                |       |         |
| Specific Gravity      | 2.295          | 0.027 | 2.310          | 0.026 | -3.3873 |
| Air Voids             | 5.5            | 1.13  | 4.9            | 0.99  | 3.5148  |
| VFA                   | 68.4           | 4.8   | 70.9           | 4.3   | -3.3443 |
| Stability             | 2421           | 430   | 2753           | 375   | -4.9934 |

### CONCLUSIONS

A change in sampling site from the plant to the field necessitates a modification of the standard Marshall test procedure. In general, the statistical parameters found in this study utilizing a modified test procedure were different from those parameters determined from plant samples. The direct consequence of these different parameters would be a change in the process levels used to identify specification limits in Louisiana's Statistically Oriented End-Result Specifications. Therefore, shifting the sampling site from the plant to the field would involve a change in current specifications.

Specific conclusions constrained by the data obtained for this study are:

- 1. The modified test procedure developed due to the change in sampling site changed the mean values and increased the variation of all Marshall properties for both Type 1 (low stability) and Type 3 (high stability) mix; stability and air void contents increased specific gravity and voids filled with asphalt decreased.
- 2. Modified test procedure Marshall stabilities can be correlated with plant stabilities for Type 1 hot mix, but Type 3 mix stability correlation coefficient was different between the research and district samples.
- 3. All Marshall properties and variation were similar for tests conducted within the same laboratory.
- 4. All Marshall properties and variation with the exception of Type 3 stability were similar for tests conducted between laboratories.

- 5. Reducing the compaction temperature in the modified procedure to job mix formula minus 25°F reduces Marshall stability means and variation to levels similar to plant samples; all other Marshall properties have increased mean values and variation.
- 6. An analysis of variation due to asphalt cement oxidation caused by reheating the mix proved inconclusive.
- 7. The use of a manual Marshall compaction hammer can influence test results by increasing specific gravity, voids filled with asphalt and Marshall stability and decreasing air void content of Marshall briquettes.

### RECOMMENDATIONS

Based on the conclusions drawn in this study, a shift in the sampling site from the plant to the field is not recommended. The variation due to the modified test procedure is much greater than the variation currently found under present specifications. A shift in sampling site would involve an increase in tolerance limits for Marshall properties. While the increase in tolerance limits is relative to the test procedure used and the quality of the hot mix would be the same, it is believed that the increased tolerance limits might create confusion among the plant technicians. Further, the increased tolerance limits might create a false sense of security for the contractor leading to an increase in deficient hot mix. Other factors to be considered would include a retraining program for plant technicians, the addition of ovens to field labs and a delay in obtaining Marshall test results.

Should the field sampling of hot mix be implemented, the following specific recommendations would need investigation.

- 1. Examine the between-lab variation utilizing samples compacted at the job mix formula temperature minus 25°F.
- 2. Examine the quality (as defined by absolute viscosity at 140°F) of the asphalt cement of specimens after reheating in an effort to determine its effect on Marshall properties.
- 3. Eliminate the use of the manual Marshall compaction hammer in the plant labs.

## LIST OF REFERENCES

- 1. Shah, S. C., Quality Control Analysis Part I Asphaltic Concrete, Louisiana Department of Highways, Research Report No. 15, November 1964.
- 2. Shah, S. C. and Yoches, Veto, <u>Quality Control Analysis Part V</u>, Louisiana Department of Highways, Research Report No. 94, December 1975.
- 3. Shah, S. C., Evaluation of Data Generated by Statistically Oriented End-Result Specifications, Louisiana Department of Transportation and Development, Research Report No. 125, January 1979.

# APPENDIX A

# TEST DATA

| Table | No. |     |      |   |   |         |   |     | Page | No |
|-------|-----|-----|------|---|---|---------|---|-----|------|----|
| A-1   |     | Mix | Туре | 1 | - | Asphalt | Е |     | 4    | 1  |
| A-2   |     | Mix | Type | 1 | - | Asphalt | L |     | 4    | 2  |
| A-3   |     | Mix | Type | 1 | _ | Asphalt | S |     | 4    | 3  |
| A-4   |     | Mix | Туре | 1 |   | Asphalt | Т |     | 4    | 4  |
| A-5   |     | Mix | Type | 3 | _ | Asphalt | Ε |     | 4    | 5  |
| A-6   |     | Mix | Туре | 3 |   | Asphalt | L |     | 4    | 6  |
| A-7   |     | Mix | Type | 3 | _ | Asphalt | S | ~-~ | 4    | 7  |
| A-8   |     | Mix | Туре | 3 | _ | Asphalt | Т |     | 4    | 8  |

TABLE A-1

MIX TYPE 1 - ASPHALT E

| SO     | URCE=P | TYPE=1 | ASPH= | E    | sou    | JRCE=D1 | TYPE=1 | ASPH= | E    | SOU    | RCE=D2 | TYPE = 1 | ASPH= | E    |
|--------|--------|--------|-------|------|--------|---------|--------|-------|------|--------|--------|----------|-------|------|
| SAMPLE | SPGR   | V010   | VFA   | STAB | SAMPLE | SPGR    | VOID   | VFA   | STAB | SAMPLE | SPGR   | VOID     | VFA   | STAB |
| †      | 2.33   | 4.1    | 75    | 1681 | 1      | 2.33    | 4.1    | 75    | 1604 | 1      | 2.34   | 3.7      | 76    | 1717 |
| 2      | 2.34   | 3.7    | 76    | 1532 | 2      | 2.32    | 4.5    | 73    | 1563 | 2      | 2.33   | 4.1      | 75    | 1604 |
| 3      | 2.33   | 4.1    | 75    | 1600 | 3      | 2.29    | 5.8    | 67    | 1316 | 3      | 2.29   | 5.8      | 67    | 1558 |
| 4      | 2.33   | 4.1    | 75    | 1726 | 4      | 2.33    | 4.1    | 75    | 2171 | 4      | 2.34   | 3.7      | 76    | 1839 |
| 5      | 2.34   | 3.7    | 76    | 1750 | 5      | 2.34    | 3.7    | 76    | 1717 | 5      | 2.34   | 3.7      | 76    | 1887 |
| 6      | 2.32   | 4.5    | 73    | 1481 | 6      | 2.29    | 5.8    | 67    | 1523 | 6      | 2.29.  | 5.8      | 67    | 1628 |
| 7      | 2.32   | 4.5    | 73    | 1627 | 7      | 2.33    | 4.1    | 75    | 1571 | 7      | 2.33   | 4.1      | 75    | 2171 |
| 8      | 2.33   | 4.1    | 75    | 1654 | 8      | 2.32    | 4.5    | 73    | 1588 | 8      | 2.32   | 4.5      | 73    | 1976 |
| 14     | 2.33   | 4.1    | . 75  | 1356 | 14     | 2.33    | 4.1    | 75    | 1636 | 14     | 2.32   | 4.5      | 73    | 1612 |
| 15     | 2.32   | 4.5    | 73    | 1573 | 15     | 2.32    | 4.5    | 73    | 1377 | 15     | 2.30   | 5.3      | 69    | 1588 |
| 16     | 2.34   | 3.7    | 76    | 1344 | 16     | 2.34    | 3.7    | 76    | 1814 | 16     | 2.34   | 3.7      | 76    | 1669 |
| 17     | 2.34   | 3.7    | 76    | 1199 | 17     | 2.35    | 3.3    | 79    | 1604 | 17     | 2.34   | 3.7      | 76    | 1588 |
| 18     | 2.34   | 3.7    | 76    | 1451 | 18     | 2.34    | 3.7    | 76    | 1636 | 18     | 2.34   | 3.7      | 76    | 1782 |
| 19     | 2.33   | 4.1    | 75    | 1551 | 19     | 2.32    | 4.5    | 73    | 2041 | 19     | 2.33   | 4.1      | 75    | 2041 |
| 20     | 2.35   | 3.3    | 79    | 1396 | 20     | 2.34    | 3.7    | 76    | 1588 | 20     | 2.34   | 3.7      | 76    | 1814 |

| SOL    | JRCE=R1 | TYPE=1 | ASPH= | E    | SOL    | RCE=R2 | TYPE=1 | ASPH= | E    | SOL    | IRCE=R3 | TYPE=1 | ASPH= | E    |
|--------|---------|--------|-------|------|--------|--------|--------|-------|------|--------|---------|--------|-------|------|
| SAMPLE | SPGR    | VOID   | VFA   | STAB | SAMPLE | SPGR   | DIOV   | VFA   | STAB | SAMPLE | SFGR    | VOID   | VFA   | STAB |
| 1      | 2.30    | 5.3    | 69    | 1466 | 1      | 2.32   | 4.5    | 73    | 1700 | 1      | 2,29    | 5.8    | 67    | 1320 |
| 2      | 2.32    | 4.5    | 73    | 1856 | 2      | 2.33   | 4.1    | 75    | 1763 | 2      | 2.31    | 4.9    | 7 1   | 1451 |
| 3      | 2.30    | 5.3    | 69    | 1747 | 3      | 2.31   | 4.9    | 7 1   | 2230 | 3      | 2.29    | 5.8    | 67    | 1320 |
| 4      | 2.32    | 4.5    | 73    | 1919 | 4      | 2.32   | 4.5    | 73    | 1903 | 4      | 2.30    | 5.3    | 69    | 1622 |
| 5      | 2.30    | 5.3    | G D   | 1357 | 5      | 2.02   | 4.5    | 73    | 1643 | 5      | 2.30    | 5.3    | 69    | 1357 |
| 6      | 2.26    | 7.0    | 62    | 1455 | 6      | 2.28   | 6.2    | 65    | 1755 | 6      | 2.27    | 6.6    | 64    | 1200 |
| 7      | 2.31    | 4.9    | 71    | 1576 | 7      | 2.31   | 4.9    | 71    | 1779 | 7      | 2.31    | 4.9    | 71    | 1435 |
| 8      | 2.31    | 4.9    | 71    | 1716 | 8      | 2.31   | 4.9    | 7 1   | 1981 | 8      | 2.31    | 4.9    | 7.1   | 1279 |
| 1.4    | 2.31    | 4.9    | 71    | 1810 | 14     | 2.32   | 4.5    | 73    | 1669 | 14     | 2.29    | 5.8    | 67    | 1373 |
| 15     | 2.30    | 5.3    | 69    | 1544 | 15     | 2.29   | 5.8    | 67    | 1763 | 15     | 2.28    | 6.2    | 65    | 1380 |
| 16     | 2.33    | 4.1    | 75    | 1435 | 16     | 2.32   | 4.5    | 73    | 1622 | 16     | 2.31    | 4.9    | 71    | 1295 |
| 17     | 2.31    | 4.9    | 71    | 1529 | 17     | 2.33   | 4.1    | 75    | 1716 | 17     | 2.30    | 5.3    | 69    | 1466 |
| 18     | 2.32    | 4.5    | 73    | 1903 | 18     | 2.33   | 4.1    | 75    | 1810 | 1.8    | 2.31    | 4.9    | 71    | 1544 |
| 19     | 2.30    | 5.3    | 69    | 1643 | 19     | 2.31   | 4.9    | 7 1   | 2137 | 19     | 2.30    | 5.3    | 69    | 1513 |
| 20     | 2.30    | 5.3    | 69    | 1960 | 20     | 2.33   | 4.1    | 75    | 2262 | 20     | 2.30    | 5.3    | 69    | 1544 |

TABLE A-2
MIX TYPE 1 - ASPHALT L

| SOI   | URCE = P   | TYPE=1  | ASPH=   | L  | SOL   | JRCE=D1   | TYPE=1  | ASPH=   | L  | SQL   | JRCE=D2   | TYPE=1  | ASPH=  | L  |
|---|--|---|---|--|---|---|---|---|--|---|---|---|--|--|
| SAMPLE  | SPGR   | OIDV  | VFA   | STAB   | SAMPLE  | .SPGR   | VOID  | VFA   | STAB   | SAMPLE  | SPGR  | VOID  | VFA  | STAB   |
| 1   | 2.36   | 3.3   | 77  | 1704   | 1   | 2.36  | 3.3   | 77  | 2360   | 1   | 2.35  | 3.7   | 75   | 2326   |
| 2   | 2.34   | 4.1   | 7.3   | 1151   | 2   | 2.33  | 4.5   | 7.1   | 1778   | 2   | 2.33  | 4.5   | 7 1  | 2622   |
| 3   | 2.35   | 3.7   | 75  | 1274   | Э   | 2.32  | 4.9   | 69  | 1699   | 3   | 2.32  | 4.9   | 69   | 2052   |
| 4   | 2.38   | 2,5   | 82  | 1461   | 4   | 2.36  | 3.3   | 77  | 2109   | 4   | 2.36  | 3.3   | 77   | 2382   |
| 5   | 2.35   | 3.7   | 75  | 1475   | 5   | 2.32  | 4.9   | 69  | 1938   | 5   | 2.31  | 5.3   | 67   | 1767   |
| 6   | 2.37   | 2.9   | 79  | 2058   | 6   | 2.33  | 4.5   | 71  | 3203   | 6   | 2.33  | 4.5   | 71   | 2348   |
| 7   | 2.37   | 2.9   | 79  | 1945   | 7   | 2.35  | 3.7   | 75  | 2098   | 7   | 2.35  | 3.7   | 75   | 2440   |
| 8   | 2.37   | 2.9   | 79  | 1646   | 8   | 2.33  | 4.5   | 71  | 1926   | 8   | 2.33  | 4.5   | 71   | 2166   |
| 9   | 2.37   | 2.9   | 79  | 1637   | 9   | 2.34  | 4.1   | 73  | 2280   | 9   | 2.35  | 3.7   | 75   | 2679   |
| 10  | 2.34   | 4.1   | 73  | 1459   | 10  | 2.30  | 5.7   | 65  | 1733   | 10  | 2.32  | 4.9   | 69   | 2428   |
| . 11  | 2.38   | 2.5   | 82  | 1431   | 1.1   | 2.35  | 3.7   | 75  | 2143   | 1 1   | 2.36  | 3.3   | 7.7  | 2485   |
| 12  | 2.36   | 3.3   | 77  | 1521   | 12  | 2.33  | 4.5   | 71  | 1721   | 12  | 2.33  | 4.5   | 71   | 1630   |
| 13  | 2.37   | 2.9   | 79  | 1600   | 13  | 2.33  | 4.5   | 7 1   | 2200   | 13  | 2.34  | 4.1   | 73   | 2200   |
| 14  | 2.35   | 3.7   | 75  | 1429   | 14  | 2.34  | 4.1   | 73  | 2645   | 14  | 2.35  | 3.7   | 75   | 2280   |
| 15  | 2.37   | 2.9   | 79  | 1508   | 15  | 2.35  | 3.7   | 75  | 2508   | 15  | 2.35  | 3.7   | 75   | 1984   |
| 16  | 2.36   | 3.3   | 77  | 1566   | 16  | 2.34  | 4.1   | 73  | 2359   | 16  | 2.34  | 4.1   | 73   | 2622   |
| 17  | 2.37   | 2.9   | 79  | 1708   | 17  | 2.35  | 3.7   | 75  | 3089   | 17  | 2.36  | 3.3   | 77   | 2587   |
| 18  | 2.36   | 3.3   | 77  | 1960   | 18  | 2.33  | 4.5   | 71  | 2189   | 18  | 2.34  | 4.1   | 73   | 2257   |
| 19  | 2.32   | 4.9   | 69  | 1118   | 19  | 2.30  | 5.7   | 65  | 1984   | 19  | 2.31  | 5.3   | 67   | 2394   |
| 20<br>2 f   | 2.37<br>2.37   | 2.9<br>2.9  | 79<br>79  | 1835<br>1735   | 20<br>21  | 2.34<br>2.32  | 4.1<br>4.9  | 73<br>69  | 2257<br>2371   | 20<br>21  | 2.34<br>2.33  | 4.1<br>4.5  | 73<br>71   | 2075<br>1927   |
| -44 .   |  |   |   |  |   | 2.02  |   |   | 2377   | 2   | 2,30  | 7.0   | • •  | 132.1  |
|   |  |   |   |  |   |   |   |   |  |   |   |   |  |  |
| SOL   | JRCE=R1  | TYPE=1  | ASPH=   | :L   | SOL   | JRCE=R2   | TYPE=1  | ASPH=   | L  | SOL   | JRCE=R3   | TYPE=1  | ASPH=  | L  |
| SOL   | JRCE=R1<br>SPGR  | TYPE=1  | ASPH=   | :L<br>STAB   | SAMPLE  | JRCE=R2<br>SPGR   | TYPE=1  | ASPH=   | L  | SOL<br>SAMPLE   | JRCE≃R3<br>SPGR   | TYPE=1  | ASPH=  | L  |
|   | SPGR   | VOID  | VFA   | STAB   | SAMPLE  | SPGR  | VOID  | VFA   | STAB   |   | SPGR  | VOID  | VFA  | STAB   |
| SAMPLE<br>1   | SPGR<br>2.34   | VOID<br>4.1   | VFA<br>73   | STAB<br>1498   | SAMPLE<br>1   | SPGR<br>2.36  | 010V  | VFA<br>77   | STAB<br>1674   | SAMPLE<br>1   | SPGR<br>2.34  | V0ID  | VFA<br>73  | STAB<br>1466   |
| SAMPLE<br>1<br>2  | SPGR<br>2.34<br>2.32   | VOID<br>4.1<br>4.9  | VFA<br>73<br>69   | STAB<br>1498<br>1622   | SAMPLE<br>1<br>2  | SPGR<br>2.36<br>2.33  | VOID<br>3.3<br>4.5  | VFA<br>77<br>71   | STAB<br>1674<br>1763   | SAMPLE  | SPGR<br>2.34<br>2.32  | VOID<br>4.1<br>4.9  | VFA<br>73<br>69                                      | STAB<br>1466<br>1310   |
| SAMPLE<br>1   | SPGR<br>2.34<br>2.32<br>2.32   | VOID 4.1 4.9 4.3  | VFA<br>73   | STAB<br>1498<br>1622<br>1560   | SAMPLE  1 2 3   | SPGR<br>2.36<br>2.33<br>2.35  | VOID 3.3 4.5 3.7  | VFA<br>77<br>71<br>75                                     | STAB<br>1674<br>1763<br>1747   | SAMPLE<br>1<br>2  | SPGR<br>2.34<br>2.32<br>2.32  | V0ID  | VFA<br>73  | STAB<br>1466<br>1310<br>1170   |
| SAMPLE<br>1<br>2<br>3                                   | SPGR<br>2.34<br>2.32<br>2.32<br>2.37   | VOID<br>4.1<br>4.9  | VFA<br>73<br>69<br>69   | STAB<br>1498<br>1622   | SAMPLE<br>1<br>2  | SPGR<br>2.36<br>2.33<br>2.35<br>2.38  | VOID<br>3.3<br>4.5  | VFA<br>77<br>71   | STAB<br>1674<br>1763   | SAMPLE  1 2 3   | SPGR<br>2.34<br>2.32  | VOID 4.1 4.9 4.9  | VFA<br>73<br>69<br>69                                | STAB<br>1466<br>1310   |
| SAMPLE<br>1<br>2<br>3<br>4                              | SPGR<br>2.34<br>2.32<br>2.32   | VOID 4.1 4.9 4.9 2.9  | VFA<br>73<br>69<br>69<br>79                                   | STAB<br>1498<br>1622<br>1560<br>1738   | SAMPLE  1 2 3 4   | SPGR<br>2.36<br>2.33<br>2.35  | VOID 3.3 4.5 3.7 2.5  | VFA<br>77<br>71<br>75<br>82                               | STAB<br>1674<br>1763<br>1747<br>2064   | SAMPLE  1 2 3 4   | SPGR<br>2.34<br>2.32<br>2.32<br>2.37  | VOID 4.1 4.9 4.9 2.9  | VFA<br>73<br>69<br>69<br>79                          | STAB<br>1466<br>1310<br>1170<br>1711   |
| SAMPLE<br>1<br>2<br>3<br>4<br>5                         | SPGR 2.34 2.32 2.32 2.37 2.31  | VOID 4.1 4.9 4.9 2.9 5.3  | VFA<br>73<br>69<br>69<br>79<br>67                             | STAB<br>1498<br>1622<br>1560<br>1738<br>1716   | SAMPLE<br>1<br>2<br>3<br>4<br>5                         | SPGR<br>2.36<br>2.33<br>2.35<br>2.38<br>2.34  | VOID 3.3 4.5 3.7 2.5 4.1  | VFA<br>77<br>71<br>75<br>82<br>73                         | STAB<br>1674<br>1763<br>1747<br>2064<br>1919   | SAMPLE<br>1<br>2<br>3<br>4<br>5                         | SPGR 2.34 2.32 2.32 2.37 2.31   | VOID 4.1 4.9 4.9 2.9 5.3  | VFA<br>73<br>69<br>69<br>79<br>67                    | STAB<br>1466<br>1310<br>1170<br>1711<br>1310   |
| SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6                    | SPGR 2.34 2.32 2.32 2.37 2.31 2.34   | VOID 4.1 4.9 4.9 2.9 5.3 4.1  | VFA 73 69 69 79 67 73   | STAB<br>1498<br>1622<br>1560<br>1738<br>1716<br>1888   | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6                    | SPGR 2.36 2.33 2.35 2.38 2.34 2.36  | VOID 3.3 4.5 3.7 2.5 4.1 3.3  | VFA 77 71 75 82 73 77                                     | STAB<br>1674<br>1763<br>1747<br>2064<br>1919<br>2129   | SAMPLE  1 2 3 4 5 6 7 8                                 | SPGR 2.34 2.32 2.37 2.31 2.33 2.35 2.33   | VOID 4.1 4.9 4.9 2.9 5.3 4.5  | VFA 73 69 69 79 67 71 75 71                          | STAB<br>1466<br>1310<br>1170<br>1711<br>1310<br>1513   |
| SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7               | SPGR 2.34 2.32 2.32 2.37 2.31 2.34 2.36  | VOID 4.1 4.9 4.9 2.9 5.3 4.1 3.3 4.1 3.7                                      | VFA 73 69 69 79 67 73 77                                      | STAB<br>1498<br>1622<br>1560<br>1738<br>1716<br>1888<br>2064<br>1960<br>1685                         | SAMPLE  1 2 3 4 5 6 7                                   | SPGR 2.36 2.33 2.35 2.38 2.34 2.36 2.37 2.36 2.37   | VOID  3.3 4.5 3.7 2.5 4.1 3.3 2.9   | VFA 77 71 75 82 73 77 79                                  | STAB<br>1674<br>1763<br>1747<br>2064<br>1919<br>2129<br>2323<br>2226<br>1885   | SAMPLE  1 2 3 4 5 6 7 8 9                               | SPGR 2.84 2.32 2.32 2.37 2.31 2.33 2.35 2.33  | VOID 4.1 4.9 4.9 2.9 5.3 4.5 3.7 4.5 3.7                              | VFA 73 69 69 79 67 71 75 71                          | STAB<br>1466<br>1310<br>1170<br>1711<br>1310<br>1513<br>1669<br>1607<br>1373   |
| SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9     | SPGR  2.34 2.32 2.37 2.31 2.34 2.36 2.34 2.35 2.35   | VOID  4.1 4.9 4.9 2.9 5.3 4.1 3.3 4.1 3.7 4.9                                 | VFA 73 69 69 79 67 73 77 73 75                                | STAB<br>1498<br>1622<br>1560<br>1738<br>1716<br>1888<br>2064<br>1960<br>1685<br>1888                 | SAMPLE  1 2 3 4 5 6 7 8 9 10                            | SPGR  2.36 2.33 2.35 2.38 2.34 2.36 2.37 2.36 2.37 2.33   | VOID  3.3 4.5 3.7 2.5 4.1 3.3 2.9 3.3 2.9 4.5   | VFA 77 71 75 82 73 77 79 77 79 71                         | STAB<br>1674<br>1763<br>1747<br>2064<br>1919<br>2129<br>2323<br>2226<br>1885<br>1841   | SAMPLE  1 2 3 4 5 6 7 8 9 10                            | SPGR  2.34 2.32 2.37 2.31 2.33 2.35 2.35 2.31   | VOID 4.1 4.9 4.9 2.9 5.3 4.5 3.7 4.5 5.3                              | VFA 73 69 69 79 67 71 75 67                          | STAB<br>1466<br>1310<br>1170<br>1711<br>1310<br>1513<br>1669<br>1607<br>1373<br>1498   |
| SAMPLE  1 2 3 4 5 6 7 8 9 10                            | SPGR 2.34 2.32 2.32 2.37 2.31 2.34 2.36 2.34 2.35  | VOID 4.1 4.9 4.9 2.9 5.3 4.1 3.3 4.1 3.7                                      | VFA 73 69 69 79 67 73 77 73 75 69 77                          | STAB<br>1498<br>1622<br>1560<br>1738<br>1716<br>1888<br>2064<br>1960<br>1685<br>1888<br>1981         | SAMPLE  1 2 3 4 5 6 7 8 9                               | SPGR  2.36 2.33 2.35 2.38 2.34 2.36 2.37 2.36 2.37 2.33 2.37  | VOID  3.3 4.5 3.7 2.5 4.1 3.3 2.9 3.3 2.9   | VFA 77 71 75 82 73 77 79 77 79 71                         | STAB<br>1674<br>1763<br>1747<br>2064<br>1919<br>2129<br>2323<br>2226<br>1885<br>1841<br>2161   | SAMPLE  1 2 3 4 5 6 7 8 9 10 11                         | SPGR  2.34 2.32 2.37 2.31 2.33 2.35 2.33 2.35 2.31 2.36                               | VOID 4.1 4.9 4.9 5.3 4.5 3.7 4.5 3.7 5.3 3.3                          | VFA 73 69 69 79 67 71 75 67 77                       | STAB<br>1466<br>1310<br>1170<br>1711<br>1310<br>1513<br>1669<br>1607<br>1373<br>1498<br>1888   |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11                         | SPGR  2.34 2.32 2.37 2.31 2.34 2.36 2.34 2.35 2.36 2.34  | VOID  4.1 4.9 4.9 2.9 5.3 4.1 3.3 4.1 3.7 4.9 3.3 4.1                         | VFA 73 69 69 79 67 73 77 73 75 69 77                          | STAB  1498 1622 1560 1738 1716 1888 2064 1960 1685 1888 1981 1934                                    | SAMPLE  1 2 3 4 5 6 7 8 9 10 11                         | SPGR  2.36 2.33 2.35 2.38 2.34 2.36 2.37 2.36 2.37 2.36 2.37 2.36   | VOID  3.3 4.5 3.7 2.5 4.1 3.3 2.9 3.3 2.9 3.3 2.9 3.3                                 | VFA 77 71 75 82 73 77 79 77 79 71 79 71                   | STAB<br>1674<br>1763<br>1747<br>2064<br>1919<br>2129<br>2323<br>2226<br>1885<br>1841<br>2161<br>2177                                 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11                         | SPGR  2.34 2.32 2.37 2.31 2.33 2.35 2.33 2.35 2.31 2.36 2.34                          | VOID 4.1 4.9 4.9 2.9 5.3 4.5 3.7 4.5 3.7 5.3 3.3 4.1                  | VFA 73 69 69 79 67 71 75 71 75 77                    | STAB<br>1466<br>1310<br>1170<br>1711<br>1310<br>1513<br>1669<br>1607<br>1373<br>1498<br>1888<br>1716                                 |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                   | SPGR  2.34 2.32 2.37 2.31 2.34 2.36 2.34 2.35 2.36 2.34 2.36 2.34 2.35   | VOID  4.1 4.9 4.9 2.9 5.3 4.1 3.3 4.1 3.7 4.9 3.3 4.1 4.5                     | VFA  73 69 69 79 67 73 77 73 75 69 77                         | STAB  1498 1622 1560 1738 1716 1888 2064 1960 1685 1888 1981 1934 1669                               | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                   | SPGR  2.36 2.33 2.35 2.38 2.34 2.36 2.37 2.36 2.37 2.36 2.37 2.36 2.37                                    | VOID  3.3 4.5 3.7 2.5 4.1 3.3 2.9 3.3 2.9 4.5 2.9 3.3 4.1                             | VFA 77 71 75 82 73 77 79 77 79 77 79 71 79 77             | STAB<br>1674<br>1763<br>1747<br>2064<br>1919<br>2129<br>2323<br>2226<br>1885<br>1841<br>2161<br>2177<br>1607                         | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                   | SPGR  2.34 2.32 2.37 2.31 2.33 2.35 2.33 2.35 2.31 2.36 2.34 2.33                     | VOID 4.1 4.9 2.9 5.3 4.5 3.7 4.5 3.7 4.5 3.7 4.5 4.1 4.5              | VFA 73 69 69 77 71 75 71 75 77 73 71                 | STAB<br>1466<br>1310<br>1170<br>1711<br>1310<br>1513<br>1669<br>1607<br>1373<br>1498<br>1716<br>1498                                 |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14                | SPGR  2.34 2.32 2.37 2.31 2.34 2.36 2.34 2.35 2.32 2.36 2.34 2.33 2.34   | VOID  4.1 4.9 4.9 2.9 5.3 4.1 3.3 4.1 3.7 4.9 3.3 4.1 4.5 4.1                 | VFA  73 69 69 79 67 73 77 73 75 69 77 73 71                   | STAB  1498 1622 1560 1738 1716 1888 2064 1960 1685 1888 1981 1934 1669 1872                          | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14                | SPGR  2.36 2.33 2.35 2.38 2.34 2.36 2.37 2.36 2.37 2.33 2.37 2.36 2.37 2.36 2.37                          | VOID  3.3 4.5 3.7 2.5 4.1 3.3 2.9 3.3 2.9 3.3 4.5 2.9 3.3 4.1 3.7                     | VFA 77 71 75 82 73 77 79 77 79 77 79 71 79 77 75          | STAB<br>1674<br>1763<br>1747<br>2064<br>1919<br>2129<br>2323<br>2226<br>1885<br>1841<br>2161<br>2177<br>1607<br>1825                 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14                | SPGR  2.34 2.32 2.37 2.31 2.33 2.35 2.33 2.35 2.31 2.36 2.34 2.33 2.35                | VOID 4.1 4.9 2.9 5.3 4.5 3.7 4.5 3.7 5.3 3.3 4.1 4.5 3.7              | VFA 73 69 79 67 71 75 71 75 71 75 77                 | STAB<br>1466<br>1310<br>1170<br>1711<br>1310<br>1513<br>1669<br>1607<br>1373<br>1498<br>1888<br>1716<br>1498<br>1747                 |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15             | SPGR  2.34 2.32 2.32 2.37 2.31 2.34 2.36 2.34 2.35 2.36 2.34 2.36 2.34 2.36 2.34 2.36  | VOID  4.1 4.9 4.9 2.9 5.3 4.1 3.3 4.1 3.7 4.9 3.3 4.1 4.5 4.1 3.3             | VFA 73 69 79 67 73 77 73 75 69 77 73 71 73 71                 | STAB  1498 1622 1560 1738 1716 1888 2064 1960 1685 1888 1981 1934 1669 1872 1836                     | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15             | SPGR  2.36 2.33 2.35 2.38 2.34 2.36 2.37 2.36 2.37 2.36 2.37 2.36 2.37                                    | VOID  3.3 4.5 3.7 2.5 4.1 3.3 2.9 3.3 2.9 4.5 2.9 3.3 4.1 3.7 2.9                     | VFA 77 71 75 82 73 77 79 77 79 71 79 71 79 71 79 77       | STAB 1674 1763 1747 2064 1919 2129 2323 2226 1885 1841 2161 2177 1607 1825 2048  | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14                | SPGR  2.34 2.32 2.37 2.31 2.33 2.35 2.35 2.31 2.36 2.34 2.33 2.35 2.34                | VOID  4.1 4.9 4.9 5.3 4.5 3.7 4.5 3.7 4.5 3.7 5.3 3.1 4.1 4.5 3.7 4.1 | VFA 73 69 79 67 71 75 71 75 77 73 71 75 73           | STAB<br>1466<br>1310<br>1170<br>1711<br>1310<br>1513<br>1669<br>1607<br>1373<br>1498<br>1888<br>1716<br>1498<br>1747<br>1685         |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16          | SPGR  2.34 2.32 2.32 2.37 2.31 2.34 2.36 2.34 2.35 2.32 2.36 2.34 2.36 2.34 2.33 2.34 2.36 2.34  | VOID  4.1 4.9 4.9 2.9 5.3 4.1 3.3 4.1 3.7 4.9 3.3 4.1 4.5 4.1 3.3 4.1         | VFA 73 69 69 77 73 75 69 77 73 75 77 73 71 73 77              | STAB  1498 1622 1560 1738 1716 1888 2064 1960 1685 1888 1981 1934 1669 1872 1836 1966                | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15             | SPGR  2.36 2.33 2.35 2.38 2.34 2.36 2.37 2.36 2.37 2.33 2.37 2.36 2.37 2.35                               | VOID  3.3 4.5 3.7 2.5 4.1 3.3 2.9 3.3 2.9 3.3 2.9 3.7                                 | VFA 77 71 75 82 73 77 79 77 79 71 79 71 79 75 75 75       | STAB<br>1674<br>1763<br>1747<br>2064<br>1919<br>2129<br>2323<br>2226<br>1885<br>1841<br>2161<br>2177<br>1607<br>1825<br>2048<br>2044 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16          | SPGR  2.34 2.32 2.37 2.31 2.33 2.35 2.35 2.31 2.36 2.34 2.33 2.35 2.34 2.34           | VOID 4.1 4.9 4.9 5.3 4.5 3.7 4.5 3.7 5.3 4.1 4.5 3.7 4.1              | VFA  73 69 69 79 67 71 75 71 75 71 75 77 73 71 75 73 | STAB<br>1466<br>1310<br>1170<br>1711<br>1310<br>1513<br>1669<br>1607<br>1373<br>1498<br>1888<br>1716<br>1498<br>1747<br>1685<br>1903 |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17       | SPGR  2.34 2.32 2.37 2.31 2.34 2.36 2.34 2.35 2.36 2.34 2.33 2.34 2.33 2.34 2.33 2.34 2.35   | VOID  4.1 4.9 4.9 5.3 4.1 3.3 4.1 3.7 4.9 3.3 4.1 4.5 4.1 3.7                 | VFA 73 69 69 77 73 77 73 71 73 71 73 75                       | STAB  1498 1622 1560 1738 1716 1888 2064 1960 1685 1888 1981 1934 1669 1872 1836 1966 1716           | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17       | SPGR  2.36 2.33 2.35 2.38 2.34 2.36 2.37 2.36 2.37 2.36 2.37 2.36 2.37 2.35 2.37 2.35                     | VOID  3.3 4.5 3.7 2.5 4.1 3.3 2.9 3.3 4.5 2.9 3.3 4.1 3.7 2.9 3.7 3.3                 | VFA 77 71 75 82 73 77 79 77 79 77 79 77 79 77 77 77 77 77 | STAB  1674 1763 1747 2064 1919 2129 2323 2226 1885 1841 2161 2177 1607 1825 2048 2044 1841   | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17       | SPGR  2.34 2.32 2.37 2.31 2.33 2.35 2.33 2.36 2.34 2.33 2.35 2.34 2.34 2.34           | VOID  4.1 4.9 4.9 5.3 4.5 3.7 4.5 3.7 4.5 3.7 4.1 4.1 4.1             | VFA 73 69 69 79 67 71 75 67 77 73 71 75 73 71        | STAB  1466 1310 1170 1711 1310 1513 1669 1607 1373 1498 1888 1716 1498 1747 1685 1903 1622   |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18    | SPGR  2.34 2.32 2.37 2.31 2.34 2.36 2.34 2.36 2.34 2.33 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 | VOID  4.1 4.9 4.9 2.9 5.3 4.1 3.3 4.1 3.7 4.9 3.3 4.1 4.5 4.1 3.3 4.1 3.7 4.5 | VFA  73 69 69 79 67 73 77 73 71 73 71 73 71 73 71             | STAB  1498 1622 1560 1738 1716 1888 2064 1960 1685 1888 1981 1934 1669 1872 1836 1966 1716 1997      | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18    | SPGR  2.36 2.33 2.35 2.38 2.34 2.36 2.37 2.36 2.37 2.36 2.37 2.36 2.37 2.36 2.37 2.35 2.37                | VOID  3.3 4.5 3.7 2.5 4.1 3.3 2.9 3.3 2.9 3.3 4.1 3.7 2.9 3.3 4.1 3.7 2.9 3.7 3.3 3.7 | VFA 77 71 75 82 73 77 79 77 79 77 79 77 77 77 77 77 77 77 | STAB  1674 1763 1747 2064 1919 2129 2323 2226 1885 1841 2161 2177 1607 1825 2048 2044 1841 1779                                      | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18    | SPGR  2.34 2.32 2.37 2.31 2.33 2.35 2.33 2.35 2.34 2.34 2.34 2.34 2.34 2.33           | VOID  4.1 4.9 4.9 5.3 4.5 3.7 4.5 3.7 4.5 3.7 4.1 4.5 4.1 4.1         | VFA 73 69 69 79 67 71 75 67 77 73 71 75 73 71        | STAB  1466 1310 1170 1711 1310 1513 1669 1607 1373 1498 1888 1716 1498 1747 1685 1903 1602 1622                                      |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 | SPGR  2.34 2.32 2.37 2.31 2.34 2.36 2.34 2.35 2.34 2.36 2.34 2.33 2.34 2.36 2.34 2.33 2.34 2.36 2.34 2.35 2.31   | VOID  4.1 4.9 4.9 2.9 5.3 4.1 3.3 4.1 3.7 4.5 4.1 3.3 4.1 5.3                 | VFA  73 69 69 79 67 73 77 73 75 69 77 73 71 73 71 73 71 73 75 | STAB  1498 1622 1560 1738 1716 1888 2064 1960 1685 1888 1981 1934 1669 1872 1836 1966 1716 1997 1466 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 | SPGR  2.36 2.33 2.35 2.38 2.34 2.36 2.37 2.36 2.37 2.36 2.37 2.36 2.37 2.36 2.37 2.36 2.37 2.36 2.37 2.38 | VOID  3.3 4.5 3.7 2.5 4.1 3.3 2.9 3.3 2.9 3.3 4.1 3.7 2.9 3.3 4.1 3.7 4.5             | VFA 77 71 75 82 73 77 79 77 79 77 79 77 75 75 77          | STAB  1674 1763 1747 2064 1919 2129 2323 2226 1885 1841 2161 2177 1607 1825 2048 2044 1841 1779 1685                                 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 | SPGR  2.34 2.32 2.37 2.31 2.33 2.35 2.35 2.31 2.36 2.34 2.33 2.35 2.34 2.33 2.35 2.31 | VOID 4.1 4.9 4.9 5.3 4.5 3.7 4.5 3.7 4.5 3.7 4.1 4.5 5.3              | VFA 73 69 69 79 67 71 75 71 75 77 73 71 75 73 71 67  | STAB  1466 1310 1170 1711 1310 1513 1669 1607 1373 1498 1747 1685 1903 1622 1622 1217  |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18    | SPGR  2.34 2.32 2.37 2.31 2.34 2.36 2.34 2.36 2.34 2.33 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 2.36 2.34 | VOID  4.1 4.9 4.9 2.9 5.3 4.1 3.3 4.1 3.7 4.9 3.3 4.1 4.5 4.1 3.3 4.1 3.7 4.5 | VFA  73 69 69 79 67 73 77 73 71 73 71 73 71 73 71             | STAB  1498 1622 1560 1738 1716 1888 2064 1960 1685 1888 1981 1934 1669 1872 1836 1966 1716 1997      | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18    | SPGR  2.36 2.33 2.35 2.38 2.34 2.36 2.37 2.36 2.37 2.36 2.37 2.36 2.37 2.36 2.37 2.35 2.37                | VOID  3.3 4.5 3.7 2.5 4.1 3.3 2.9 3.3 2.9 3.3 4.1 3.7 2.9 3.3 4.1 3.7 2.9 3.7 3.3 3.7 | VFA 77 71 75 82 73 77 79 77 79 77 79 77 77 77 77 77 77 77 | STAB  1674 1763 1747 2064 1919 2129 2323 2226 1885 1841 2161 2177 1607 1825 2048 2044 1841 1779                                      | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18    | SPGR  2.34 2.32 2.37 2.31 2.33 2.35 2.33 2.35 2.34 2.34 2.34 2.34 2.34 2.33           | VOID  4.1 4.9 4.9 5.3 4.5 3.7 4.5 3.7 4.5 3.7 4.1 4.5 4.1 4.1         | VFA 73 69 69 79 67 71 75 67 77 73 71 75 73 71        | STAB  1466 1310 1170 1711 1310 1513 1669 1607 1373 1498 1888 1716 1498 1747 1685 1903 1602 1622                                      |

TABLE A-3
MIX TYPE 1 - ASPHALT S

| SC  | URCE=P   | TYPE=1  | ASPH=   | S  | SOL   | JRCE=D1  | TYPE = 1   | ASPH=   | S  | SOU   | RCE=D2   | TYPE = 1  | ASPH≃  | s   |
|---|--|---|---|--|---|--|--|---|--|---|--|---|--|---|
| SAMPLE  | SPGR   | VOID  | VFA   | STAB   | SAMPLE  | SPGR   | VOID   | VFA   | STAB   | SAMPLE  | SPGR   | VOID  | VFA  | STAB  |
| 1   | 2.31   | 4.5   | 74  | 1983   | 1   | 2.29   | 5.4  | 70  | 2287   | 1   | 2.28   | 5.8   | 68   | 2199  |
| 2   | 2.32   | 4.1   | 75  | 1804   | 2   | 2.30   | 5.0  | 71  | 2064   | 2   | 2.29   | 5.4   | 70   | 2064  |
| 3   | 2.30   | 5.0   | 71  | 1874   | 3   | 2.29   | 5.4  | 70  | 2122   | 3   | 2.29   | 5.4   | 70   | 2122  |
| 4   | 2.32   | 4.1   | 75  | 1579   | 4   | 2.31   | 4.5  | 74  | 2311   | 4   | 2.32   | 4.1   | 75   | 2152  |
| 5   | 2.31   | 4.5   | 74  | 2417   | 5   | 2.27   | 6.2  | 66  | 2244   | 5   | 2.28   | 5.8   | 68   | 1611  |
| 6   | 2.30   | 5.0   | 71  | 1852   | 6   | 2.28   | 5.8  | 68  | 2366   | 6   | 2.30   | 5.0   | 7 1  | 2747  |
| 7   | 2.31   | 4.5   | 74  | 2506   | 7   | 2.28   | 5.8  | 68  | 2688   | 7   | 2.29   | 5.4   | 70   | 2425  |
| 8   | 2.27   | 6.2   | 66  | 1516   | 8   | 2.25   | 7.0  | 64  | 2349   | 8   | 2.26   | 6.6   | 65   | 2667  |
| 9   | 2.33   | 3.7   | 77  | 1993   | 9   | 2.30   | 5.0  | 71  | 2827   | 9   | 2.31   | 4.5   | 74   | 2533  |
| 10  | 2.30   | 5.0   | 71  | 2359   | 10  | 2.29   | 5.4  | 70  | 2835   | 10  | 2.30   | 5.0   | 71   | 2916  |
| 1 1   | 2.31   | 4.5   | 74  | 2329   | 11  | 2.27   | 6.2  | 66  | 2668   | 1 1   | 2.28   | 5.8   | 68   | 2843  |
| 12  | 2.31   | 4.5   | 74  | 2124   | 12  | 2.29   | 5.4  | 70  | 2763   | 12  | 2.29   | 5.4   | 70   | 282   |
| 13  | 2.30   | 5.0   | 71  | 2328   | 13  | 2.27   | 6.2  | 66  | 226C   | 13  | 2.28   | 5.8   | 68   | 2459  |
| 14  | 2.31   | 4.5   | 74  | 2172   | 14  | 2.27   | 6.2  | 66  | 2436   | 1.4   | 2.28   | 5.8   | 68   | 2939  |
| 15  | 2.33   | 3.7   | 77  | 1779   | 15  | 2.31   | 4.5  | 74  | 235C   | 15  | 2.32   | 4.1   | 75   | 2270  |
| 16  | 2.33   | 3.7   | 77  | 1821   | 16  | 2.30   | 5.0  | 71  | 2718   | 16  | 2.29   | 5.4   | 70   | 2596  |
| 17  | 2.30   | 5.0   | 71  | 1916   | 17  | 2.27   | 6.2  | 66  | 2420   | 17  | 2.28   | 5.8   | 68   | 2901  |
| 18  | 2.32   | 4.1   | 75  | 1670   | 18  | 2.27   | 6.2  | 66  | 2405   | 18  | 2.28   | 5.8   | 68   | 2878  |
| 19  | 2.33   | 3.7   | 7.7   | 1697   | 19  | 2.30   | 5.0  | 71  | 2843   | 19  | 2.29   | 5.4   | 70   | 2644  |
| 20  | 2.30   | 5.0   | 71  | 1656   | 20  | 2.29   | 5.4  | 70  | 2922   | 20  | 2.30   | 5.0   | 71   | 2922  |
|   |  |   |   |  |   |  |  |   |  |   |  |   |  |   |
| SOU   | IRCE=R1  | TYPE = 1  | ASPH=   | \$   | - · \$0U  | RCE≂R2   | TYPE=1   | ASPH=   | S  | SOL   | IRCE=R3  | TYPE = 1  | ASPH=  | s   |
| SOU<br>SAMPLE                                     | IRCE=R1<br>SPGR  | TYPE = 1  | ASPH=   | S  | SAMPLE  | RCE=R2<br>SPGR   | TYPE=1   | ASPH=   | S  | SOU   | IRCE=R3<br>SPGR  | TYPE=1  | ASPH=<br>VFA                                     | STAB  |
|   |  |   |   |  |   | SPGR   | VOID   |   |  |   |  |   |  |   |
| SAMPLE  | SPGR   | VOID  | VFA   | STAB   | SAMPLE  | SPGR<br>2.27   | V0ID<br>6.2  | VFΔ   | STAB   | SAMPLE  | SPGR   | VOID  | VFA  | STAB  |
| SAMPLE<br>1                                       | SPGR<br>2.29   | V0ID<br>5.4   | VFA<br>70   | STAB<br>1650   | SAMPLE<br>1<br>2                                    | SPGR<br>2.27<br>2.28   | VOID<br>6.2<br>5.8   | VFA<br>6G                                     | STAB<br>1620   | SAMPLE<br>1                                       | SPGR<br>2.29   | V01D<br>5.4   | VFA<br>70  | STAB<br>1695  |
| SAMPLE<br>1<br>2                                  | SPGR<br>2.29<br>2.31   | VOID<br>5.4<br>4.5                                    | VFA<br>70<br>74   | STAB<br>1650<br>2621   | SAMPLE<br>1<br>2<br>3                               | SPGR<br>2.27<br>2.28<br>2.27   | VOID<br>6.2<br>5.8<br>6.2  | VFA<br>66<br>68                               | STAB<br>1620<br>2205   | SAMPLE<br>1<br>2                                  | SPGR<br>2.29<br>2.31   | VOID<br>5.4<br>4.5  | VFA<br>70<br>74                                  | STAB<br>1695<br>2340  |
| SAMPLE<br>1<br>2<br>3                             | SPGR<br>2.29<br>2.31<br>2.29   | VOID<br>5.4<br>4.5<br>5.4                             | VFA<br>70<br>74<br>70                                   | STAB<br>1650<br>2621<br>2605   | SAMPLE<br>1<br>2                                    | SPGR 2.27 2.28 2.27 2.30   | VOID<br>6.2<br>5.8   | VFA<br>66<br>68<br>66                         | STAB<br>1620<br>2205<br>2130   | SAMPLE<br>1<br>2<br>3                             | SPGR<br>2.29<br>2.31<br>2.29   | VOID<br>5.4<br>4.5<br>5.4                                 | VFA<br>70<br>74<br>70                            | STAB<br>1695<br>2340<br>1825  |
| SAMPLE  1 2 3 4                                   | SPGR<br>2.29<br>2.31<br>2.29<br>2.31                                   | VOID<br>5.4<br>4.5<br>5.4<br>4.5                      | VFA<br>70<br>74<br>70<br>74                             | STAB<br>1650<br>2621<br>2605<br>2293   | SAMPLE<br>1<br>2<br>3<br>4<br>5                     | SPGR 2.27 2.28 2.27 2.30 2.27  | VOID 6.2 5.8 6.2 5.0 6.2   | VFA<br>66<br>68<br>66<br>71                   | STAB<br>1620<br>2205<br>2130<br>2028   | SAMPLE  1 2 3 4                                   | SPGR<br>2.29<br>2.31<br>2.29<br>2.29   | VOID 5.4 4.5 5.4 5.4                                      | VFA<br>70<br>74<br>70<br>70                      | STAB<br>1695<br>2340<br>1825<br>2090  |
| SAMPLE<br>1 2 3 4 5                               | SPGR<br>2.29<br>2.31<br>2.29<br>2.31<br>2.28                           | VOID 5.4 4.5 5.4 4.5 5.8                              | VFA 70 74 70 74 68                                      | STAB<br>1650<br>2621<br>2605<br>2293<br>2100   | SAMPLE<br>1<br>2<br>3<br>4                          | SPGR 2.27 2.28 2.27 2.30 2.27 2.28   | VOID 6.2 5.8 6.2 5.0 6.2 5.8                                     | VFA<br>66<br>68<br>66<br>71<br>66             | STAB<br>1620<br>2205<br>2130<br>2028<br>2370   | SAMPLE<br>1<br>2<br>3<br>4<br>5                   | SPGR 2.29 2.31 2.29 2.29 2.26  | VOID 5.4 4.5 5.4 5.4 6.6                                  | VFA<br>70<br>74<br>70<br>70<br>65                | STAB<br>1695<br>2340<br>1825<br>2090<br>1980<br>2220<br>2100                                    |
| SAMPLE  1 2 3 4 5 6                               | SPGR 2.29 2.31 2.29 2.31 2.28 2.28                                     | VOID 5.4 4.5 5.4 4.5 5.8 5.8                          | VFA 70 74 70 74 68 68                                   | STAB<br>1650<br>2621<br>2605<br>2293<br>2100<br>2670   | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7           | SPGR 2.27 2.28 2.27 2.30 2.27 2.28 2.27  | VOID 6.2 5.8 6.2 5.0 6.2   | VFA 66 68 66 71 66 68                         | STAB<br>1620<br>2205<br>2130<br>2028<br>2370<br>2325                                       | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6              | SPGR 2.29 2.31 2.29 2.29 2.26 2.26   | VOID 5.4 4.5 5.4 5.4 6.6 6.6                              | VFA 70 74 70 70 65                               | STAB<br>1695<br>2340<br>1825<br>2090<br>1980<br>2220<br>2100<br>2100                            |
| SAMPLE  1 2 3 4 5 6 7                             | SPGR 2.29 2.31 2.29 2.31 2.28 2.28 2.28                                | VOID 5.4 4.5 5.4 4.5 5.8 5.8 5.8                      | VFA 70 74 70 74 68 68 68                                | STAB<br>1650<br>2621<br>2605<br>2293<br>2100<br>2670<br>2550   | SAMPLE  1 2 3 4 5 6 7 8                             | SPGR 2.27 2.28 2.27 2.30 2.27 2.28 2.27 2.23   | VOID 6.2 5.8 6.2 5.0 6.2 5.8 6.2                                 | VFA 66 68 66 71 66 68 66                      | STAB<br>1620<br>2205<br>2130<br>2028<br>2370<br>2325<br>2355                               | SAMPLE  1 2 3 4 5 6 7                             | SPGR 2.29 2.31 2.29 2.29 2.26 2.26 2.26  | VOID 5.4 4.5 5.4 5.4 6.6 6.6 6.6                          | VFA 70 74 70 70 65 65 65                         | STAB<br>1695<br>2340<br>1825<br>2090<br>1980<br>2220<br>2100                                    |
| SAMPLE  1 2 3 4 5 6 7 8                           | SPGR 2.29 2.31 2.29 2.31 2.28 2.28 2.28 2.25                           | VOID 5.4 4.5 5.4 4.5 5.8 5.8 5.8 7.0                  | VFA 70 74 70 74 68 68 68 68                             | STAB<br>1650<br>2621<br>2605<br>2293<br>2100<br>2670<br>2550<br>2670   | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9 | SPGR 2.27 2.28 2.27 2.30 2.27 2.28 2.27 2.23 2.29  | VOID 6.2 5.8 6.2 5.0 6.2 5.8 6.2 7.9                             | VFA 66 68 66 71 66 68 66 60                   | STAB<br>1620<br>2205<br>2130<br>2028<br>2370<br>2325<br>2355<br>2280                       | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8    | SPGR 2.29 2.31 2.29 2.29 2.26 2.26 2.26 2.25   | VOID 5.4 4.5 5.4 5.4 6.6 6.6 6.6 7.0                      | VFA 70 74 70 70 65 65 65 64                      | STAB<br>1695<br>2340<br>1825<br>2090<br>1980<br>2220<br>2100<br>2100                            |
| SAMPLE  1 2 3 4 5 6 7 8 9                         | SPGR 2.29 2.31 2.29 2.31 2.28 2.28 2.28 2.28 2.25 2.31                 | VOID 5.4 4.5 5.4 4.5 5.8 5.8 5.8 7.0 4.5              | VFA 70 74 70 74 68 68 68 64 71                          | STAB<br>1650<br>2621<br>2605<br>2293<br>2100<br>2670<br>2550<br>2670<br>2636                                 | SAMPLE  1 2 3 4 5 6 7 8 9 10                        | SPGR 2.27 2.28 2.27 2.30 2.27 2.28 2.27 2.28 2.27 2.29 2.27                                | VOID 6.2 5.8 6.2 5.0 6.2 5.8 6.2 5.4 6.2                         | VFA 66 68 66 68 66 60 70                      | STAB<br>1620<br>2205<br>2130<br>2028<br>2370<br>2325<br>2355<br>2280<br>2160               | SAMPLE  1 2 3 4 5 6 7 8 9                         | SPGR  2.29 2.31 2.29 2.26 2.26 2.26 2.25 2.29  | VOID 5.4 4.5 5.4 5.4 6.6 6.6 6.6 7.0 5.4                  | VFA 70 74 70 70 65 65 64 70                      | STAB 1695 2340 1825 2090 1980 2220 2100 2100 2055   |
| SAMPLE  1 2 3 4 5 6 7 8 9                         | SPGR  2.29 2.31 2.29 2.31 2.28 2.28 2.28 2.28 2.28 2.28                | VOID  5.4 4.5 5.4 4.5 5.8 5.8 7.0 4.5 5.8             | VFA 70 74 70 74 68 68 68 64 71 68                       | STAB  1650 2621 2605 2293 2100 2670 2550 2670 2636 2877  | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9 | SPGR 2.27 2.28 2.27 2.30 2.27 2.28 2.27 2.28 2.27 2.23 2.29 2.27 2.27                      | VOID 6.2 5.8 6.2 5.0 6.2 5.8 6.2 7.9 5.4                         | VFA 66 68 66 71 66 68 66 70 66                | STAB  1620 2205 2130 2028 2370 2325 2355 2280 2160 2250                                    | SAMPLE  1 2 3 4 5 6 7 8 9                         | SPGR  2.29 2.31 2.29 2.26 2.26 2.26 2.25 2.29 2.28 2.28 2.28                               | VOID 5.4 4.5 5.4 6.6 6.6 6.6 7.0 5.4 5.8 5.8              | VFA 70 74 70 65 65 65 64 70 68 68                | STAB  1695 2340 1825 2090 1980 2220 2100 2100 2055 2324 2235 1885                               |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11                   | SPGR  2.29 2.31 2.29 2.31 2.28 2.28 2.28 2.25 2.31 2.28 2.25 2.31 2.28 | VOID  5.4 4.5 5.8 5.8 7.0 4.5 5.8 5.8 5.8             | VFA 70 74 68 68 68 64 71 68 70                          | STAB  1650 2621 2605 2293 2100 2670 2550 2670 2636 2877 2385   | SAMPLE  1 2 3 4 5 6 7 8 9 10 11                     | SPGR 2.27 2.28 2.27 2.30 2.27 2.28 2.27 2.28 2.27 2.29 2.27                                | VOID 6.2 5.8 6.2 5.0 6.2 5.8 6.2 7.9 5.4 6.2 6.2                 | VFA 66 68 66 71 66 68 66 70 66 66             | STAB  1620 2205 2130 2028 2370 2325 2355 2280 2160 2250 2400                               | SAMPLE  1 2 3 4 5 6 7 8 9 10 11                   | SPGR  2.29 2.31 2.29 2.26 2.26 2.26 2.25 2.29 2.28 2.28                                    | VOID 5.4 4.5 5.4 6.6 6.6 7.0 5.4 5.8 5.8 6.6              | VFA 70 74 70 65 65 65 64 70 68 68 68 68          | STAB  1695 2340 1825 2090 1980 2220 2100 2100 2055 2324 2235 1885 1725                          |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12                | SPGR  2.29 2.31 2.29 2.31 2.28 2.28 2.28 2.28 2.29 2.29                | VOID  5.4 4.5 5.8 5.8 5.8 5.8 5.8 5.8 5.4 5.4         | VFA 70 74 70 74 68 68 68 64 71 68 70 70                 | STAB  1650 2621 2605 2293 2100 2670 2550 2670 2636 2877 2385 2714  | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13               | SPGR  2.27 2.28 2.27 2.30 2.27 2.28 2.27 2.23 2.29 2.27 2.27 2.28 2.27 2.28 2.27           | VOID 6.2 5.8 6.2 5.0 6.2 5.8 6.2 7.9 5.4 6.2 5.4 6.2 5.8 6.6     | VFA 66 68 66 71 66 68 60 70 66 68             | STAB  1620 2205 2130 2028 2370 2325 2355 2280 2160 2250 2400 2205                          | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12                | SPGR  2.29 2.31 2.29 2.26 2.26 2.26 2.25 2.29 2.28 2.28 2.28                               | VOID 5.4 4.5 5.4 6.6 6.6 6.6 7.0 5.4 5.8 5.8              | VFA 70 74 70 65 65 65 64 70 68 68                | STAB  1695 2340 1825 2090 1980 2220 2100 2100 2055 2324 2235 1885 1725 1905                     |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13             | SPGR  2.29 2.31 2.28 2.28 2.28 2.25 2.31 2.28 2.29 2.29 2.27           | VOID  5.4 4.5 5.8 5.8 5.8 7.0 4.5 5.4 6.2             | VFA 70 74 68 68 68 64 71 68 70 70 66                    | STAB<br>1650<br>2621<br>2605<br>2293<br>2100<br>2670<br>2550<br>2670<br>2636<br>2877<br>2385<br>2714<br>2520 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14            | SPGR  2.27 2.28 2.27 2.30 2.27 2.28 2.27 2.23 2.29 2.27 2.27 2.28 2.26 2.26                | VOID 6.2 5.8 6.2 5.0 6.2 5.8 6.2 7.9 5.4 6.2 6.2 5.8             | VFA 66 68 66 67 66 68 66 68 65                | STAB  1620 2205 2130 2028 2370 2325 2355 2280 2160 2250 2400 2205 2250                     | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13             | SPGR  2.29 2.31 2.29 2.26 2.26 2.26 2.25 2.29 2.28 2.28 2.28 2.28                          | VOID 5.4 4.5 5.4 6.6 6.6 7.0 5.4 5.8 5.8 6.6              | VFA 70 74 70 65 65 65 64 70 68 68 68 65 65 75    | STAB 1695 2340 1825 2090 1980 2220 2100 2100 2055 2324 2235 1885 1725 1905 1919                 |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14          | SPGR  2.29 2.31 2.28 2.28 2.28 2.25 2.31 2.28 2.25 2.31 2.28 2.27 2.27 | VOID  5.4 4.5 5.8 5.8 5.8 7.0 4.5 5.8 5.4 6.2 6.2     | VFA 70 74 70 74 68 68 68 64 71 68 70 70 66 66           | STAB  1650 2621 2605 2293 2100 2670 2550 2670 2636 2877 2385 2714 2520 3304                                  | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13               | SPGR  2.27 2.28 2.27 2.30 2.27 2.28 2.27 2.23 2.29 2.27 2.28 2.27 2.27 2.28 2.26 2.31      | VOID 6.2 5.8 6.2 5.0 6.2 5.8 6.2 7.9 5.4 6.2 5.8 6.6 6.6         | VFA 66 68 66 71 66 68 60 70 66 68 65 65       | STAB  1620 2205 2130 2028 2370 2325 2355 2280 2160 2250 2400 2205 2250 2656                | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14          | SPGR  2.29 2.31 2.29 2.26 2.26 2.26 2.25 2.28 2.28 2.28 2.28 2.28 2.28 2.29 2.28 2.29 2.29 | VOID  5.4 4.5 5.4 5.4 6.6 6.6 6.7 5.4 5.8 5.8 6.6 6.1 5.4 | VFA 70 74 70 75 65 65 64 70 68 68 68 65 75       | STAB  1695 2340 1825 2090 1980 2220 2100 2100 2055 2324 2235 1885 1725 1905 1919 1860           |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 | SPGR  2.29 2.31 2.28 2.28 2.28 2.28 2.29 2.27 2.27 2.33 2.30 2.28      | VOID  5.4 4.5 5.8 5.8 5.8 5.8 5.4 6.2 6.2 6.2 5.8     | VFA  70  74  68  68  68  71  68  70  70  66  67  71  68 | STAB  1650 2621 2605 2293 2100 2670 2550 2670 2636 2877 2385 2714 2520 3304 2512 3026 2656                   | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15         | SPGR  2.27 2.28 2.27 2.30 2.27 2.28 2.27 2.23 2.29 2.27 2.27 2.28 2.26 2.26                | VOID 6.2 5.8 6.2 5.0 6.2 5.8 6.2 7.9 5.4 6.2 6.8 6.6 4.5         | VFA 66 68 66 71 66 68 60 70 66 68 65 65 74    | STAB  1620 2205 2130 2028 2370 2325 2355 2280 2160 2250 2400 2205 2250 2656 2278           | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 | SPGR  2.29 2.31 2.29 2.26 2.26 2.26 2.28 2.28 2.28 2.28 2.28                               | VOID 5.4 4.5 5.4 6.6 6.6 7.0 5.8 5.8 6.6 4.1 5.2          | VFA 70 74 70 65 65 65 64 70 68 68 68 65 75 70 66 | STAB  1695 2340 1825 2090 1980 2220 2100 2100 2055 2924 2235 1885 1725 1905 1919 1860 2086      |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16    | SPGR  2.29 2.31 2.29 2.31 2.28 2.28 2.28 2.29 2.27 2.27 2.33 2.30      | VOID  5.4 4.5 5.8 5.8 5.8 5.4 4.5 5.8 6.2 6.2 3.7 5.0 | VFA  70 74 70 74 68 68 68 71 68 70 70 66 77 71          | STAB  1650 2621 2605 2293 2100 2670 2550 2670 2636 2877 2385 2714 2520 3304 2512 3026                        | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16      | SPGR  2.27 2.28 2.27 2.30 2.27 2.28 2.27 2.28 2.27 2.23 2.29 2.27 2.28 2.26 2.31 2.28 2.25 | VOID 6.2 5.8 6.2 5.0 6.2 5.8 6.2 7.9 5.4 6.2 5.6 6.6 6.5 5.8     | VFA 66 68 66 71 66 68 60 70 66 68 65 67 74 68 | STAB  1620 2205 2130 2028 2370 2325 2355 2280 2160 2250 2400 2205 2250 2656 2278 2416      | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16    | SPGR  2.29 2.31 2.29 2.26 2.26 2.26 2.25 2.28 2.28 2.28 2.28 2.28 2.28 2.29 2.28 2.29 2.29 | VOID  5.4 4.5 5.4 5.4 6.6 6.6 6.7 5.4 5.8 5.8 6.6 6.1 5.4 | VFA 70 74 70 75 65 65 64 70 68 68 68 65 75       | STAB  1695 2340 1825 2090 1980 2220 2100 2100 2055 2324 2235 1885 1725 1905 1919 1860 2086 2205 |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 | SPGR  2.29 2.31 2.28 2.28 2.28 2.28 2.29 2.27 2.27 2.33 2.30 2.28      | VOID  5.4 4.5 5.8 5.8 5.8 5.8 5.4 6.2 6.2 6.2 5.8     | VFA  70  74  68  68  68  71  68  70  70  66  67  71  68 | STAB  1650 2621 2605 2293 2100 2670 2550 2670 2636 2877 2385 2714 2520 3304 2512 3026 2656                   | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17   | SPGR  2.27 2.28 2.27 2.30 2.27 2.28 2.27 2.29 2.27 2.27 2.28 2.26 2.31 2.28                | VOID 6.2 5.2 5.2 5.2 5.2 5.2 5.2 5.2 6.2 5.3 6.2 5.3 6.5 6.5 7.0 | VFA 66 68 66 71 66 68 66 70 66 68 65 74 68 64 | STAB  1620 2205 2130 2028 2370 2325 2355 2280 2160 2250 2400 2205 2250 2656 2278 2416 2265 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 | SPGR  2.29 2.31 2.29 2.26 2.26 2.26 2.28 2.28 2.28 2.28 2.28                               | VOID 5.4 4.5 5.4 6.6 6.6 7.0 5.8 5.8 6.6 4.1 5.2          | VFA 70 74 70 65 65 65 64 70 68 68 68 65 75 70 66 | STAB  1695 2340 1825 2090 1980 2220 2100 2100 2055 2924 2235 1885 1725 1905 1919 1860 2086      |

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TABLE A-4
MIX TYPE 1 - ASPHALT T

| St   | OURCE=P  | TYPE≈1  | ASPH=  | T  | SOL   | IRCE =D 1  | TYPE=1   | ASPH=  | т  | SOL   | JRCE=D2  | TYPE=1   | ASPH=  | T  |
|--|--|---|--|--|---|--|--|--|--|---|--|--|--|--|
| SAMPLE   | SPGR   | VOID  | VFA  | STAB   | SAMPLE  | SPGR   | VOID   | VFA  | STAB   | SAMPLE  | SPGR   | VOID   | VFA  | STAB   |
| 1  | 2.34   | 3.7   | 77   | 1331   | 1   | 2.32   | 4.5  | 73   | 1716   | 1   | 2.32   | 4.5  | 73   | 1814   |
| 2  | .4 32  | 4.5   | 73   | 1299   | 2   | 2.30   | 5.3  | 69   | 1810   | 2   | 2.32   | 4.5  | 73   | 1875   |
| 3  | 2.32   | 4.5   | 73   | 1531   | 3   | 2.29   | 5,8  | 67   | 2043   | 3   | 2.30   | 5.3  | 69   | 1891   |
| 4  | 2.32   | 4.5   | 73   | 1711   | 4   | 2.31   | 4.9  | 71   | 2104   | 4   | 2.30   | 5.3  | 69   | 2485   |
| 5  | 2.33   | 4.1   | 75   | 1974   | 5   | 2.29   | 5.8  | 67   | 2455   | 5   | 2.30   | 5,3  | 69   | 2455   |
| 6  | 2.32   | 4.5   | 73   | 2019   | G   | 2.30   | 5.3  | 69   | 2112   | 6   | 2.29   | 5.8  | 67   | 2005   |
| 7  | 2.33   | 4.1   | 75   | 1774   | 7   | 2.29   | 5.8  | 67   | 1921   | 7   | 2,29   | 5.8  | 67   | 1891   |
| 8  | 2.34   | 3.7   | 77   | 1608   | 8   | 2.31   | 4.9  | 7 1  | 2080   | 8   | 2.30   | 5.3  | 69   | 1982   |
| 9  | 2.32   | 4.5   | 73   | 1489   | 9   | 2.30   | 5.3  | 69   | 2028   | 9   | 2.29   | 5.8  | 67   | 2155   |
| 10   | 2.32   | 4.5   | 73   | 1563   | 10  | 2.30   | 5.3  | 69   | 2013   | 10  | 2.30   | 5.3  | 69   | 2023   |
| 11   | 2.33   | 4.1   | 75   | 1837   | 1.1   | 2.30   | 5.3  | 69   | 2331   | 11  | 2.30   | 5.3  | 69   | 2165   |
| 12   | 2.32   | 4.5   | 73   | 1922   | 12  | 2.29   | 5.8  | 67   | 1936   | 12  | 2.30   | 5.3  | 69   | 2119   |
| 13   | 2.32   | 4.5   | 73   | 1952   | 13  | 2.29   | 5.8  | 67   | 2229   | 13  | 2.28   | 6.2  | 66   | 2118   |
| 14   | 2.32   | 4.5   | 73   | 1780   | 14  | 2.28   | 6.2  | 66   | 2196   | 14  | 2.28   | 6.2  | 66   | 2243   |
| 15   | 2.32   | 4.5   | 73   | 1621   | 15  | 2.29   | 5.8  | 67   | 1921   | 15  | 2.29   | 5.8  | 67   | 1997   |
| 16   | 2.33   | 4.1   | 75   | 1655   | 16  | 2.29   | 5.8  | 67   | 2104   | 16  | 2.30   | 5.3  | 69   |  |
| 17   | 2.33   | 4.1   | 75<br>75   | 1657   | 17  | 2.30   | 5.3  | 69   |  |   | 2.30   |  |  | 1814   |
| 18   | 2.33   | 4.1   | 75   | 1964   | 18  | 2.28   |  | _  | 1830   | 17  |  | 5.8  | 67   | 1862   |
| 19   | 2.33   | 4.1   | 75<br>75   | 1696   | 19  | 2.20   | 6.2  | 66   | 1982   | 18  | 2.29   | 5.8  | 67   | 2229   |
| 20   | 2.33   | 3.7   | 77   | 1452   | 20  | 2.31   | 4.9<br>4.9   | 7 1<br>7 1   | 1845<br>1891   | 19<br>20  | 2.29<br>2.31   | 5.8<br>4.9   | 67<br>71   | 1979   |
|  |  |   |  |  | . •   | -,-,   |  |  | 1001   |   | 2.57   | -7.5   | , ,  | 1860   |
| 501  | URCE=R1  | TYPE=1  | ASPH=  | T  | SOL   | JRCE=R2  | TYPE=1   | ASPH=  | Т  | SOL   | IRCE=R3  | TYPE=1   | ASPH≃  | T  |
| SAMPLE   | SPGR   | VOID  |  |  |   |  |  |  |  |   |  |  |  | 1  |
|  |  | VOID  | VFA  | STAB   | SAMPLE  | SPGR   | VOID   | VFA  | STAB   | SAMPLE  | SPGR   | VOID   | VFΔ  | STAB   |
| - 1  |  | V01D  | VFA  | STAB   |   | SPGR   | VOID   | VFA  | STAB   |   | SPGR   | VOID   | VFA.   |  |
| 1  | 2 2 t  |   |  |  | 1   |  |  |  |  | 1   | ,  | •  |  | STAB   |
| 2  | 2.31   | 4.9   | 71   | 1669   | 1<br>2  | 2.31   | 4.9  | 71   | 1622   | 1 2   | 2.30   | 5.3  | 70   | STAB<br>1530   |
| 2<br>3   | 2.31   | 4.9<br>4.9  | 7 1<br>7 1   | 1669<br>1732   | 1<br>2<br>3   | 2.31   | 4.9<br>5.3   | 71<br>70   | 1622<br>1841   | 1<br>2<br>3   | 2.30<br>2.28   | 5.3<br>6.2   | 70<br>66   | STAB<br>1530<br>1530   |
| 2<br>3<br>4  | 2.31<br>2.29   | 4.9<br>4.9<br>5.8   | 7 1<br>7 1<br>67   | 1669<br>1732<br>2190   | 1<br>2<br>3<br>4  | 2.31<br>2.30<br>2.29   | 4.9<br>5.3<br>5.8  | 71<br>70<br>67   | 1622<br>1841<br>2130   | 1<br>2<br>3<br>4  | 2.30<br>2.28<br>2.28   | 5.3<br>6.2<br>6.2  | 70<br>66<br>66   | STAB<br>1530<br>1530<br>1770   |
| 2<br>3<br>4<br>5   | 2.31<br>2.29<br>2.28   | 4.9<br>4.9<br>5.8<br>6.2  | 71<br>71<br>67<br>66   | 1669<br>1732<br>2190<br>1815   | 1<br>2<br>3<br>4<br>5   | 2.31<br>2.30<br>2.29<br>2.29   | 4.9<br>5.3<br>5.8<br>5.8   | 71<br>70<br>67<br>67   | 1622<br>1841<br>2130<br>2390   | 1<br>2<br>3<br>4<br>5   | 2.30<br>2.28<br>2.28<br>2.28   | 5.3<br>6.2<br>6.2<br>6.2   | 70<br>66<br>66<br>66   | 1530<br>1530<br>1770<br>1845   |
| 2<br>3<br>4<br>5<br>6  | 2.31<br>2.29<br>2.28<br>2.28   | 4.9<br>4.9<br>5.8<br>6.2<br>6.2   | 71<br>71<br>67<br>66<br>66   | 1669<br>1732<br>2190<br>1815<br>2325   | 1<br>2<br>3<br>4<br>5   | 2.31<br>2.30<br>2.29<br>2.29<br>2.30   | 4.9<br>5.3<br>5.8<br>5.8<br>5.3  | 71<br>70<br>67<br>67   | 1622<br>1841<br>2130<br>2390<br>2293   | 1<br>2<br>3<br>4<br>5<br>6  | 2.30<br>2.28<br>2.28<br>2.28<br>2.28   | 5.3<br>6.2<br>6.2<br>6.2<br>6.2  | 70<br>66<br>66<br>66<br>66   | STAB<br>1530<br>1530<br>1770<br>1845<br>1890   |
| 2<br>3<br>4<br>5<br>6<br>7   | 2.31<br>2.29<br>2.28<br>2.28<br>2.29   | 4.9<br>4.9<br>5.8<br>6.2<br>6.2<br>5.8  | 71<br>71<br>67<br>66<br>66<br>67   | 1669<br>1732<br>2190<br>1815<br>2325<br>2184   | 1<br>2<br>3<br>4<br>5<br>6<br>7   | 2.31<br>2.30<br>2.29<br>2.29<br>2.30<br>2.30   | 4.9<br>5.3<br>5.8<br>5.8<br>5.3  | 71<br>70<br>67<br>67<br>70   | 1622<br>1841<br>2130<br>2390<br>2293<br>2527   | 1<br>2<br>3<br>4<br>5<br>6<br>7   | 2.30<br>2.28<br>2.28<br>2.28<br>2.28<br>2.28                                 | 5.3<br>6.2<br>6.2<br>6.2<br>6.2<br>5.8   | 70<br>66<br>66<br>66<br>66   | 1530<br>1530<br>1770<br>1845<br>1890<br>1830   |
| 2<br>3<br>4<br>5<br>6<br>7<br>8  | 2.31<br>2.29<br>2.28<br>2.28<br>2.29<br>2.30   | 4.9<br>4.9<br>5.8<br>6.2<br>6.2<br>5.8<br>5.3   | 71<br>71<br>67<br>66<br>66<br>67   | 1669<br>1732<br>2190<br>1815<br>2325<br>2184<br>1794   | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8  | 2.31<br>2.30<br>2.29<br>2.29<br>2.30<br>2.30<br>2.30   | 4.9<br>5.3<br>5.8<br>5.3<br>5.3<br>5.3   | 71<br>70<br>67<br>67<br>70<br>70   | 1622<br>1841<br>2130<br>2390<br>2293<br>2527<br>2280   | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8  | 2.30<br>2.28<br>2.28<br>2.28<br>2.28<br>2.29<br>2.29                         | 5.3<br>6.2<br>6.2<br>6.2<br>6.2<br>5.8<br>5.8  | 70<br>66<br>66<br>66<br>66<br>67<br>67                               | 51AB<br>1530<br>1530<br>1770<br>1845<br>1890<br>1830   |
| 2<br>3<br>4<br>5<br>6<br>7<br>8<br>9   | 2.31<br>2.29<br>2.28<br>2.28<br>2.29<br>2.30<br>2.29   | 4.9<br>4.9<br>5.8<br>6.2<br>5.8<br>5.3<br>5.8   | 71<br>71<br>67<br>66<br>66<br>67<br>70   | 1669<br>1732<br>2190<br>1815<br>2325<br>2184<br>1794<br>1903   | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9   | 2.31<br>2.30<br>2.29<br>2.29<br>2.30<br>2.30<br>2.30<br>2.30   | 4.9<br>5.8<br>5.8<br>5.3<br>5.3<br>5.8<br>4.9  | 71<br>70<br>67<br>67<br>70<br>70<br>67   | 1622<br>1841<br>2130<br>2390<br>2293<br>2527<br>2280<br>2138   | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9   | 2.30<br>2.28<br>2.28<br>2.28<br>2.28<br>2.29<br>2.29<br>2.29                 | 5.3<br>6.2<br>6.2<br>6.2<br>6.2<br>5.8<br>5.8  | 70<br>66<br>66<br>66<br>66<br>67<br>67<br>66                         | 1530<br>1530<br>1770<br>1845<br>1890<br>1830<br>1530   |
| 2<br>3<br>4<br>5<br>6<br>7<br>8<br>9   | 2.31<br>2.29<br>2.28<br>2.28<br>2.29<br>2.30<br>2.29<br>2.29   | 4.9<br>4.9<br>5.8<br>6.2<br>5.8<br>5.8<br>5.8   | 71<br>71<br>67<br>66<br>66<br>67<br>70<br>67                                     | 1669<br>1732<br>2190<br>1815<br>2325<br>2184<br>1794<br>1903<br>1890   | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9   | 2.31<br>2.30<br>2.29<br>2.29<br>2.30<br>2.30<br>2.31<br>2.31   | 4.9<br>5.8<br>5.8<br>5.3<br>5.8<br>5.3<br>4.9  | 71<br>70<br>67<br>67<br>70<br>70<br>67<br>71   | 1622<br>1841<br>2130<br>2390<br>2293<br>2527<br>2280<br>2138<br>2309   | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9   | 2.30<br>2.28<br>2.28<br>2.28<br>2.28<br>2.29<br>2.29<br>2.29<br>2.28<br>2.28 | 5.3<br>6.2<br>6.2<br>6.2<br>6.2<br>5.8<br>5.8<br>6.2<br>6.2  | 70<br>66<br>66<br>66<br>67<br>67<br>66<br>66                         | 5TAB<br>   |
| 2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10                                     | 2.31<br>2.29<br>2.28<br>2.28<br>2.29<br>2.30<br>2.29<br>2.29<br>2.29   | 4.9<br>4.8<br>5.2<br>5.3<br>5.8<br>5.8<br>5.8<br>5.8  | 71<br>71<br>67<br>66<br>66<br>67<br>70<br>67<br>67                               | 1669<br>1732<br>2190<br>1815<br>2325<br>2184<br>1794<br>1903<br>1890<br>2100   | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10   | 2.31<br>2.30<br>2.29<br>2.30<br>2.30<br>2.30<br>2.31<br>2.31<br>2.31   | 4.93883389955544953  | 71<br>70<br>67<br>67<br>70<br>67<br>70<br>67<br>71<br>71                               | 1622<br>1841<br>2130<br>2390<br>2293<br>2527<br>2280<br>2138<br>2309<br>2309   | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9   | 2.30<br>2.28<br>2.28<br>2.28<br>2.28<br>2.29<br>2.29<br>2.29<br>2.28<br>2.28 | 5.3<br>6.2<br>6.2<br>6.2<br>6.2<br>5.8<br>5.8<br>6.2<br>6.2<br>6.2   | 70<br>66<br>66<br>66<br>67<br>67<br>66<br>66                         | STAB<br>1530<br>1770<br>1845<br>1890<br>1830<br>1530<br>1545<br>1669<br>1885   |
| 2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11                               | 2.31<br>2.29<br>2.28<br>2.28<br>2.29<br>2.30<br>2.29<br>2.29<br>2.29   | 4.9<br>4.9<br>56.2<br>5.8<br>5.8<br>5.8<br>5.8<br>6.2   | 71<br>71<br>67<br>66<br>66<br>67<br>70<br>67<br>67<br>67                         | 1669<br>1732<br>2190<br>1815<br>2325<br>2184<br>1794<br>1903<br>1890<br>2100<br>2190   | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11                                     | 2.31<br>2.30<br>2.29<br>2.29<br>2.30<br>2.30<br>2.31<br>2.31<br>2.30<br>2.29   | 4.9<br>5.8<br>5.8<br>5.3<br>5.3<br>5.8<br>9.9<br>4.9<br>5.8  | 71<br>70<br>67<br>67<br>70<br>70<br>67<br>71<br>71<br>70<br>67                         | 1622<br>1841<br>2130<br>2390<br>2293<br>2527<br>2280<br>2138<br>2309<br>2309<br>2278   | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11   | 2.30<br>2.28<br>2.28<br>2.28<br>2.28<br>2.29<br>2.29<br>2.29<br>2.28<br>2.28 | 5.3<br>6.2<br>6.2<br>6.2<br>6.2<br>5.8<br>5.8<br>6.2<br>6.2<br>6.2<br>6.2                                    | 70<br>66<br>66<br>66<br>67<br>67<br>66<br>66<br>66                   | 5TAB   |
| 2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12                         | 2.31<br>2.29<br>2.28<br>2.28<br>2.30<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29                                 | 4.99<br>5.22<br>5.38<br>5.38<br>5.38<br>5.38<br>5.66<br>6.6   | 71<br>71<br>67<br>66<br>66<br>67<br>70<br>67<br>67<br>67<br>66                   | 1669<br>1732<br>2190<br>1815<br>2325<br>2184<br>1794<br>1903<br>1890<br>2100<br>2190<br>1725                                 | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13                         | 2.31<br>2.30<br>2.29<br>2.29<br>2.30<br>2.30<br>2.31<br>2.31<br>2.31<br>2.31<br>2.30<br>2.29                         | 4.555555544555555555555555555555555555   | 71<br>70<br>67<br>67<br>70<br>70<br>67<br>71<br>71<br>70<br>67                         | 1622<br>1841<br>2130<br>2390<br>2293<br>2527<br>2280<br>2138<br>2309<br>2309<br>2278<br>2153                                 | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13                               | 2.30<br>2.28<br>2.28<br>2.28<br>2.29<br>2.29<br>2.29<br>2.29<br>2.28<br>2.28 | 5.2<br>6.2<br>6.2<br>6.2<br>5.8<br>5.8<br>6.2<br>6.2<br>6.2<br>6.2   | 70<br>66<br>66<br>66<br>67<br>67<br>66<br>66<br>66<br>66             | STAB   |
| 2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13                   | 2.31<br>2.29<br>2.28<br>2.28<br>2.30<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29<br>2.28<br>2.27                         | 4.9982283888268<br>55555665   | 71<br>71<br>67<br>66<br>66<br>67<br>70<br>67<br>67<br>66<br>64<br>67             | 1669<br>1732<br>2190<br>1815<br>2325<br>2184<br>1794<br>1903<br>1890<br>2100<br>2190<br>1725<br>2130                         | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13                         | 2.31<br>2.30<br>2.29<br>2.30<br>2.30<br>2.30<br>2.31<br>2.31<br>2.30<br>2.29<br>2.30<br>2.29<br>2.30                 | 45555555445555555555555555555555555555   | 71<br>70<br>67<br>67<br>70<br>70<br>67<br>71<br>71<br>70<br>67                         | 1622<br>1841<br>2130<br>2390<br>2293<br>2527<br>2280<br>2138<br>2309<br>2309<br>2278<br>2153<br>1923                         | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13                               | 2.30<br>2.28<br>2.28<br>2.28<br>2.29<br>2.29<br>2.29<br>2.28<br>2.28         | 5.2<br>6.2<br>6.2<br>6.8<br>5.8<br>6.2<br>6.2<br>6.2<br>6.2<br>6.6   | 70<br>66<br>66<br>66<br>67<br>66<br>66<br>66<br>64<br>64             | 5TAB   |
| 2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15       | 2.31<br>2.29<br>2.28<br>2.28<br>2.29<br>2.30<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29<br>2.28                                 | 4.9<br>4.9<br>5.2<br>5.2<br>5.8<br>5.8<br>5.8<br>6.9<br>6.9<br>6.9<br>6.9   | 71<br>71<br>67<br>66<br>66<br>67<br>70<br>67<br>67<br>67<br>66<br>64<br>67<br>66 | 1669<br>1732<br>2190<br>1815<br>2325<br>2184<br>1794<br>1903<br>1890<br>2100<br>2190<br>1725<br>2130<br>1890                 | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15             | 2.31<br>2.30<br>2.29<br>2.30<br>2.30<br>2.30<br>2.31<br>2.31<br>2.31<br>2.30<br>2.29<br>2.30<br>2.29<br>2.30         | 4.555555555555555555555555555555555555   | 71<br>70<br>67<br>67<br>70<br>70<br>67<br>71<br>71<br>70<br>67<br>70<br>67             | 1622<br>1841<br>2130<br>2390<br>2293<br>2527<br>2280<br>2138<br>2309<br>2309<br>2278<br>2153<br>1923<br>2250                 | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15                   | 2.30<br>2.28<br>2.28<br>2.28<br>2.29<br>2.29<br>2.29<br>2.28<br>2.28         | 5.3<br>6.2<br>6.2<br>6.2<br>6.8<br>5.8<br>6.2<br>6.2<br>6.6<br>6.6<br>6.2                                    | 70<br>66<br>66<br>66<br>67<br>67<br>66<br>66<br>66<br>64<br>64       | 5TAB1530 .1530 .1770 .1845 .1890 .1530 .1545 .1669 .1885 .1711 .1580 .1710 .1770                                       |
| 2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13                   | 2.31<br>2.29<br>2.28<br>2.28<br>2.29<br>2.30<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29<br>2.28<br>2.27<br>2.27<br>2.29 | 4.9<br>4.8<br>5.2<br>5.3<br>8.8<br>5.8<br>5.8<br>6.8<br>6.8<br>6.8<br>6.8<br>6.8<br>6.8<br>6.8<br>6.8<br>6.8<br>6 | 71<br>71<br>67<br>66<br>66<br>67<br>70<br>67<br>67<br>66<br>64<br>67<br>66       | 1669<br>1732<br>2190<br>1815<br>2325<br>2184<br>1794<br>1903<br>1890<br>2100<br>2190<br>1725<br>2130<br>1890<br>2100         | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15             | 2.31<br>2.30<br>2.29<br>2.30<br>2.30<br>2.30<br>2.29<br>2.31<br>2.31<br>2.30<br>2.29<br>2.30<br>2.29<br>2.30         | 4.5.8.8.3.3.8.9.9.3.8.3.8.2.3  | 71<br>70<br>67<br>67<br>70<br>70<br>67<br>71<br>71<br>70<br>67<br>70<br>67             | 1622<br>1841<br>2130<br>2390<br>2293<br>2527<br>2280<br>2138<br>2309<br>2309<br>2278<br>2153<br>1923<br>2250<br>2246         | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15<br>16             | 2.30<br>2.28<br>2.28<br>2.28<br>2.29<br>2.29<br>2.28<br>2.28<br>2.28         | 5.3<br>6.2<br>6.2<br>6.2<br>6.2<br>5.8<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2<br>8.3<br>6.2                      | 70<br>66<br>66<br>66<br>67<br>67<br>66<br>66<br>64<br>64<br>66<br>67 | 1530<br>1530<br>1530<br>1770<br>1845<br>1890<br>1530<br>1545<br>1669<br>1885<br>1711<br>1580<br>1770                   |
| 2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15       | 2.31<br>2.29<br>2.28<br>2.28<br>2.29<br>2.30<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29<br>2.28                                 | 4.9<br>4.9<br>5.2<br>5.2<br>5.8<br>5.8<br>5.8<br>6.9<br>6.9<br>6.9<br>6.9   | 71<br>71<br>67<br>66<br>66<br>67<br>70<br>67<br>67<br>67<br>66<br>64<br>67<br>66 | 1669<br>1732<br>2190<br>1815<br>2325<br>2184<br>1794<br>1903<br>1890<br>2100<br>2190<br>1725<br>2130<br>1890                 | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15             | 2.31<br>2.30<br>2.29<br>2.30<br>2.30<br>2.31<br>2.31<br>2.30<br>2.29<br>2.30<br>2.30<br>2.29<br>2.30<br>2.29<br>2.30 | 4.5.8.8.3.3.8.9.9.3.8.2.3.5<br>5.5.5.5.5.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.5 | 71<br>70<br>67<br>67<br>70<br>70<br>67<br>71<br>71<br>70<br>67<br>70<br>67<br>70<br>67 | 1622<br>1841<br>2130<br>2390<br>2293<br>2527<br>2280<br>2138<br>2309<br>2309<br>2278<br>2153<br>1923<br>2250<br>2246<br>2153 | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15<br>16<br>17       | 2.30<br>2.28<br>2.28<br>2.28<br>2.29<br>2.29<br>2.29<br>2.28<br>2.28         | 5.3<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2<br>5.8<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2 | 70<br>66<br>66<br>66<br>67<br>66<br>66<br>64<br>66<br>67<br>66       | 57AB<br>. 1530<br>1530<br>1770<br>1845<br>1890<br>1530<br>1545<br>1669<br>1885<br>1711<br>1580<br>1711<br>1770<br>1635 |
| 2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15       | 2.31<br>2.29<br>2.28<br>2.28<br>2.29<br>2.30<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29<br>2.28<br>2.27<br>2.27<br>2.29 | 4.9<br>4.8<br>5.2<br>5.3<br>8.8<br>5.8<br>5.8<br>6.8<br>6.8<br>6.8<br>6.8<br>6.8<br>6.8<br>6.8<br>6.8<br>6.8<br>6 | 71<br>71<br>67<br>66<br>66<br>67<br>70<br>67<br>67<br>66<br>64<br>67<br>66       | 1669<br>1732<br>2190<br>1815<br>2325<br>2184<br>1794<br>1903<br>1890<br>2100<br>2190<br>1725<br>2130<br>1890<br>2100         | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15             | 2.31<br>2.30<br>2.29<br>2.30<br>2.30<br>2.31<br>2.31<br>2.30<br>2.29<br>2.31<br>2.30<br>2.29<br>2.30<br>2.29<br>2.30 | 4.55555544555556544.   | 71<br>70<br>67<br>67<br>70<br>67<br>71<br>71<br>70<br>67<br>70<br>67<br>70<br>67<br>70 | 1622<br>1841<br>2130<br>2390<br>2293<br>2527<br>2280<br>2138<br>2309<br>2278<br>2153<br>1923<br>2250<br>2246<br>2153<br>2340 | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15<br>16<br>17<br>18 | 2.30<br>2.28<br>2.28<br>2.28<br>2.29<br>2.29<br>2.29<br>2.28<br>2.28         | 5.32<br>6.22<br>6.22<br>6.28<br>6.22<br>6.26<br>6.28<br>6.28<br>6.2  | 70666666666666666666666666666666666666                               | STAB . 1530 1530 1770 1845 1890 1830 1545 1669 1885 1711 1580 1711 1770 1770 1635 1725                                 |
| 2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15<br>16 | 2.31<br>2.29<br>2.28<br>2.28<br>2.30<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29<br>2.29<br>2.28<br>2.27<br>2.29<br>2.28<br>2.27 | 4.99<br>4.822<br>5.388<br>5.555<br>6.656<br>5.665<br>6.656<br>6.656<br>6.656                                      | 71<br>71<br>67<br>66<br>66<br>67<br>70<br>67<br>67<br>66<br>64<br>67<br>66       | 1669<br>1732<br>2190<br>1815<br>2325<br>2184<br>1794<br>1903<br>1890<br>2100<br>2190<br>1725<br>2130<br>1890<br>2100<br>1695 | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15<br>16<br>17 | 2.31<br>2.30<br>2.29<br>2.30<br>2.30<br>2.31<br>2.31<br>2.30<br>2.29<br>2.30<br>2.30<br>2.29<br>2.30<br>2.29<br>2.30 | 4.5.8.8.3.3.8.9.9.3.8.2.3.5<br>5.5.5.5.5.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.6.5.4.5.5.5.5 | 71<br>70<br>67<br>67<br>70<br>70<br>67<br>71<br>71<br>70<br>67<br>70<br>67<br>70<br>67 | 1622<br>1841<br>2130<br>2390<br>2293<br>2527<br>2280<br>2138<br>2309<br>2309<br>2278<br>2153<br>1923<br>2250<br>2246<br>2153 | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15<br>16<br>17       | 2.30<br>2.28<br>2.28<br>2.28<br>2.29<br>2.29<br>2.29<br>2.28<br>2.28         | 5.3<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2<br>5.8<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2<br>6.2 | 70<br>66<br>66<br>66<br>67<br>66<br>66<br>64<br>66<br>67<br>66       | 57AB<br>. 1530<br>1530<br>1770<br>1845<br>1890<br>1830<br>1545<br>1669<br>1885<br>1711<br>1580<br>1711<br>1770<br>1635 |

TABLE A-5
MIX TYPE 3 - ASPHALT E

| SC     | JURCE = P | TYPE=3 | ASPH= | E    | sou    | RCE=D1 | TYPE=3 | ASPH= | E    | SOL    | IRGE=D2 | TYPE=3 | ASPH= | E    |
|--------|-----------|--------|-------|------|--------|--------|--------|-------|------|--------|---------|--------|-------|------|
| SAMPLE | SPGR      | VOID   | VFA   | STAB | SAMPLE | SPGR   | VOID   | VFA   | STAB | SAMPLE | SPGR    | VOID   | VFA   | STAB |
| 1      | 2.31      | 4.1    | 75    | 2208 | 1      | 2.25   | 6.6    | 65    | 2155 | 1      | 2.27    | 5.8    | 68    | 2576 |
| 2      | 2.31      | 4.1    | 75    | 1940 | 2      | 2.28   | 5.4    | 70    | 2252 | 2      | 2.28    | 5.4    | 70    | 2980 |
| 3      | 2.32      | 3.7    | 77    | 1726 | 3      | 2.28   | 5.4    | 70    | 1814 | 3      | 2.29    | 5.0    | 71    | 2057 |
| 4      | 2.31      | 4.1    | 75    | 2059 | 4      | 2.31   | 4.1    | 75    | 2754 | 4      | 2.29    | 5.0    | 71    | 2560 |
| 5      | 2 31      | 4.1    | 75    | 1838 | 5      | 2.30   | 4.6    | 73    | 2948 | 5      | 2.30    | 4.6    | 73    | 2754 |
| 6      | 2.32      | 3.7    | 77    | 1896 | 6      | 2.30   | 4.6    | 73    | 2171 | 6      | 2.21    | 4.1    | 75    | 2236 |
| 7      | 2.31      | 4.1    | 75    | 1973 | 7      | 2.28   | 5.4    | 70    | 2025 | 7      | 2.29    | 5.0    | 71    | 2592 |
| 8      | 2.30      | 4.6    | 73    | 1918 | 8      | 2.26   | 6.2    | 66    | 2090 | 8      | 2.25    | 6.6    | 65    | 2495 |
| 9      | 2.31      | 4.1    | 75    | 2230 | 9      | 2.29   | 5.0    | 71    | 1944 | 9      | 2.29    | 5.0    | 71    | 2268 |
| 10     | 2.32      | 3.7    | 77    | 2044 | 10     | 2.29   | 5.0    | 71    | 2543 | 10     | 2.28    | 5.4    | 70    | 2786 |
| 11     | 2.31      | 4.1    | 75    | 1338 | 1 1    | 2.31   | 4.1    | 75    | 1555 | 11     | 2.31    | 4.1    | 75    | 2025 |
| 12     | 2.31      | 4.1    | 75    | 1737 | 12     | 2.30   | 4.6    | 73    | 2333 | 12     | 2.30    | 4.6    | 73    | 2657 |
| 13     | 2.32      | 3.7    | 77    | 2252 | 13     | 2.30   | 4.6    | 73    | 2025 | 13     | 2.30    | 4.6    | 73    | 2187 |

| S      | DURCE = R 1 | TYPE=3 | ASPH: | =E   | SOL    | JRCE=R2 | TYPE=3 | ASPH= | E    | SOU    | RCE=R3 | TYPE=3 | ASPH= | E    |
|--------|-------------|--------|-------|------|--------|---------|--------|-------|------|--------|--------|--------|-------|------|
| SAMPLE | SPGR        | VOID   | VFA   | STAB | SAMPLE | SPGR    | VOID   | VFA   | STAB | SAMPLE | SPGR   | VOID   | VFA   | STAB |
| 1      | 2.26        | 6.2    | 66    | 2175 | 1      | 2.26    | 6.2    | 66    | 2325 | 1      | 2.25   | 6.6    | 65    | 1740 |
| 2      | 2.28        | 5.4    | 70    | 2520 | 2      | 2.27    | 5.8    | 68    | 2415 | 2      | 2.26   | 6.2    | 66    | 2055 |
| 3      | 2.30        | 4.6    | 73    | 2370 | 3 .    | 2.29    | 5.0    | 71    | 2460 | 3      | 2.28   | 5.4    | 70    | 1995 |
| 4      | 2.29        | 5.0    | 71    | 2535 | . 4    | 2.30    | 4.6    | 73    | 2667 | 4      | 2.27   | 5.8    | 68    | 1995 |
| 5      | 2.27        | 5.8    | 68    | 2445 | 5      | 2.28    | 5.4    | 70    | 2610 | 5      | 2.28   | 5 4    | 70    | 2160 |
| 6      | 2.29        | 5.0    | 71    | 2745 | 6      | 2.29    | 5.0    | 7 1   | 2475 | 6      | 2.27   | 5.8    | 68    | 2190 |
| 7      | 2.28        | 5.4    | 70    | 2700 | 7      | 2.27    | 5.8    | 68    | 2850 | 7      | 2.28   | 5.4    | 70    | 2190 |
| 8      | 2.25        | 6.6    | 65    | 2475 | 8      | 2.25    | 6.6    | 65    | 2475 | 8      | 2.25   | 6.6    | 65    | 1860 |
| 9      | 2.26        | 6.2    | 66    | 2115 | 9      | 2.27    | 5.8    | 68    | 2444 | 9      | 2.25   | 6.6    | 65    | 1950 |
| 10     | 2.28        | 5.4    | 70    | 2640 | 10     | 2.29    | 5.0    | 7 1   | 2848 | 10     | 2.26   | 6.2    | 66    | 2040 |
| 1.1    | 2.31        | 4.1    | 75    | 2309 | 11     | 2.31    | 4.1    | 75    | 2418 | 11     | 2.30   | 4.6    | 73    | 2137 |
| 12     | 2.30        | 4.6    | 73    | 2480 | 12     | 2.30    | 4.6    | 73    | 2605 | 12     | 2.29   | 5.0    | 71    | 2085 |
| 13     | 2.29        | 5.0    | 7 1   | 2370 | 13     | 2.30    | 4.6    | 73    | 2636 | 13     | 2.28   | 5.4    | 70    | 2280 |

TABLE A-6
MIX TYPE 3 - ASPHALT L

| SO   | URCE=P  | TYPE=3  | ∧SPH=  |   | SOL  | JRCE +D1   | TYPE=3  | ASPH=  | L   | sol  | JRCE=D2   | TYPE=3  | ASPH=   | ١  |
|--|---|---|--|---|--|--|---|--|---|--|---|---|---|--|
| SAMPLE   | SPGR  | VOID  | VFA  | STAB  | SAMPLE   | SPGR   | VOID  | VFA  | STAB  | SAMPLE   | SPGR  | VOID  | VFA   | STAB   |
| 1  | 2 35  | 3 3   | 78   | 1811  | i  | 5.34   | 3.7   | 16   | 2997  | 1  | 2.34  | 3.7   | 76  | 3323   |
| 2  | 2.33  | 4.1   | 7.4  | 2084  | 2  | 2.31   | 4.9   | 70   | 3349  | 2  | 2.32  | 4.5   | 72  | 3668   |
| 3  | 2.34  | 3.7   | 76   | 2131  | 3  | 2,33   | 4.1   | 74   | 3535  | 3  | 2.32  | 4.5   | 72  | 4572   |
| 4  | 2.33  | 4.1   | 74   | 1847.   | 4  | 2,33   | 4.1   | 74   | 3296  | 4  | 2.33  | 4.1   | 74  | 2990   |
| 5  | 2.36  | 2.9   | 80   | 2802  | 5  | 2.33   | 4.1   | 74   | 3495  | 5  | 2.34  | 3.7   | 76  | 3987   |
| 6  | 2.35  | 3.3   | 78   | 2051  | 6  | 2.33   | 4.1   | 74   | 3654  | 6  | 2.33  | 4.1   | 74  | 4426   |
| 7  | 2.35  | 3.3   | 78   | 2456  | 7  | 2.32   | 4.5   | 72   | 3482  | 7  | 2.33  | 4.1   | 74  | 4439   |
| 8  | 2.35  | 3.3   | 78   | 2148  | 8  | 2.32   | 4.5   | 72   | 3721  | 8  | 2.33  | 4.1   | 74  | 4200   |
| 9  | 2.35  | 3.3   | 78   | 2724  | 9  | 2.30   | 5.3   | 69   | 4598  | 9  | 2.31  | 4.9   | 70  | 4425   |
| 10   | 2.35  | 3.3   | 78   | 2158  | 10   | 2.33   | 4.1   | 74   | 3163  | 10   | 2.33  | 4.1   | 7.4   | 3269   |
| 11   | 2.35  | 3.3   | 78   | 2375  | 1.1  | 2.33   | 4.1   | 74   | 2817  | 11   | 2.34  | 3.7   | 76  | 3696   |
| 12   | 2.35  | 3.3   | 78   | 1814  | 12   | 2.31   | 4.9   | 70   | 4505  | 12   | 2.30  | 5.3-  | 69  | 5409   |
| 13   | 2.34  | 3.7   | 76   | 2373  | 13   | 2.33   | 4.1   | 74   | 4957  | 13   | 2.34  | 3.7   | 76  | 5157   |
| 14   | 2.35  | 3.3   | 78   | 2152  | 14   | 2.33   | 4.1   | 74   | 3043  | 14   | 2.34  | 3.7   | 7 G   | 4067   |
| 15   | 2.34  | 3.7   | 76   | 2581  | 15   | 2.34   | 3.7   | 76   | 3867  | 15   | 2.34  | 3.7   | 76  | 3894   |
| 16   | 2.35  | 3.3   | 78   | 2501  | 16   | 2.33   | 4.1   | 74   | 3721  | 16   | 2.34  | 3.7   | 76  | 3708   |
| 17   | 2.35  | 3.3   | 78   | 2503  | 17   | 2.34   | 3.7   | 76   | 4226  | 17   | 2.34  | 3.7   | 76  | 3827   |
| 18   | 2.35  | 3.3   | 78   | 2522  | 18   | 2.34   | 3.7   | 76   | 3721  | 18   | 2.33  | 4.1   | 74  | 3934   |
| 19   | 2.35  | 3.3   | 78   | 2159  | 19   | 2.33   | 4.1   | 74   | 3628  | 19   | 2.34  | 3.7   | 76  | 4423   |
| 20   | 2.36  | 2.9   | 80   | 2423  | 50   | 2.33   | 4.1   | 74   | 3588  | 20   | 2.34  | 3.7   | 76  | 2897   |
|  |   |   |  |   |  |  |   |  |   |  |   |   |   |  |
| SOU  | RCE=R1  | TYPE=3  | ASPH=  | :L  | sau  | IRCE=R2  | TYPE=3  | ASPH=L   |   | Sau  | RCE=R3  | TYPE=3  | ASPH=L  |  |
| SOU<br>SAMPLE  | RCE=R1<br>SPGR  | TYPE=3  | ASPH=  | STAB  | SAMPLE   | RCE=R2<br>SPGR   | TYPE=3  | ASPH=L<br>VFA  | STAB  | SOU<br>SAMPLE  | RCE=R3<br>SPGR  | TYPE=3  | ASPH=L<br>VFA   | STAB   |
|  |   |   |  |   |  |  |   |  |   |  |   |   |   |  |
| SAMPLE   | SPGR  | VOID  | VFA  | STAB  | SAMPLE   | SPGR   | VOID  | VFA  | STAB  | SAMPLE   | SPGR  | VOID  | VFA   | STAB   |
| SAMPLE<br>1  | SPGR<br>2.33  | V01D  | VFA<br>74  | STAB<br>2574  | SAMPLE<br>1  | SPGR<br>2.35   | V0ID<br>3.3   | VFA  | STAB<br>3010  | SAMPLE<br>1  | SPGR<br>2.33  | V010<br>4.1   | VFA   | STAB<br>2496   |
| SAMPLE<br>1<br>2                                     | SPGR<br>2.33<br>2.33  | VOID 4.1 4.1  | VFA<br>74<br>74  | STAB<br>2574<br>2992  | SAMPLE<br>1<br>2                                     | SPGR<br>2.35<br>2.34   | VOID<br>3.3<br>3.7  | VFA<br>78<br>76  | STAB<br>3010<br>3258  | SAMPLE<br>1<br>2                                     | SPGR<br>2.33<br>2.32  | V0I0<br>4.1<br>4.5  | VFA<br>74<br>72   | STAB<br>2496<br>2527   |
| SAMPLE  1 2 3  | SPGR<br>2.33<br>2.33<br>2.32  | VOID 4.1 4.1 4.5  | VFA<br>74<br>74<br>72  | STAB<br>2574<br>2892<br>2792  | SAMPLE  1 2 3  | SPGR<br>2.35<br>2.34<br>2.34   | VOID<br>3.3<br>3.7<br>3.7                                     | VFA<br>78<br>76<br>76  | 3010<br>3258<br>3421<br>2714<br>3110  | SAMPLE<br>1<br>2<br>3<br>4<br>5                      | SPGR<br>2.33<br>2.32<br>2.33                                      | VOIO<br>4.1<br>4.5<br>4.1   | VFA<br>74<br>72<br>74   | STAB<br>2496<br>2527<br>2761   |
| SAMPLE  1 2 3 4 5 6                                  | SPGR<br>2.33<br>2.33<br>2.32<br>2.35  | VOID 4.1 4.1 4.5 3.3  | VFA 74 74 72 78  | STAB<br>2574<br>2892<br>2792<br>2714  | SAMPLE  1 2 3 4                                      | SPGR<br>2.35<br>2.34<br>2.34<br>2.34   | VOID 3.3 3.7 3.7 3.7  | VFA 78 76 76 76  | STAB  3010 3258 3421 2714 3110 3377   | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6                 | SPGR<br>2.33<br>2.32<br>2.33<br>2.33                              | VOID 4.1 4.5 4.1 4.1  | VFA<br>74<br>72<br>74<br>74   | STAB  2496 2527 2761 2652 2558 2823  |
| SAMPLE  1 2 3 4 5 6 7                                | SPGR 2.33 2.33 2.32 2.35 2.33 2.33 2.34   | VOID 4.1 4.1 4.5 3.3 4.1  | VFA 74 74 72 78 74 74 74 76  | STAB  2574 2992 2792 2714 2964 3288 3080  | SAMPLE<br>1<br>2<br>3<br>4<br>5                      | SPGR 2.35 2.34 2.34 2.36 2.34 2.34   | VOID 3.3 3.7 3.7 2.9 3.7 3.7                                  | VFA  78  76  76  76  80  76  76  | STAB  3010 3258 3421 2714 3110 3377 3347  | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7            | SPGR  2.33 2.32 2.33 2.33 2.33 2.33 2.33                          | VOID 4.1 4.5 4.1 4.1 4.1 4.1 4.1                                      | VFA 74 72 74 74 74 74 74  | STAB  2496 2527 2761 2652 2558 2823 2902   |
| SAMPLE  1 2 3 4 5 6 7 8                              | SPGR 2.33 2.33 2.32 2.35 2.33 2.33 2.34 2.33  | VOID 4.1 4.1 4.5 3.3 4.1 4.1 3.7 4.1  | VFA 74 74 72 78 74 74 76 74  | STAB  2574 2992 2792 2714 2964 3288 3080 2995   | \$AMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8      | SPGR  2.35 2.34 2.34 2.36 2.34 2.34 2.34 2.34                                    | VOID  3.3 3.7 3.7 2.9 3.7 3.7 3.7 3.7                         | 78<br>76<br>76<br>76<br>80<br>76<br>76<br>76   | STAB  3010 3258 3421 2714 3110 3377 3347 3584   | SAMPLE  1 2 3 4 5 6 7 8                              | SPGR 2.33 2.32 2.33 2.33 2.33 2.33 2.33 2.3                       | VOID 4.1 4.5 4.1 4.1 4.1 4.1 4.1 4.5                                  | VFA 74 74 74 74 74 74 74 74 72                                      | STAB  2496 2527 2761 2652 2558 2823 2902 2902  |
| SAMPLE  1 2 3 4 5 6 7                                | SPGR  2.33 2.33 2.32 2.35 2.33 2.33 2.34 2.33 2.29  | VOID  4.1 4.5 3.3 4.1 4.1 3.7 4.1 5.8   | VFA 74 74 72 78 74 76 74 67  | STAB  2574 2992 2792 2714 2964 3288 3080 2995 2939                                    | SAMPLE  1 2 3 4 5 6 7                                | SPGR  2.35 2.34 2.34 2.36 2.34 2.34 2.34 2.34 2.32                               | VOID  3.3 3.7 3.7 2.9 3.7 3.7 3.7 4.5                         | 78<br>76<br>76<br>80<br>76<br>76<br>76<br>76<br>76   | STAB  3010 3258 3421 2714 3110 3377 3347 3584 3643  | SAMPLE  1 2 3 4 5 6 7 8 9                            | SPGR  2.33 2.32 2.33 2.33 2.33 2.33 2.33 2.                       | VOID 4.1 4.5 4.1 4.1 4.1 4.1 4.5 5.8                                  | VFA 74 74 74 74 74 74 72 67   | STAB  2496 2527 2761 2652 2558 2823 2902 2902 2910   |
| SAMPLE  1 2 3 4 5 6 7 8 9 10                         | SPGR  2.33 2.33 2.32 2.35 2.33 2.33 2.34 2.33 2.29 2.33   | VOID  4.1 4.5 3.3 4.1 4.1 3.7 4.1 5.8 4.1                                     | VFA 74 74 72 78 74 74 76 74 67   | STAB  2574 2892 2792 2714 2964 3288 3080 2995 2939 3095                               | SAMPLE  1 2 3 4 5 6 7 8 9 10                         | SPGR  2.35 2.34 2.34 2.36 2.34 2.34 2.34 2.34 2.32 2.35                          | VOID  3.3 3.7 3.7 2.9 3.7 3.7 3.7 4.5 3.3                     | 78<br>76<br>76<br>76<br>80<br>76<br>76<br>76<br>76<br>77                                     | STAB  3010 3258 3421 2714 3110 3377 3347 3584 3643 3214   | SAMPLE  1 2 3 4 5 6 7 8 9                            | SPGR  2.33 2.32 2.33 2.33 2.33 2.33 2.33 2.                       | VOID  4.1 4.5 4.1 4.1 4.1 4.1 4.5 5.8 4.1                             | VFA  74  74  74  74  74  74  72  67                                 | STAB  2496 2527 2761 2652 2558 2823 2902 2902 2910 2870                                    |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11                      | SPGR  2.33 2.33 2.35 2.33 2.33 2.34 2.33 2.34   | VOID  4.1 4.5 3.3 4.1 4.1 3.7 4.1 5.8 4.1 3.7                                 | VFA 74 74 72 78 74 74 76 74 76 74 67   | STAB  2574 2992 2792 2714 2964 3288 3080 2995 2995 3095 2995                          | SAMPLE  1 2 3 4 5 6 7 8 9 10 11                      | SPGR  2.35 2.34 2.34 2.34 2.36 2.34 2.34 2.34 2.34 2.35                          | VOID  3.3 3.7 3.7 3.7 2.9 3.7 3.7 3.7 3.7 3.3 3.3             | 78<br>76<br>76<br>76<br>80<br>76<br>76<br>76<br>76<br>77<br>78                               | STAB  3010 3258 3421 2714 3110 3377 3347 3584 3643 3214 2917                                    | 5AMPLE  1 2 3 4 5 6 7 8 9 10                         | SPGR  2.33 2.32 2.33 2.33 2.33 2.33 2.33 2.                       | VOID  4.1 4.5 4.1 4.1 4.1 4.1 4.5 5.8 4.1 3.7                         | VFA 74 72 74 74 74 74 74 72 67 74 76                                | STAB  2496 2527 2761 2652 2558 2823 2902 2902 2910 2870 2667                               |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11                      | SPGR  2.33 2.32 2.35 2.33 2.33 2.34 2.33 2.29 2.33 2.34 2.35  | VOID  4.1 4.1 4.5 3.3 4.1 4.1 3.7 4.1 5.8 4.1 3.7 3.3                         | VFA 74 74 72 78 74 74 76 74 67 74 76 78  | STAB  2574 2992 2792 2714 2964 3288 3080 2995 2995 3095 2995                          | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12                   | SPGR  2.35 2.34 2.34 2.34 2.36 2.34 2.34 2.35 2.35 2.35                          | VOID  3.3 3.7 3.7 3.7 2.9 3.7 3.7 4.5 3.3 3.3 3.3             | 78<br>76<br>76<br>76<br>80<br>76<br>76<br>76<br>77<br>78<br>78                               | STAB  3010 3258 3421 2714 3110 3377 3347 3584 3643 3214 2917 3080                               | 5AMPLE  1 2 3 4 5 6 7 8 9 10 11                      | SPGR  2.33 2.32 2.33 2.33 2.33 2.33 2.32 2.29 2.33 2.34 2.34      | VOID  4.1 4.5 4.1 4.1 4.1 4.1 4.5 5.8 4.1 3.7 3.7                     | VFA 74 72 74 74 74 74 74 74 76 76                                   | STAB  2496 2527 2761 2652 2558 2823 2902 2902 2910 2870 2667 2885                          |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                | SPGR  2.33 2.33 2.32 2.35 2.33 2.34 2.33 2.29 2.33 2.34 2.35 2.34 2.35 2.34   | VOID  4.1 4.1 4.5 3.3 4.1 4.1 3.7 4.1 5.8 4.1 3.7 3.3 4.5                     | VFA 74 74 72 78 74 74 76 74 67 74 76 78 78   | STAB  2574 2992 2792 2714 2964 3288 3080 2995 2939 3095 2939 3072 2746                | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                | SPGR  2.35 2.34 2.34 2.34 2.34 2.34 2.34 2.35 2.35 2.35 2.35                     | VOID  3.3 3.7 3.7 2.9 3.7 3.7 4.5 3.3 3.3 3.3                 | 78<br>76<br>76<br>76<br>80<br>76<br>76<br>76<br>77<br>78<br>78<br>78                         | STAB  3010 3258 3421 2714 3110 3377 3347 3584 3643 3214 2917 3080 3036                          | 5AMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                | SPGR  2.33 2.32 2.33 2.33 2.33 2.33 2.32 2.39 2.33 2.34 2.34 2.32 | VOID  4.1 4.5 4.1 4.1 4.1 4.1 4.5 5.8 4.1 3.7 3.7 4.5                 | VFA 74 72 74 74 74 74 74 74 76 76 76 72                             | STAB  2496 2527 2761 2652 2558 2823 2902 2902 2910 2870 2667 2885 2450                     |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14             | SPGR  2.33 2.33 2.35 2.35 2.33 2.34 2.33 2.29 2.33 2.34 2.35 2.32 2.34 2.35   | VOID  4.1 4.1 4.5 3.3 4.1 4.1 3.7 4.1 5.8 4.1 3.7 3.3 4.5 4.1                 | VFA 74 74 72 78 74 76 74 67 74 76 78 72 78   | STAB  2574 2992 2792 2714 2964 3288 3080 2995 2939 3095 2995 3072 2746 2995           | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14             | SPGR  2.35 2.34 2.34 2.34 2.34 2.34 2.35 2.35 2.35 2.35 2.35                     | VOID  3.3 3.7 3.7 2.9 3.7 3.7 4.5 3.3 3.3 3.3 3.3 3.3         | 78<br>76<br>76<br>76<br>76<br>76<br>76<br>76<br>77<br>78<br>78<br>78                         | STAB  3010 3258 3421 2714 3110 3377 3347 3584 3643 3214 2917 3080 3036 3072                     | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14             | SPGR  2.33 2.32 2.33 2.33 2.33 2.33 2.33 2.                       | VOID  4.1 4.5 4.1 4.1 4.1 4.1 4.5 5.8 4.1 3.7 3.7 4.5 4.1             | VFA  74  74  74  74  74  74  74  74  76  76                         | STAB  2496 2527 2761 2652 2558 2823 2902 2910 2870 2667 2885 2450 2667                     |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15          | SPGR  2.33 2.33 2.35 2.35 2.33 2.34 2.33 2.29 2.33 2.34 2.33 2.35 2.34 2.35 2.35                                    | VOID  4.1 4.1 4.5 3.3 4.1 4.1 3.7 4.1 5.8 4.1 3.7 3.3 4.5 4.1 3.3             | VFA 74 74 72 78 74 76 74 67 74 76 77 74 76 78 72 74 78   | STAB  2574 2992 2714 2964 3288 3080 2995 2995 2995 3072 2746 2995 3057                | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15          | SPGR  2.35 2.34 2.34 2.34 2.34 2.34 2.35 2.35 2.35 2.35 2.35 2.35                | VOID  3.3 3.7 3.7 2.9 3.7 3.7 4.5 3.3 3.3 3.3 3.3 3.3         | 78<br>76<br>76<br>76<br>76<br>76<br>76<br>76<br>76<br>77<br>78<br>78<br>78<br>78             | STAB  3010 3258 3421 2714 3110 3377 3347 3584 3643 3214 2917 3080 3036 3072 3080                | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15          | SPGR  2.33 2.33 2.33 2.33 2.33 2.33 2.33 2.                       | VOID  4.1 4.5 4.1 4.1 4.1 4.1 4.5 5.8 4.1 3.7 3.7 4.5 4.1 4.1         | VFA  74  74  74  74  74  74  74  76  76  72  74  74  74             | STAB  2496 2527 2761 2652 2558 2823 2902 2902 2910 2870 2667 2885 2450 2667 2652           |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16       | SPGR  2.33 2.33 2.35 2.33 2.34 2.33 2.29 2.33 2.34 2.33 2.29 2.33 2.34 2.35 2.34                                    | VOID  4.1 4.5 3.3 4.1 4.1 3.7 4.1 5.8 4.1 3.7 4.1 3.7 3.3 4.5 4.1 3.3 3.7     | VFA 74 74 74 76 74 67 74 76 77 74 76 78 72 74 78   | STAB  2574 2992 2714 2964 3288 3080 2995 2939 3095 2995 3072 2746 2995 3057 2933      | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16       | SPGR  2.35 2.34 2.34 2.34 2.34 2.34 2.35 2.35 2.35 2.35 2.35 2.35 2.35           | VOID  3.3 3.7 3.7 2.9 3.7 3.7 4.5 3.3 3.3 3.3 3.3 3.3 3.3     | 78<br>76<br>76<br>76<br>76<br>76<br>76<br>76<br>76<br>78<br>78<br>78<br>78<br>78             | STAB  3010 3258 3421 2714 3110 3377 3347 3584 3643 3214 2917 3080 3036 3072 3080 3406           | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16       | SPGR  2.33 2.32 2.33 2.33 2.33 2.33 2.33 2.                       | VOID  4.1 4.5 4.1 4.1 4.1 4.5 5.8 4.1 3.7 3.7 4.5 4.1 4.1 4.1         | VFA  74  74  74  74  74  74  74  76  76  76                         | STAB  2496 2527 2761 2652 2558 2823 2902 2902 2910 2870 2667 2885 2450 2667 2652 2777      |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR  2.33 2.33 2.35 2.33 2.33 2.34 2.35 2.33 2.34 2.35 2.33 2.34 2.35 2.33 2.34 2.35 2.33 2.34 2.35                | VOID  4.1 4.5 3.3 4.1 4.1 3.7 4.1 5.8 4.1 3.7 3.3 4.5 4.1 3.7 3.3 4.5 4.1     | VFA 74 74 72 78 74 76 74 67 74 76 78 72 78 76 78 76 77   | STAB  2574 2992 2792 2714 2964 3288 3080 2995 3095 2995 3072 2746 2995 3057 2933 3051 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR  2.35 2.34 2.34 2.34 2.36 2.34 2.34 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 | VOID  3.3 3.7 3.7 2.9 3.7 3.7 3.7 3.7 3.3 3.3 3.3 3.3 3.3 3.3 | 78<br>76<br>76<br>76<br>80<br>76<br>76<br>76<br>78<br>78<br>78<br>78<br>78<br>78             | STAB  3010 3258 3421 2714 3110 3377 3347 3584 3643 3214 2917 3080 3036 3072 3080 3406 3199      | 5AMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR  2.33 2.33 2.33 2.33 2.33 2.33 2.34 2.34                     | VOID  4.1 4.5 4.1 4.1 4.1 4.1 4.5 5.8 4.1 3.7 3.7 4.5 4.1 4.1 4.1 4.1 | VFA  74  74  74  74  74  74  72  67  74  76  76  72  74  74  74  74 | STAB  2496 2527 2761 2652 2558 2823 2902 2900 2667 2885 2450 2667 2652 2777 2543           |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 | SPGR  2.33 2.32 2.35 2.33 2.33 2.34 2.35 2.33 2.34 2.35 2.32 2.33 2.34 2.35 2.32 2.33 2.35 2.34 2.35 2.35 2.34 2.35 | VOID  4.1 4.1 4.5 3.3 4.1 4.1 3.7 4.1 5.8 4.1 3.7 3.3 4.5 4.1 3.7 3.3 4.5 4.1 | VFA 74 74 72 78 74 76 74 76 77 76 78 72 74 78 76 74 78 76 74 78 76 74 78 76 74 77 76 77 76 77 77 78 78 | STAB  2574 2992 2792 2714 2964 3288 3080 2995 2995 3072 2746 2995 3057 2933 3051 3347 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 | SPGR  2.35 2.34 2.34 2.34 2.36 2.34 2.34 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 | VOID  3.3 3.7 3.7 2.9 3.7 3.7 4.5 3.3 3.3 3.3 3.3 3.3 3.7 4.1 | 78<br>76<br>76<br>76<br>76<br>76<br>76<br>76<br>77<br>78<br>78<br>78<br>78<br>78<br>78<br>78 | STAB  3010 3258 3421 2714 3110 3377 3347 3584 3643 3214 2917 3080 3036 3072 3080 3406 3199 3466 | 5AMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 | SPGR  2.33 2.32 2.33 2.33 2.33 2.33 2.34 2.34                     | VOID  4.1 4.5 4.1 4.1 4.1 4.1 4.5 5.8 4.1 3.7 3.7 4.5 4.1 4.1 4.1 4.5 | VFA  74  74  74  74  74  74  74  76  76  76                         | STAB  2496 2527 2761 2652 2558 2823 2902 2910 2870 2667 2885 2450 2667 2652 2777 2543 2714 |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR  2.33 2.33 2.35 2.33 2.33 2.34 2.35 2.33 2.34 2.35 2.33 2.34 2.35 2.33 2.34 2.35 2.33 2.34 2.35                | VOID  4.1 4.5 3.3 4.1 4.1 3.7 4.1 5.8 4.1 3.7 3.3 4.5 4.1 3.7 3.3 4.5 4.1     | VFA 74 74 72 78 74 76 74 67 74 76 78 72 78 76 78 76 77   | STAB  2574 2992 2792 2714 2964 3288 3080 2995 3095 2995 3072 2746 2995 3057 2933 3051 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR  2.35 2.34 2.34 2.34 2.36 2.34 2.34 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 | VOID  3.3 3.7 3.7 2.9 3.7 3.7 3.7 3.7 3.3 3.3 3.3 3.3 3.3 3.3 | 78<br>76<br>76<br>76<br>80<br>76<br>76<br>76<br>78<br>78<br>78<br>78<br>78<br>78             | STAB  3010 3258 3421 2714 3110 3377 3347 3584 3643 3214 2917 3080 3036 3072 3080 3406 3199      | 5AMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR  2.33 2.33 2.33 2.33 2.33 2.33 2.34 2.34                     | VOID  4.1 4.5 4.1 4.1 4.1 4.1 4.5 5.8 4.1 3.7 3.7 4.5 4.1 4.1 4.1 4.1 | VFA  74  74  74  74  74  74  72  67  74  76  76  72  74  74  74  74 | STAB  2496 2527 2761 2652 2558 2823 2902 2900 2667 2885 2450 2667 2652 2777 2543           |

TABLE A-7
MIX TYPE 3 - ASPHALT S

| \$0   | URCE=P   | TAbE=3   | ∧SPH=   | S  | SOU  | RCE=D1  | TYPE=3  | ASPH=                                      | S   | sou  | RCE=D2  | TYPE=3   | ASPH=  | s   |
|---|--|--|---|--|--|---|---|--|---|--|---|--|--|---|
| SAMPLE  | SPGR   | VOID   | VFA   | STAB   | SAMPLE   | SPGR  | VOID  | VFA  | STAB  | SAMPLE   | SPGR .  | VOID   | VFA  | STAB  |
| 1   | 2.33   | 4.1  | 74  | 2445   | 1  | 2.29  | 5.8   | 66   | 2563  | 1  | 2.29  | 5.8  | 66   | 2703  |
| 2   | 2.33   | 4.1  | 74  | 2129   | 2  | 2.29  | 5.8   | 66   | 3001  | 2  | 2.29  | 5.8  | 66   | 2906  |
| 3   | 2.33   | 4.1  | 74  | 2541   | 3  | 2.30  | 5.3   | 68   | 2465  | 3  | 2.28  | 6.2  | 65   | 2252  |
| 4   | 2.32   | 4.5  | 72  | 1512   | 4  | 2.31  | 4.9   | 70   | 2104  | 4  | 2.30  | 5.3  | 68   | 2430  |
| 5   | 2.34   | 3.7  | 76  | 2498   | 5  | 2.29  | 5.8   | 66   | 2517  | 5  | 2.29  | 5.8  | 66   | 2718  |
| 6   | 2.31   | 4.9  | 70  | 1687   | 6  | 2.29  | 5.8   | 66   | 2802  | 6  | 2.29  | 5.8  | 6G   | 2753  |
| 7   | 2.34   | 3,7  | 76  | 2580   | 7  | -2.30   | 5.3   | 68   | 2916  | 7  | 2.31  | 4.9  | 70   | 3064  |
| 8   | 2.32   | 4.5  | 72  | 2129   | 8  | 2.29  | 5.8   | 66   | 2558  | 8  | 2.29  | 5.8  | 66   | 2428  |
| 9   | 2.34   | 3.7  | 76  | 2249   | 9  | 2.30  | 5.3   | 68   | 3106  | 9  | 2.30  | 5.3  | 68   | 3096  |
| 10  | 2.34   | 3.7  | 76  | 2277   | 10   | 2.29  | 5.8   | 66   | 3048  | 10   | 2.29  | 5.8  | 66   | 2731  |
| 11  | 2.33   | 4.1  | 74  | 2409   | 11   | 2.30  | 5.3   | 68   | 2985  | 1 1  | 2.29  | 5.8  | 66   | 2695  |
| 12  | 2.33   | 4.1  | 74  | 2373   | 12   | 2.30  | 5.3   | 68   | 3143  | 12   | 2.29  | 5.8  | 66   | 2708  |
| 13  | 2.33   | 4.1  | 74  | 2485   | 13   | 2.29  | 5.8   | 66   | 2649  | 13   | 2.28  | 6.2  | 65   | 2634  |
| 14  | 2.34   | 3.7  | 76  | 2194   | 14   | 2.30  | 5.3   | 68   | 2992  | 14   | 2.29  | 5.8  | 66   | 2741  |
| 15  | 2.33   | 4.1  | 74  | 2473   | 15   | 2.29  | 5.8   | 66   | 2848  | 15   | 2.29  | 5.8  | 66   | 2825  |
| 16  | 2.31   | 4.9  | 70  | 1599   | 16   | 2.27  | 6.6   | 63   | 2412  | 16   | 2.28  | 6.2  | 65   | 2672  |
| 17  | 2.34   | 3.7  | 76  | 2591   | 17   | 2.29  | 5.8   | 66   | 2803  | 17   | 2.29  | 5.8  | 66   | 2668  |
| 18  | 2.34   | 3.7  | 76  | 2524   | 18   | 2.28  | 6.2   | 65   | 2672  | 18   | 2.29  | 5.8  | 66   | 2851  |
| 19  | 2.34   | 3.7  | 76  | 2504   | 19   | 2.29  | 5.8   | 66   | 2660  | 19   | 2.29  | 5.8  | 66   | 2660  |
| 20  | 2.33   | 4.1  | 74  | 2661   | 20   | 2.29  | 5.8   | 66   | 2843  | 20   | 2.29  | 5.8  | 66   | 2660  |
| 21  | 2.33   | 4.1  | 74  | 2058   | 2 1  | 2.31  | 4.9   | 70   | 3206  | 21   | 2.30  | 5.3  | 68   | 2843  |
|   |  |  |   |  |  |   |   |  |   |  |   |  |  |   |
| SOU   | IRCE=R1  | TYPE=3   | ASPH=   | ·S   | SO   | URCE=R2   | TABE=3  | ASPH                                       | =S  | SOL  | JRCE=R3   | TYPE=3   | ASPH=  | ·S  |
| SAMPLE  | JRCE=R1<br>SPGR  | TYPE=3   | ASPH=   | STAB   | SAMPLE   | URCE=R2<br>SPGR   | TYPE=3  | ASPH<br>VFA                                | ≈S<br>STAB  | SAMPLE   | JRCE=R3<br>SPGR   | TYPE=3   | ASPH=  | STAB  |
|   |  |  |   |  |  |   |   |  |   |  |   |  |  |   |
| SAMPLE  | SPGR   | VOID   | VFA   | STAB   | SAMPLE   | SPGR  | VOID  | VFA  | STAB  | SAMPLE   | SPGR  | VOID   | VFA  | STAB  |
| SAMPLE<br>1   | SPGR<br>2.28   | V0ID<br>6.2  | VFA<br>65                                     | STAB<br>2310   | SAMPLE<br>1  | SPGR<br>2.26  | V0ID<br>7.0   | VFA  | STAB<br>1800  | SAMPLE<br>1  | SPGR<br>2.27  | V0ID   | VFA<br>64  | STAB<br>1800  |
| SAMPLE<br>1<br>2  | SPGR<br>2.28<br>2.28   | VOID<br>6.2<br>6.2   | VFA<br>65<br>65                               | STAB<br>2310<br>2265   | SAMPLE<br>1<br>2                                     | SPGR<br>2.26<br>2.26  | VOID<br>7.0<br>7.0  | VFA<br>62<br>62                            | STAB<br>1800<br>1920  | SAMPLE<br>1<br>2                                     | SPGR<br>2.27<br>2.28  | VOID<br>6.6<br>6.2   | VFA<br>64<br>65                                  | STAB<br>1800<br>1935  |
| SAMPLE  1 2 3   | SPGR<br>2.28<br>2.28<br>2.29   | VOID<br>6.2<br>6.2<br>5.8  | VFA<br>65<br>65<br>67                         | STAB<br>2310<br>2265<br>2160   | SAMPLE<br>1<br>2<br>3                                | SPGR<br>2.26<br>2.26<br>2.26  | VOID<br>7.0<br>7.0<br>7.0   | VFA<br>62<br>62<br>62                      | STAB<br>1800<br>1920<br>1920  | SAMPLE  1 2 3  | SPGR<br>2.27<br>2.28<br>2.27  | VOID<br>6.6<br>6.2<br>6.6  | VFA<br>64<br>65<br>64                            | STAB<br>.1800<br>.1935<br>.1965   |
| SAMPLE  1 2 3 4   | SPGR<br>2.28<br>2.28<br>2.29<br>2.30   | VOID 6.2 6.2 5.8 5.3   | VFA<br>65<br>65<br>67<br>69                   | STAB 2310 2265 2160 2262   | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6                 | SFGR 2.26 2.26 2.26 2.28 2.25 2.26  | 7.0<br>7.0<br>7.0<br>7.0<br>6.2<br>7.4<br>7.0                                 | VFA 62 62 62 65 60 62                      | 5TAB<br>1800<br>1920<br>1920<br>1755<br>1830<br>2040  | SAMPLE  1 2 3 4 5                                    | SPGR 2.27 2.28 2.27 2.30  | VOID 6.6 6.2 6.6 5.3 6.2 6.2                                       | VFA 64 65 64 69 65                               | STAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070  |
| SAMPLE<br>1<br>2<br>3<br>4<br>5                         | SPGR 2.28 2.28 2.29 2.30 2.28  | VOID 6.2 6.2 5.8 5.3 6.2   | VFA<br>65<br>65<br>67<br>69<br>65             | STAB 2310 2265 2160 2262 2100  | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7            | SFGR 2 . 26 2 . 26 2 . 26 2 . 28 2 . 25 2 . 26 2 . 29                       | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8   | VFA 62 62 62 65 60 62 67                   | STAB  1800 1920 1920 1755 1830 2040 2295  | SAMPLE  1 2 3 4 5 6 7                                | SPGR 2.27 2.28 2.27 2.30 2.28 2.28 2.30   | VOID 6.6 6.2 6.6 5.3 6.2 6.2 5.3                                   | VFA 64 65 64 69 65 65 65                         | STAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481  |
| SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6                    | SPGR 2.28 2.28 2.29 2.30 2.28 2.29   | VOID 6.2 6.2 5.8 5.3 6.2 5.8   | VFA 65 65 67 69 65                            | STAB 2310 2265 2160 2262 2100 2700   | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8       | SFGR 2.26 2.26 2.26 2.28 2.25 2.26  | 7.0<br>7.0<br>7.0<br>7.0<br>6.2<br>7.4<br>7.0                                 | VFA 62 62 65 60 62 67 65                   | STAB  1800 1920 1920 1755 1830 2040 2295 2144   | SAMPLE  1 2 3 4 5 6 7 8                              | SPGR  2.27 2.28 2.27 2.30 2.28 2.28 2.30 2.30   | VOID 6.6 6.2 6.6 5.3 6.2 6.2 5.3 5.3                               | VFA 64 65 64 69 65 69 69                         | STAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481<br>2434  |
| SAMPLE  1 2 3 4 5 6 7                                   | SPGR  2.28 2.28 2.29 2.30 2.28 2.29 2.31   | VOID 6.2 6.2 5.8 5.3 6.2 5.8 4.9   | VFA<br>65<br>65<br>67<br>69<br>65<br>67       | STAB  2310 2265 2160 2262 2100 2700 2496   | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7            | SFGR 2 . 26 2 . 26 2 . 26 2 . 28 2 . 25 2 . 26 2 . 29                       | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8   | VFA 62 62 62 65 60 62 67                   | STAB  1800 1920 1920 1755 1830 2040 2295  | SAMPLE  1 2 3 4 5 6 7                                | SPGR 2.27 2.28 2.27 2.30 2.28 2.28 2.30   | VOID 6.6 6.2 6.6 5.3 6.2 6.2 5.3                                   | VFA 64 65 64 69 65 65 65                         | STAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481<br>2434<br>2010  |
| SAMPLE  1 2 3 4 5 6 7 8 9                               | SPGR  2.28 2.29 2.30 2.28 2.29 2.31 2.31   | VOID 6.2 6.2 5.8 5.3 6.2 5.8 4.9 4.9                                     | VFA 65 65 67 69 65 67 70                      | STAB  2310 2265 2160 2262 2100 2700 2496 2855  | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8       | SFGR  2 . 26 2 . 26 2 . 28 2 . 25 2 . 26 2 . 29 2 . 28                      | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8 6.2   | VFA 62 62 65 60 62 67 65                   | STAB  1800 1920 1920 1755 1830 2040 2295 2144   | SAMPLE  1 2 3 4 5 6 7 8                              | SPGR  2.27 2.28 2.27 2.30 2.28 2.28 2.30 2.30   | VOID 6.6 6.2 6.6 5.3 6.2 6.2 5.3 5.3                               | VFA 64 65 64 69 65 69 69                         | STAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481<br>2434  |
| SAMPLE  1 2 3 4 5 6 7 8 9 10                            | SPGR  2.28 2.29 2.30 2.28 2.29 2.31 2.31 2.29  | VOID 6.2 6.2 5.8 5.3 6.2 5.8 4.9 4.9 5.8                                 | VFA 65 65 67 69 65 70 70 67                   | STAB  2310 2265 2160 2262 2100 2700 2496 2855 2542   | SAMPLE  1 2 3 4 5 6 7 8 9                            | SFGR  2 . 26 2 . 26 2 . 28 2 . 25 2 . 26 2 . 29 2 . 28 2 . 28               | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8 6.2 6.2                                     | VFA 62 62 62 65 60 62 67 65                | STAB  1800 1920 1920 1755 1830 2040 2295 2144 2235  | SAMPLE  1 2 3 4 5 6 7 8 9                            | SPGR  2.27 2.28 2.27 2.30 2.28 2.28 2.28 2.30 2.30 2.29   | VOID 6.6 6.2 6.6 5.3 6.2 6.2 5.3 5.3                               | VFA 64 65 64 69 65 69 69                         | \$TAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481<br>2431<br>2010<br>2220<br>2496   |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11                         | SPGR  2.28 2.29 2.30 2.28 2.29 2.31 2.31 2.30 2.30 2.30 2.31   | VOID 6.2 6.2 5.8 5.3 6.2 5.8 4.9 5.8 5.3                                 | VFA 65 65 67 69 65 67 70 67                   | STAB  2310 2265 2160 2262 2100 2700 2496 2855 2542 2666  | SAMPLE  1 2 3 4 5 6 7 8 9                            | SFGR  2.26 2.26 2.28 2.25 2.26 2.29 2.28 2.28 2.27                          | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8 6.2 6.2 6.6                                 | VFA 62 62 62 65 60 62 67 65 65             | STAB  1800 1920 1920 1755 1830 2040 2295 2144 2235 2130   | SAMPLE  1 2 3 4 5 6 7 8 9                            | SPGR  2.27 2.28 2.27 2.30 2.28 2.28 2.30 2.30 2.29 2.29   | VOID 6.2 6.3 6.3 6.2 6.5 5.3 5.3 5.3                               | VFA 64 65 64 69 65 69 67 67                      | \$TAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481<br>2431<br>2010<br>2220<br>2486<br>2215   |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                   | SPGR  2.28 2.29 2.30 2.28 2.29 2.31 2.31 2.29 2.30 2.30 2.30 2.31 2.29                               | VOID 6.2 6.2 5.8 5.3 6.2 5.8 4.9 5.8 5.3                                 | VFA 65 67 69 65 67 70 67 69                   | 2310<br>2265<br>2160<br>2262<br>2100<br>2700<br>2496<br>2855<br>2542<br>2666<br>2777   | SAMPLE  1 2 3 4 5 6 7 8 9 10                         | SFGR  2.26 2.26 2.28 2.25 2.26 2.29 2.28 2.28 2.28 2.27 2.26                | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8 6.2 6.2 6.6 6.2                             | VFA 62 62 65 60 67 65 64 65                | STAB  1800 1920 1920 1755 1830 2040 2295 2144 2235 2130 2070                                    | SAMPLE  1 2 3 4 5 6 7 8 9 10                         | SPGR  2.27 2.28 2.27 2.30 2.28 2.28 2.30 2.29 2.29 2.29 2.29  | VOID 6.6 6.2 6.3 6.2 6.3 6.2 5.3 5.8 5.8                           | VFA 64 65 64 69 65 69 67 67                      | \$TAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481<br>2431<br>2010<br>2220<br>2496   |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                   | SPGR  2.28 2.29 2.30 2.28 2.29 2.31 2.31 2.29 2.30 2.30 2.30 2.31                                    | VOID 6.2 6.2 5.8 5.3 6.2 5.8 4.9 5.8 5.3 5.3 5.3 5.3                     | VFA 65 67 69 65 67 70 70 67 69 67 69          | STAB  2310 2265 2160 2262 2100 2700 2496 2855 2542 2666 2777 2808 2115 2356  | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12                   | SFGR  2.26 2.26 2.28 2.25 2.26 2.29 2.28 2.28 2.29 2.28 2.28                | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8 6.2 6.2 6.6 6.2 5.8                         | VFA 62 62 65 60 62 67 65 64 65             | 5TAB  1800 1920 1920 1755 1830 2040 2295 2144 2235 2130 2070 2355                               | SAMPLE  1 2 3 4 5 6 7 8 9 10 11                      | SPGR  2.27 2.28 2.27 2.30 2.28 2.28 2.30 2.29 2.29 2.29 2.29 2.30   | VOID 6.6 6.2 6.3 6.2 6.3 6.2 6.3 5.8 6.5 6.6 6.2 6.8               | VFA 64 65 64 65 65 69 67 67 65 67                | STAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481<br>2431<br>2010<br>2220<br>2496<br>2215<br>1860<br>1845  |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15             | SPGR  2.28 2.29 2.30 2.28 2.29 2.31 2.31 2.29 2.30 2.30 2.30 2.30 2.30 2.30                          | VOID 6.2 6.2 5.8 5.3 6.2 5.8 4.9 4.9 5.8 5.3 5.8 5.3 5.8                 | VFA 65 67 69 67 70 67 69 67 69 67             | STAB  2310 2265 2160 2262 2100 2700 2496 2855 2542 2666 2777 2808 2115 2356 2356   | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                | SFGR  2.26 2.26 2.28 2.25 2.26 2.29 2.28 2.28 2.27 2.28                     | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8 6.2 6.2 6.6 5.8 6.6                         | VFA 62 62 65 60 62 65 65 65 65 67 64       | 5TAB  1800 1920 1920 1755 1830 2040 2295 2144 2235 2130 2070 2355 1860                          | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                | SPGR  2.27 2.28 2.27 2.30 2.28 2.28 2.30 2.29 2.29 2.29 2.29 2.29 2.29                                    | VOID 6.6 6.2 6.3 6.2 6.2 6.3 6.2 5.3 6.3 6.6 5.6 6.2               | VFA 64 654 69 655 69 67 67 69 65                 | \$TAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481<br>2431<br>2010<br>2220<br>2496<br>2215<br>1860<br>1845<br>1965   |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16          | SPGR  2.28 2.29 2.30 2.28 2.29 2.31 2.29 2.30 2.31 2.29 2.30 2.31 2.29 2.30 2.30 2.30                | VOID 6.2 6.2 5.8 5.3 6.2 5.8 4.9 5.8 5.3 5.8 5.8 6.2                     | VFA 65 65 67 69 65 67 70 67 69 69 67 69 67 69 | 2310<br>2265<br>2160<br>2262<br>2100<br>2700<br>2496<br>2855<br>2542<br>2666<br>2777<br>2808<br>2115<br>2356<br>2356<br>2175         | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14             | SFGR  2.26 2.26 2.28 2.25 2.26 2.29 2.28 2.27 2.27                          | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8 6.2 6.2 6.6 6.6 7.0 7.0                     | VFA 62 62 65 60 67 65 64 64 64             | STAB  1800 1920 1920 1755 1830 2040 2295 2144 2235 2130 2070 2355 1860 1890 2010 1920           | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14             | SPGR  2.27 2.28 2.27 2.30 2.28 2.30 2.30 2.30 2.30 2.29 2.29 2.29 2.29 2.29 2.29 2.29 2.2                 | VOID 6.6 6.0 6.3 6.3 6.3 6.5 6.5 6.5 6.6 6.6 6.6 6.6 6.6 6.6 6.6   | VFA 64 65 64 65 69 67 67 65 65 65 65 65          | \$TAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481<br>2431<br>2010<br>2220<br>2496<br>2215<br>1860<br>1845<br>1965<br>1665                                 |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17       | SPGR  2.28 2.29 2.30 2.28 2.29 2.31 2.31 2.29 2.30 2.30 2.30 2.30 2.30 2.29 2.30 2.29 2.28 2.29      | VOID 6.2 6.2 5.3 6.2 5.8 4.9 5.3 5.3 4.8 5.3 5.8 5.8 5.8 5.8 5.8 5.8 5.8 | VFA 65 65 67 69 65 67 70 67 69 67 69 67 69 67 | 2310<br>2265<br>2160<br>2262<br>2100<br>2700<br>2496<br>2855<br>2542<br>2600<br>2777<br>2808<br>2115<br>2356<br>2356<br>2175<br>2418 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR  2.26 2.26 2.28 2.25 2.26 2.29 2.28 2.27 2.27 2.27 2.27 2.27 2.27 2.27 | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8 6.2 6.6 6.2 5.8 6.6 7.0 7.0 6.2             | VFA 622650626566766466265                  | STAB  1800 1920 1920 1755 1830 2040 2295 2144 2235 2130 2070 2355 1860 1890 2010 1920 1755      | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | \$PGR  2.27 2.28 2.27 2.30 2.28 2.28 2.30 2.29 2.29 2.29 2.29 2.29 2.29 2.29 2.2                          | VOID 6.263223388663282655555556655                                 | VFA 64 654 665 669 677 695 675 69                | \$TAB<br>1800<br>1935<br>1965<br>1825<br>2070<br>2481<br>2431<br>2010<br>2220<br>2496<br>2215<br>1860<br>1845<br>1965<br>1665<br>2012                                 |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 12 13 14 15 16 17 18       | SPGR  2.28 2.29 2.30 2.28 2.29 2.31 2.31 2.29 2.30 2.30 2.30 2.31 2.29 2.30 2.30 2.20 2.20 2.29 2.28 | VOID 6.2 6.8 5.3 6.2 5.8 4.9 4.9 5.3 5.8 5.8 5.8 5.8 5.8 5.8 5.8 5.8     | VFA 65 65 67 69 65 67 70 67 69 67 69 67 67    | 2310<br>2265<br>2160<br>2262<br>2100<br>2700<br>2496<br>2855<br>2542<br>2666<br>2777<br>2808<br>2115<br>2356<br>2356<br>2175         | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16       | SFGR  2.26 2.26 2.25 2.26 2.29 2.28 2.27 2.28 2.27 2.26 2.27 2.26 2.27 2.27 | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8 6.2 6.2 6.6 6.6 7.0 7.0                     | VFA 62 62 65 67 65 67 664 62 62            | STAB  1800 1920 1920 1755 1830 2040 2295 2144 2235 2130 2070 2355 1860 1890 2010 1920           | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 | SPGR  2.27 2.28 2.27 2.30 2.28 2.28 2.30 2.30 2.30 2.29 2.29 2.29 2.29 2.29 2.29 2.29 2.2                 | VOID 6.263223388883282632 5.5556.2                                 | VFA 645 656 657 665 667 665 665 665 665          | \$TAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481<br>2431<br>2010<br>2220<br>2496<br>2215<br>1860<br>1845<br>1965<br>1965<br>1965<br>1965<br>1965<br>1965 |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 | SPGR  2.28 2.29 2.30 2.28 2.29 2.31 2.31 2.29 2.30 2.31 2.29 2.30 2.29 2.30 2.29 2.30                | VOID 6.2 6.2 6.8 5.0 6.2 6.8 6.8 6.8 6.8 6.8 6.8 6.8 6.8 6.8 6.8         | VFA 65 67 69 65 67 70 70 67 69 67 69 67       | 2310<br>2265<br>2160<br>2262<br>2100<br>2700<br>2496<br>2855<br>2542<br>2600<br>2777<br>2808<br>2115<br>2356<br>2356<br>2175<br>2418 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR  2.26 2.26 2.28 2.25 2.26 2.29 2.28 2.27 2.27 2.27 2.27 2.27 2.27 2.27 | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8 6.2 6.6 6.2 5.8 6.6 7.0 7.0 6.2             | VFA 622650626566766466265                  | STAB  1800 1920 1920 1755 1830 2040 2295 2144 2235 2130 2070 2355 1860 1890 2010 1920 1755      | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 | SPGR  2.27 2.28 2.27 2.30 2.28 2.28 2.30 2.30 2.29 2.29 2.29 2.29 2.29 2.29 2.28 2.27 .230 2.28 2.27 .230 | VDID 6.2632233888832826328 5.5555665656565656565656565656565656565 | VFA 64549655696576656565656565656565656565656565 | \$TAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481<br>2434<br>2010<br>2220<br>2496<br>2215<br>1860<br>1845<br>1965<br>1965<br>2012<br>1935<br>2130         |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 12 13 14 15 16 17 18       | SPGR  2.28 2.29 2.30 2.28 2.29 2.31 2.31 2.29 2.30 2.30 2.30 2.31 2.29 2.30 2.30 2.20 2.20 2.29 2.28 | VOID 6.2 6.8 5.3 6.2 5.8 4.9 4.9 5.3 5.8 5.8 5.8 5.8 5.8 5.8 5.8 5.8     | VFA 65 65 67 69 65 67 70 67 69 67 69 67 67    | STAB  2310 2265 2160 2262 2100 2700 2496 2855 2542 2600 2777 2808 2115 2356 2356 2175 2418 2527                                      | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 | SFGR  2.26 2.26 2.28 2.25 2.26 2.29 2.28 2.27 2.27 2.27 2.27 2.27 2.27 2.27 | VOID  7.0 7.0 7.0 6.2 7.4 7.0 5.8 6.2 6.6 6.6 7.0 7.0 6.2 6.6 6.6 7.0 6.2 6.6 | VFA 62 62 65 60 62 65 65 67 64 62 62 65 64 | 5TAB  1800 1920 1920 1755 1830 2040 2295 2144 2235 2130 2070 2355 1860 1890 2010 1920 1755 1995 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 | SPGR  2.27 2.28 2.27 2.30 2.28 2.28 2.30 2.30 2.30 2.29 2.29 2.29 2.29 2.29 2.29 2.29 2.2                 | VOID 6.263223388883282632 5.5556.2                                 | VFA 645 656 657 665 667 665 665 665 665          | \$TAB<br>1800<br>1935<br>1965<br>1825<br>2055<br>2070<br>2481<br>2431<br>2010<br>2220<br>2496<br>2215<br>1860<br>1845<br>1965<br>1965<br>1965<br>1965<br>1965<br>1965 |

TABLE A-8
MIX TYPE 3 - ASPHALT T

| 50   | URCE=P   | TYPE=3   | ASPH=1  | 「  | SOL  | JRCE=D1  | TYPE=3  | ASPH:  | =T  | SOL  | IRCE=D2  | TYPE=3  | ASPH=   | :T  |
|--|--|--|---|--|--|--|---|--|---|--|--|---|---|---|
| SAMPLE   | SPGR   | VOID   | VFA   | STAB   | SAMPLE   | SPGR   | VOID  | VFA  | STAB  | SAMPLE   | SPGR   | ADID  | VFA   | STAB  |
| 1  | 2.36   | 3 3  | 78  | 1738   | •  | 2.30   | 5.7   | 67   | 2415  | 1  | 2.31   | 5.3   | 63  | 2389  |
|  |  |  | 74  | 1744   | 2  | 2.28   | 6.6   | 64   | 2192  | 2  | 2.28   | 6.6   | 64  | 2028  |
| 2  | 2.34   | 4.1  |   |  |  | 2.29   | 6.1   | 66   | 2375  | 3  | 2.30   | 5.7   | 67  | 2394  |
| 3  | 2.36   | 3.3  | 78  | 2056   | 3  |  |   | 70   | 2507  | 4  | 2.32   | 4.9   | 70  | 2653  |
| 4  | 2.36   | 3.3  | 78  | 1846   | 4  | 2.32   | 4.9   |  | 2668  | 5  | 2.30   | 5.7   | 67  | 2639  |
| 5  | 2.35   | 3.7  | 76  | 1856   | 5  | 2.29   | 6.1   | 66   |   | 6  | 2.31   | 5.3   | 69  | 2318  |
| 6  | 2.35   | 3.7  | 76  | 1520   | 6  | 2.33   | 4.5   | 72   | 2546  | 7  | 2.30   | 5.7   | 67  | 2379  |
| 7  | 2.34   | 4.1  | 74  | 1734   | 7  | 2.31   | 5.3   | 69   | 2440  |  |  |   | 70  | 2654  |
| 8  | 2.34   | 4.1  | 74  | 1717   | 8  | 2.31   | 5.3   | 69   | 2470  | 8  | 2.32   | 4.9   | 69  |   |
| 9  | 2.34   | 4.1  | 74  | 1599   | 9  | 2.30   | 5.7   | 67   | 2577  | 9  | 2.31   | 5.3   |   | 2456  |
| 10   | 2.34   | 4.1  | 74  | 1824   | 10   | 2.33   | 4.5   | 72   | 2638  | 10   | 2.31   | 5.3   | 69  | 2668  |
| 11   | 2.35   | 3.7  | 76  | 1728   | 1 1  | 2.32   | 4.9   | 70   | 2288  | 11   | 2.31   | 5.3   | 69  | 2361  |
| 12   | 2.34   | 4.1  | 74  | 1835   | 12   | 2.30   | 5.7   | 67   | 2668  | 12   | 2.31   | 5.3   | 69  | 2551  |
| 13   | 2.34   | 4.1  | 74  | 1652   | 13   | 2.32   | 4.9   | 70   | 2318  | 13   | 2.31   | 5.3   | 69  | 2546  |
| 14   | 2.35   | 3.7  | 76  | 1721   | 14   | 2.34   | 4.1   | 74   | 2501  | 14   | 2.32   | 4.9   | 70  | 2492  |
| 15   | 2.35   | 3.7  | 76  | 1712   | 15   | 2.31   | 5.3   | 69   | 2507  | 15   | 2.30   | 5.7   | 67  | 2610  |
| 16   | 2.35   | 3.7  | 76  | 1651   | 16   | 2.33   | 4.5   | 72   | 2624  | 16   | 2.30   | 5.7   | 67  | 2592  |
| 17   | 2.34   | 4.1  | 74  | 1749   | 17   | 2.30   | 5.7   | 67   | 2389  | 17   | 2.31   | 5.3   | 69  | 2440  |
| 18   | 2.35   | 3.7  | 76  | 1543   | 18   | 2.32   | 4.9   | 70   | 2507  | 18   | 2.32   | 4.9   | 70  | 2379  |
| 19   | 2.33   | 4.5  | 72  | 1498   | 19   | 2.31   | 5.3   | 69   | 2522  | 19   | 2.32   | 4.9   | 70  | 2389  |
| 20   | 2.36   | 3.3  | 78  | 1867   | 20   | 2,32   | 4.9   | 70   | 2933  | 20   | 2.30   | 5.7   | 67  | 3034  |
|  |  |  |   |  |  |  |   |  |   |  |  |   |   |   |
| SOU  | RCE=R1   | TYPE=3   | ASPH=1  | ·  | SOU!   | RCE≃R2   | TYPE=3  | ASPH=  | T   | SOU  | RCE=R3   | TYPE=3  | ASPH=   | T / ·   |
| SOU<br>SAMPLE  | RCE=R1<br>SPGR   | TYPE=3   | ASPH=1  | STAB   | SOUI   | RCE=R2<br>SPGR   | TYPE=3  | ASPH≃^<br>VFA  | T   | SOU<br>SAMPLE  | RCE=R3<br>SPGR   | TYPE=3  | ASPH=   | T STAB  |
| SAMPLE   | SPGR   | VOID   | VFA   | STAB   |  |  |   |  |   |  |  |   |   |   |
| SAMPLE<br>1  | SPGR<br>2.28   | V01D<br>6.6  | VFA<br>64                                     | STAB<br>2055   | SAMPLE   | SPGR   | VOID  | VFA  | STAB  | SAMPLE   | SPGR   | VOID  | VFA   | STAB  |
| SAMPLE<br>1<br>2                                     | SPGR<br>2.28<br>2.27   | VOID<br>6.6<br>7.0                                   | VFA<br>64<br>62                               | STAB<br>2055<br>1950   | SAMPLE<br>1  | SPGR<br>2.30   | V0ID<br>5.7   | VFA<br>67  | STAB<br>2542  | SAMPLE<br>1  | SPGR<br>2.27<br>2.26   | V0ID<br>7.0   | VFA   | STAB<br>· 1580  |
| SAMPLE<br>1<br>2<br>3                                | SPGR<br>2.28<br>2.27<br>2.29   | VOID<br>6.6<br>7.0<br>6.1                            | VFA<br>64                                     | STAB<br>2055   | SAMPLE<br>1<br>2                                     | SPGR<br>2.30<br>2.27   | VOID<br>5.7<br>7.0  | VFA<br>67<br>62  | STAB<br>2542<br>2625  | SAMPLE<br>1<br>2                                     | SPGR<br>2.27   | VOID<br>7.0<br>7.4  | VFA<br>62<br>61   | STAB<br>- 1580<br>1665  |
| SAMPLE  1 2 3 4                                      | SPGR 2.28 2.27 2.29 2.29   | VOID<br>6.6<br>7.0                                   | VFA<br>64<br>62<br>66                         | STAB<br>2055<br>1950<br>2550   | SAMPLE<br>1<br>2<br>3                                | SPGR<br>2.30<br>2.27<br>2.30   | VOID<br>5.7<br>7.0<br>5.7   | VFA<br>67<br>62<br>67  | STAB<br>2542<br>2625<br>2995  | SAMPLE  1 2 3  | SPGR<br>2.27<br>2.26<br>2.28   | VOID<br>7.0<br>7.4<br>6.6   | VFA<br>62<br>61<br>64                                     | STAB<br>- 1580<br>- 1665<br>- 1755  |
| SAMPLE<br>1<br>2<br>3<br>4<br>5                      | SPGR 2.28 2.27 2.29 2.29 2.28  | VOID 6.6 7.0 6.1 6.1 6.6                             | VFA<br>64<br>62<br>66<br>66                   | STAB<br>2055<br>1950<br>2550<br>2370   | SAMPLE  1 2 3 4                                      | SPGR<br>2.30<br>2.27<br>2.30<br>2.30                                       | VOID<br>5.7<br>7.0<br>5.7<br>5.7                                  | VFA<br>67<br>62<br>67<br>67  | STAB<br>2542<br>2625<br>2995<br>3026  | SAMPLE  1 2 3 4                                      | SPGR 2.27 2.26 2.28 2.27   | VOID 7.0 7.4 6.6 7.0  | VFA<br>62<br>61<br>64<br>62                               | STAB<br>- 1580<br>- 1665<br>- 1755<br>- 2070  |
| SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6                 | SPGR 2.28 2.27 2.29 2.29 2.28 2.29   | VOID 6.6 7.0 6.1 6.6 6.6 6.1                         | VFA<br>64<br>62<br>66<br>66<br>64             | STAB<br>2055<br>1950<br>2550<br>2370<br>2880   | SAMPLE  1 2 3 4 5                                    | SPGR 2.30 2.27 2.30 2.30 2.30 2.32   | VOID 5.7 7.0 5.7 5.7 4.9  | VFA<br>67<br>62<br>67<br>67<br>70  | STAB  2542 2625 2995 3026 2855  | SAMPLE  1 2 3 4 5                                    | SPGR 2.27 2.26 2.28 2.27 2.28  | VOID 7.0 7.4 6.6 7.0 6.6  | VFA<br>62<br>61<br>64<br>62<br>64                         | STAB<br>- 1580<br>- 1665<br>- 1755<br>- 2070<br>- 1711  |
| SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7            | SPGR  2.28 2.27 2.29 2.29 2.28 2.29 2.31   | VOID 6.6 7.0 6.1 6.1 6.6 6.1 5.3                     | VFA<br>64<br>62<br>66<br>66<br>64<br>66<br>69 | STAB  2055 1950 2550 2370 2880 2465 2542   | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7            | SPGR 2.30 2.27 2.30 2.30 2.32 2.32 2.31                                    | VOID 5.7 7.0 5.7 5.7 4.9 4.9                                      | VFA<br>67<br>62<br>67<br>67<br>70  | STAB  2542 2625 2995 3026 2855 3007   | SAMPLE  1 2 3 4 5 6                                  | SPGR  2.27 2.26 2.28 2.27 2.28 2.30 2.29   | VOID  7.0 7.4 6.6 7.0 6.6 5.7   | VFA 62 61 64 62 64 67                                     | STAB<br>- 1580<br>- 1665<br>- 1755<br>- 2070<br>- 1711<br>- 1997                                |
| SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8       | SPGR 2.28 2.27 2.29 2.29 2.28 2.29 2.31 2.32   | VOID 6.6 7.0 6.1 6.6 6.1 5.3 4.9                     | VFA 64 62 66 66 64 66 69 70                   | STAB  2055 1950 2550 2370 2880 2465 2542 2480  | SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8       | SPGR 2.30 2.27 2.30 2.30 2.32 2.32 2.31 2.33                               | VOID 5.7 7.0 5.7 5.7 4.9 4.9 5.3                                  | VFA<br>67<br>62<br>67<br>67<br>70<br>70<br>69  | STAB  2542 2625 2995 3026 2855 3007 2964  | SAMPLE  1 2 3 4 5 6 7                                | SPGR  2.27 2.26 2.28 2.27 2.28 2.30 2.29 2.30  | VOID  7.0 7.4 6.6 7.0 6.6 5.7 6.1                                     | VFA 62 61 64 62 64 67 66                                  | STAB<br>- 1580<br>- 1665<br>- 1755<br>- 2070<br>- 1711<br>- 1997<br>- 1785                      |
| SAMPLE<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9  | SPGR  2.28 2.27 2.29 2.29 2.28 2.29 2.31 2.32 2.29   | VOID 6.6 7.0 6.1 6.1 6.6 6.1 5.3 4.9 6.1             | VFA 64 62 66 66 64 66 69 70 66                | STAB  2055 1950 2550 2370 2880 2465 2542 2480 2070   | SAMPLE  1 2 3 4 5 6 7 8 9                            | SPGR 2.30 2.27 2.30 2.30 2.32 2.32 2.31 2.33 2.32                          | VOID 5.7 7.0 5.7 5.7 4.9 4.9 5.3 4.5 4.9                          | VFA<br>67<br>62<br>67<br>67<br>70<br>70<br>69<br>72  | STAB  2542 2625 2995 3026 2855 3007 2964 2933 2293  | SAMPLE  1 2 3 4 5 6 7 8 9                            | SPGR  2.27 2.26 2.28 2.27 2.28 2.30 2.29 2.30 2.30   | VOID  7.0 7.4 6.6 7.0 6.6 5.7 6.1 5.7 5.7                             | VFA 62 61 64 62 64 67 66 67                               | STAB<br>- 1580<br>- 1665<br>- 1755<br>- 2070<br>- 1711<br>- 1997<br>- 1785<br>- 1997<br>- 1685  |
| SAMPLE  1 2 3 4 5 6 7 8 9                            | SPGR  2.28 2.27 2.29 2.29 2.28 2.29 2.31 2.32 2.29 2.30  | VOID 6.6 7.0 6.1 6.1 6.6 6.1 5.3 4.9 6.1 5.7         | VFA 64 62 66 66 64 66 69 70 66 67             | STAB  2055 1950 2550 2370 2880 2465 2542 2480 2070 2542  | SAMPLE  1 2 3 4 5 6 7 8 9                            | SPGR 2.30 2.27 2.30 2.30 2.32 2.32 2.31 2.33 2.32 2.32                     | VOID 5.7 7.0 5.7 5.7 5.7 4.9 4.9 5.3 4.5 4.9 4.9                  | VFA 67 62 67 67 70 70 69 72 70   | STAB  2542 2625 2995 3026 2855 3007 2964 2933   | SAMPLE  1 2 3 4 5 6 7 8                              | SPGR  2.27 2.26 2.28 2.27 2.28 2.30 2.30 2.30 2.30   | VOID  7.0 7.4 6.6 7.0 6.6 5.7 6.1 5.7                                 | VFA 62 61 64 62 64 67 66                                  | STAB<br>1580<br>1665<br>1755<br>2070<br>1711<br>1997<br>1785<br>1997<br>1685<br>2122            |
| SAMPLE  1 2 3 4 5 6 7 8 9 10                         | SPGR  2.28 2.27 2.29 2.28 2.29 2.31 2.32 2.29 2.30 2.28  | VOID 6.6 7.0 6.1 6.6 6.1 5.3 4.9 6.1 5.7 6.6         | VFA 64 62 66 66 64 66 69 70 66 67 64          | STAB  2055 1950 2550 2370 2880 2465 2542 2480 2070 2542 1860                                     | SAMPLE  1 2 3 4 5 6 7 8 9 10 11                      | SPGR 2.30 2.27 2.30 2.30 2.32 2.32 2.31 2.33 2.32 2.32 2.31                | VOID 5.7 7.0 5.7 5.7 4.9 4.9 5.3 4.5 4.9 4.9 5.3                  | VFA 67 62 67 70 70 69 72 70 70 69  | STAB  2542 2625 2995 3026 2855 3007 2964 2933 2293 2854   | SAMPLE  1 2 3 4 5 6 7 8 9 10 11                      | SPGR  2.27 2.26 2.28 2.27 2.28 2.30 2.29 2.30 2.30 2.30 2.28   | VOID  7.0 7.4 6.6 7.0 6.6 5.7 6.1 5.7 5.7 6.6                         | VFA 62 61 64 62 64 67 66 67 67                            | STAB  1580 1665 1755 2070 1711 1997 1785 1997 1685 2122 1740                                    |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11                      | SPGR  2.28 2.27 2.29 2.28 2.29 2.31 2.32 2.30 2.28 2.31  | VOID 6.6 7.0 6.1 6.6 6.1 5.3 4.9 6.1 5.7 6.6 5.3     | VFA 64 62 66 66 64 66 67 66 64 69             | STAB  2055 1950 2550 2370 2880 2465 2542 2480 2070 2542 1860 2574                                | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12                   | SPGR 2.30 2.27 2.30 2.30 2.32 2.31 2.33 2.32 2.31 2.31 2.31                | VOID 5.7 7.0 5.7 5.7 4.9 4.9 5.3 4.5 4.9 5.3 5.3                  | VFA 67 62 67 70 70 69 72 70 70   | STAB  2542 2625 2995 3026 2855 3007 2964 2933 2293 2293 2854 2683                               | SAMPLE  1 2 3 4 5 6 7 8 9 10                         | SPGR  2.27 2.26 2.28 2.27 2.28 2.30 2.29 2.30 2.30 2.30 2.30 2.28 2.31                               | VOID  7.0 7.4 6.6 7.0 6.6 5.7 6.1 5.7 5.7                             | VFA 62 61 64 62 64 67 66 67 67 67 64                      | STAB<br>1580<br>1665<br>1755<br>2070<br>1711<br>1997<br>1785<br>1997<br>1685<br>2122            |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                | SPGR  2.28 2.27 2.29 2.29 2.28 2.29 2.31 2.32 2.29 2.30 2.28 2.31 2.30                               | VOID 6.6 7.0 6.1 6.6 6.1 5.3 4.9 6.1 5.7 6.6 5.3 5.7 | VFA 64 62 66 64 66 69 70 66 67 64 69 67       | STAB  2055 1950 2550 2370 2880 2465 2542 2480 2070 2542 1860 2574 1888                           | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                | SPGR 2.30 2.27 2.30 2.30 2.32 2.31 2.33 2.32 2.31 2.31 2.31 2.33           | VOID 5.7 7.0 5.7 5.7 4.9 4.9 5.3 4.5 4.9 4.9 5.3                  | VFA 67 62 67 70 70 69 72 70 69 69  | STAB  2542 2625 2995 3026 2855 3007 2964 2933 2293 2854 2683 3010                               | SAMPLE  1 2 3 4 5 6 7 8 9 10 11                      | SPGR  2.27 2.26 2.28 2.27 2.28 2.30 2.29 2.30 2.30 2.30 2.28   | VOID  7.0 7.4 6.6 7.0 6.6 5.7 6.1 5.7 5.7 5.7 6.6 5.3                 | VFA 62 61 64 62 64 67 66 67 67 64 69                      | STAB  - 1580 - 1665 - 1755 - 2070 - 1711 - 1997 - 1785 - 1997 - 1685 - 2122 - 1740 - 2044       |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                | SPGR  2.28 2.27 2.29 2.28 2.29 2.31 2.32 2.29 2.30 2.30 2.30 2.30                                    | VOID 6.6 7.0 6.1 6.1 6.6 6.1 5.3 4.9 6.1 5.7 6.6 5.3 | VFA 64 62 66 64 66 69 70 66 67 64 69 67       | STAB  2055 1950 2550 2370 2880 2465 2542 2480 2070 2542 1860 2574 1888 2480                      | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14             | SPGR  2.30 2.27 2.30 2.30 2.32 2.31 2.33 2.32 2.31 2.33 2.31 2.33 2.32     | VOID  5.7 7.0 5.7 5.7 4.9 4.9 5.3 4.5 4.9 5.3 4.5 4.9 5.3 4.5     | VFA 67 62 67 70 70 69 72 70 69 69 69 72  | STAB  2542 2625 2995 3026 2855 3007 2964 2933 2293 2854 2683 3010 2340                          | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13                | SPGR  2.27 2.26 2.28 2.27 2.28 2.30 2.29 2.30 2.30 2.30 2.30 2.31 2.30 2.30 2.31                     | VOID  7.0 7.4 6.6 7.0 6.6 5.7 6.1 5.7 5.7 5.7 5.7 6.6 5.3 5.7         | VFA 62 61 64 62 64 67 66 67 67 64 69 67                   | STAB  1580 1665 1755 2070 1711 1997 1785 1997 1685 2122 1740 2044 1685                          |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15          | SPGR  2.28 2.27 2.29 2.29 2.28 2.29 2.31 2.32 2.29 2.30 2.28 2.31 2.30 2.28 2.30 2.29                | VOID 6.6 7.0 6.1 6.6 6.1 5.3 4.9 6.1 5.7 6.6         | VFA 64 62 66 66 69 70 66 67 67 66             | STAB  2055 1950 2550 2370 2880 2465 2542 2480 2070 2542 1860 2574 1888 2480 2168                 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15          | SPGR  2.30 2.27 2.30 2.30 2.32 2.31 2.33 2.32 2.31 2.31 2.33 2.32 2.31     | VOID  5.7 7.0 5.7 5.7 4.9 4.9 5.3 4.5 4.9 5.3 4.5 4.9 5.3 5.3     | VFA 67 62 67 70 70 69 72 70 69 69 69 72 70   | STAB  2542 2625 2995 3026 2855 3007 2964 2933 2293 2854 2683 3010 2340 2590                     | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14             | SPGR  2.27 2.26 2.28 2.27 2.28 2.30 2.30 2.30 2.30 2.30 2.30 2.30 2.30                               | VOID  7.0 7.4 6.6 7.0 6.6 5.7 6.1 5.7 5.7 6.6 5.3 5.7 5.7 5.7         | VFA 62 61 64 62 64 67 66 67 67 67 67 67                   | STAB  1580 1665 1755 2070 1711 1997 1785 1997 1685 2122 1740 2044 1685 1997 1669                |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16       | SPGR  2.28 2.27 2.29 2.29 2.31 2.32 2.29 2.31 2.30 2.28 2.30 2.29 2.30 2.28                          | VOID 6.6 7.0 6.1 6.6 6.1 5.3 4.9 6.1 5.7 6.6 5.7 6.6 | VFA 64 62 66 66 64 66 67 64 69 67 66 67       | STAB  2055 1950 2550 2370 2880 2465 2542 2480 2070 2542 1860 2574 1888 2480 2168 2085            | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16       | SPGR 2.30 2.27 2.30 2.30 2.32 2.31 2.33 2.32 2.31 2.31 2.31 2.31           | VOID  5.7 7.0 5.7 5.7 4.9 4.9 5.3 4.5 4.9 5.3 4.5 4.9 5.3 5.3 5.7 | VFA 67 62 67 70 70 69 72 70 69 72 70 69 69 72 70 69 67   | STAB  2542 2625 2995 3026 2855 3007 2964 2933 2293 2854 2683 3010 2340 2340 2590 2964 2777      | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16       | SPGR  2.27 2.26 2.28 2.27 2.28 2.30 2.30 2.30 2.30 2.31 2.30 2.30 2.30 2.30 2.30 2.30                | VOID  7.0 7.4 6.6 7.0 6.6 5.7 6.1 5.7 5.7 6.6 5.7 5.7 6.6             | VFA 62 61 62 64 67 66 67 67 64 69 67 67 64                | STAB  1580 1665 1755 2070 1711 1997 1785 1997 1685 2122 1740 2044 1685 1997 1669                |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR  2.28 2.29 2.29 2.28 2.29 2.31 2.30 2.28 2.31 2.30 2.28 2.30 2.28 2.31                          | VOID 6.6 7.0 6.1 6.6 6.1 5.3 4.9 6.1 5.7 6.6 5.7     | VFA 64 62 66 66 64 66 67 64 69 67 66 67       | STAB  2055 1950 2550 2370 2880 2465 2542 2480 2070 2542 1860 2574 1888 2480 2168 2085 1607       | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR 2.30 2.27 2.30 2.30 2.32 2.31 2.33 2.32 2.31 2.31 2.33 2.32 2.31 2.31 | VOID 5.7 7.0 5.7 5.7 4.9 4.9 5.3 4.5 4.9 5.3 5.3 4.5 5.3 5.3      | VFA 67 62 67 70 70 69 72 70 70 69 72 70 69 69 69 72 70 69  | STAB  2542 2625 2995 3026 2855 3007 2964 2933 2293 2293 2854 2683 3010 2340 2590 2964 2777 2434 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR  2.27 2.28 2.27 2.28 2.30 2.29 2.30 2.30 2.30 2.30 2.30 2.30 2.30 2.28 2.31 2.30 2.30 2.30 2.30 | VOID  7.0 7.4 6.6 7.0 6.6 5.7 6.1 5.7 5.7 6.6 5.3 5.7 5.7 6.6 6.6     | VFA 62 61 64 62 64 67 66 67 67 67 67 64 69 67 67 67       | STAB  1580 1665 1755 2070 1711 1997 1785 1997 1685 2122 1740 2044 1685 1997 1669 1740 1440      |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 | SPGR  2.28 2.27 2.29 2.28 2.29 2.31 2.32 2.29 2.30 2.30 2.28 2.31 2.30 2.30 2.29 2.28 2.30 2.30 2.30 | VOID 6.6 7.0 6.1 6.6 6.1 5.3 4.9 6.1 5.7 6.6 5.7 5.7 | VFA 64 62 66 64 66 69 70 66 67 64 69 67 66 67 | \$TAB  2055 1950 2550 2370 2880 2465 2542 2480 2070 2542 1860 2574 1888 2480 2168 2085 1607 2309 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 | SPGR 2.30 2.27 2.30 2.30 2.32 2.31 2.33 2.32 2.31 2.31 2.33 2.32 2.31 2.31 | VOID 5.7 7.0 5.7 4.9 4.9 5.3 4.5 4.9 5.3 4.5 5.3 4.5 4.9 5.3 4.9  | VFA 67 62 67 70 70 69 72 70 69 72 70 69 69 72 70 69 67   | STAB  2542 2625 2995 3026 2855 3007 2964 2933 2293 2854 2683 3010 2340 2340 2590 2964 2777      | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 | SPGR  2.27 2.26 2.28 2.27 2.28 2.30 2.29 2.30 2.30 2.30 2.30 2.30 2.30 2.30 2.30                     | VOID  7.0 7.4 6.6 7.0 6.6 5.7 6.1 5.7 5.7 6.6 5.3 5.7 5.7 6.6 6.6 5.7 | VFA 62 61 64 62 64 67 66 67 67 67 67 67 67 67 67 67 67 67 | STAB  1580 1665 1755 2070 1711 1997 1785 1997 1685 2122 1740 2044 1685 1997 1669 1740 1440 1685 |
| SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR  2.28 2.29 2.29 2.28 2.29 2.31 2.30 2.28 2.31 2.30 2.28 2.30 2.28 2.31                          | VOID 6.6 7.0 6.1 6.6 6.1 5.3 4.9 6.1 5.7 6.6 5.7     | VFA 64 62 66 66 64 66 67 64 69 67 66 67       | STAB  2055 1950 2550 2370 2880 2465 2542 2480 2070 2542 1860 2574 1888 2480 2168 2085 1607       | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR 2.30 2.27 2.30 2.30 2.32 2.31 2.33 2.32 2.31 2.31 2.33 2.32 2.31 2.31 | VOID 5.7 7.0 5.7 5.7 4.9 4.9 5.3 4.5 4.9 5.3 5.3 4.5 5.3 5.3      | VFA 67 62 67 70 70 69 72 70 69 69 72 70 69 69 72 70 69 70 70 69 70 70 70 70 70 70 70 70 70 70 70 70 70 | STAB  2542 2625 2995 3026 2855 3007 2964 2933 2293 2854 2683 3010 2340 2590 2964 2777 2434 2527 | SAMPLE  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17    | SPGR  2.27 2.28 2.27 2.28 2.30 2.29 2.30 2.30 2.30 2.30 2.30 2.30 2.30 2.28 2.31 2.30 2.30 2.30 2.30 | VOID  7.0 7.4 6.6 7.0 6.6 5.7 6.1 5.7 5.7 6.6 5.3 5.7 5.7 6.6 6.6     | VFA 62 61 64 62 64 67 66 67 67 67 67 64 69 67 67 67       | STAB  1580 1665 1755 2070 1711 1997 1785 1997 1685 2122 1740 2044 1685 1997 1669 1740 1440      |

# APPENDIX B

# STATISTICAL PARAMETERS

| Table | No. |     |      |   |   |         |   |              | Page | No. |
|-------|-----|-----|------|---|---|---------|---|--------------|------|-----|
| B-1   |     | Mix | Туре | 1 | _ | Asphalt | E |              | 5    | 1   |
| B-2   |     | Mix | Туре | 1 | _ | Asphalt | L |              | 5    | 2   |
| B-3   |     | Mix | Type | 1 |   | Asphalt | S |              | 5    | 3   |
| B-4   |     | Mix | Type | 1 | _ | Asphalt | T |              | 5    | 4   |
| B-5   |     | Mix | Туре | 3 | _ | Asphalt | Ε |              | 5    | 5   |
| B-6   |     | Mix | Type | 3 | ~ | Asphalt | L |              | 5    | 6   |
| B-7   |     | Mix | Type | 3 | _ | Asphalt | S |              | 5    | 7   |
| B-8   |     | Mix | Type | 3 | _ | Asphalt | Т |              | 5    | 8   |
| B-9   |     | All | Type | 1 | M | ix      |   |              | 5    | 9   |
| B-10  | )   | All | Type | 3 | M | ix      |   |              | 6    | 0   |
| B-11  | 1.  |     |      |   |   |         |   | Compaction - | 6    | 1   |

TABLE B-1

MIX TYPE 1 - ASPHALT E

| YARTABLE              | Z                                       | MEAN               | STANDARD<br>DEVIATION | MIN1MUM<br>VALUE | MAXIMUM<br>VALUE |                                      |
|-----------------------|---|--------------------|-----------------------|------------------|------------------|--------------------------------------|
|                       |   | TYPEs1             | ASPH=L                | SOURCE=D1        |                  | i<br>i<br>t<br>1<br>1<br>1<br>1      |
| 0                     | 5                                       | D. 73.4            | 0.017                 | 2.300            | 2.360            | 0.711                                |
| VOTD                  |   | 4.000.4<br>.000.00 | 0.664                 | 3.300            | 5.700            | 15.344                               |
| VE V                  | 2.1                                     | 71.857             | 3.321                 | 65.000           | 77.000           | 4.622                                |
| STAB                  | 21                                      | 2218.571           | 403.782               | 1699.000         | 3203,000         | 18.200                               |
|                       | 1 | TYPE=1             | ASPH=L                | SOURCE=D2        |                  |                                      |
| abas                  | , c                                     | 2 338              | 0.015                 | 2.310            | 2.360            | 0.657                                |
| VOTB                  | 21                                      | 4.176              | 0.615                 | 3.300            | 5.300            | 14.720                               |
| 757 / N               | 21                                      | 72.619             | 3.074                 | 67.000           | 77.000           | 4.233                                |
| STAB                  | 21                                      | 2269.095           | 284.287               | 1630.000         | 2679.000         | 12.529                               |
|                       |   | TYPE=1             | ASPH=L                | SOURCE=P         |                  | \$<br>                               |
| abas                  | 0.1                                     | 2.361              | 0.015                 | 2.320            | 2.380            | 0.627                                |
| V010                  | 100                                     | 3.262              | 0.592                 | 2.500            | 4.900            | 18.149                               |
| VFA                   | 21                                      | 77.286             | 3.101                 | 000.69           | 82.000           | 4.012                                |
| STAB                  | 2.1                                     | 1581.952           | 246.947               | 1118.000         | 2058.000         | 15.610                               |
|                       | ;<br>;<br>;<br>;<br>;                   | TYPE=1             | ASPH=L                | SOURCE=R1        |                  |                                      |
| SPGR                  | 21                                      | 2.339              | 0.017                 | 2.310            | 2.370            | 0.719                                |
| VOID                  | 2.1                                     | 4.157              | 0.673                 | 2.900            | 5.300            | 16.183                               |
| VFA                   | 2.1                                     | 72.714             | 3.364                 | 67.000           | 79.000           | 4.626                                |
| STAB                  | 2.1                                     | 1794.810           | 184.036               | 1466.000         | 2064.000         | 10.254                               |
|                       |   | TYPE=1             | ASPH=L                | SOURCE=R2        |                  | 1<br>5<br>6<br>1<br>5<br>1<br>1<br>2 |
| d5/d5                 | 2.1                                     | 2,353              | 0.015                 | 2.330            | 2.380            | 0.621                                |
| VOID                  | 21                                      | 3.567              | 0.584                 | 2.500            | 4.500            | 16.380                               |
| V F A                 | 21                                      | 75.714             | 3.019                 | 71.000           | 82.000           | 3.987                                |
| STAB                  | 21                                      | 1935.857           | 200.673               | 1607.000         | 2323.000         | 10.366                               |
| ;<br>;<br>!<br>!<br>! | :<br>!<br>!<br>!<br>:                   | SE SE PE           | ASPITEI               | SpingCe=R3       |                  | :<br>:<br>:<br>!<br>!<br>!<br>!<br>! |
| 3595                  | 0                                       | 2.335              | 0.016                 | 2.310            | 2.370            | 0.685                                |
| V01D                  | 21                                      | 4.290              | 0.640                 | 2.900            | 5.300            | 14.922                               |
| VFA                   | 22                                      | 72.048             | 3.201                 | 67.000           | 79.000           | 4,443                                |
| STAB                  | 21                                      | 1552,286           | 205.732               | 1170.000         | 1903.000         | 13.253                               |

TABLE B-2

MIX TYPE 1 - ASPHALT L

| VARIABLE                                | z  | MEAN                                 | STANDARD<br>DEVIATION              | MINIMUM<br>VALUE                     | MAXIMUM<br>VALUE                                    | C . V .                                   |
|---|--|--------------------------------------|------------------------------------|--------------------------------------|---|---|
| 1 | 1            | TYPE=1                               | ASPH=E                             | SOURCE=D1                            |   |   |
| SPGR<br>VOID<br>VFA<br>STAB             | <u>ស ស ស ស</u>                                     | 2.326<br>4.273<br>73.933<br>1649.933 | 0.017<br>0.720<br>3.240<br>221.043 | 2.290<br>3.300<br>67.000<br>1316.000 | 2.350<br>5.800<br>79.000<br>2171.000                | 0.741<br>16.839<br>4.382<br>13.397        |
|   |  | TYPE=1                               | ASPH≃E                             | SOURCE=D2                            |   | F 1 5 6 5 7 5                             |
| SPGR<br>VOID<br>VFA<br>STAB             | <del>1</del> 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   | 2.326<br>4.273<br>73.733<br>1764.933 | 0.018<br>0.766<br>3.327<br>187.790 | 2.290<br>3.700<br>67.000<br>1558.000 | 2.340<br>5.800<br>76.000<br>2171.000                | 0.793<br>17.919<br>4.512<br>10.640        |
|   | 1            | TYPE=1                               | 1 ASPH=E                           | SOURCE=P                             | ;<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 | 1<br>1<br>1<br>2<br>5<br>2<br>2<br>8<br>8 |
| SPGR<br>VOID<br>VFA<br>STAB             | <u>ក្រក</u> ភ                                      | 2.333<br>3.993<br>75.200<br>1528.067 | 0.009<br>0.353<br>1.521<br>156.427 | 2.320<br>3.300<br>73.000<br>1199.000 | 2.350<br>4.500<br>79.000<br>1750.000                | 0.379<br>8.852<br>2.023<br>10.237         |
|   | 1<br>1<br>3<br>3<br>1<br>1<br>1<br>1               | TYPE=1                               | ASPH=E                             | SOURCE=R1                            |   |   |
| SPGR<br>VOID<br>VFA<br>STAB             | 51<br>51<br>51                                     | 2.306<br>5.067<br>70.267<br>1661.067 | 0.016<br>0.659<br>2.987<br>197.808 | 2.260<br>4.100<br>62.000<br>1357.000 | 2.330<br>7.000<br>75.000<br>1960.000                | 0.692<br>13.000<br>4.251<br>11.908        |
|   | 1 1 1 1 1 1 1                                      | TYPE=1                               | ASPH=E                             | SOURCE=R2                            |   |   |
| SPGR<br>VOID<br>VFA<br>STAB             | <del>2</del> 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 | 2.315<br>4.700<br>72.067<br>1848.867 | 0.015<br>0.613<br>2.915<br>209.646 | 2.280<br>4.100<br>65.000<br>1622.000 | 2.330<br>6.200<br>75.000<br>2262.000                | 0.629<br>13.042<br>4.044<br>11.339        |
|   | <br>   | TYPE=1                               | ASPH=E                             | SOURCE=R3                            |   | 1   |
| SPGR<br>VOID<br>VFA<br>STAB             | <u>ស ស ស</u> ស                                     | 2.298<br>5.413<br>68.667<br>1406.600 | 0.012<br>0.525<br>2.257<br>117.260 | 2.270<br>4.900<br>64.000<br>1200.000 | 2.310<br>6.600<br>71.000<br>1622.000                | 0.525<br>9.696<br>3.287<br>8.336          |

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TABLE B-3
MIX TYPE 1 - ASPHALT S

| VARIABLE | И     | MEAN     |          | VALUE<br>MINIMUM   |                 | C.V.    |
|----------|-------|----------|----------|--------------------|-----------------|---------|
|          | ~~=~~ | TYPE=1   | ASPH=S   | SOURCE=D1          |                 |         |
| SPGR     | 20    | 2.285    | 0.016    | 2,250              | 2.310           | 0.703   |
| V01D     | 20    | 5.590    | 0.659    | 4.500              |                 | 11.794  |
| VI       | 20    | 68.900   | 2.827    | 64.000<br>2064.000 | 74.000          | 4 . 102 |
| STAB     | 20    | 2493.900 | 263.018  | 2064.000           | 2922.000        | 10.546  |
|          |       | TYPE = 1 | ASPH=S   | SOURCE=D2          |                 |         |
| SPGR     | 20    | 2.290    | 0.015    | 2.260              | 2.320           | 0.641   |
| ADID     | 20    | 5,365    | 0.616    | 4.100              | 6.600           | 11.479  |
| VFA      | 20    | 69.900   | 2.532    | 65.000             | 75.000          | 3.622   |
| STAB     | 20    | 2535.650 | 367.105  | 1611.000           | 2939.000        | 14.478  |
|          |       | TYPE=    | 1 ASPH=S | SOURCE=P           |                 |         |
| SPGR     | 20    | 2.310    | 0.015    | 2.270              | 2.330           | 0.635   |
| AOID     | 20    | 4.515    | 0.625    | 3.700              | 6.200<br>77.000 | 13.846  |
| VFA      | 20    | 73.450   | 2.819    | 66.000             | 77.000          | 3.837   |
| STAB     | 20    | 1968.750 | 298.688  | 1516.000           | 2506.000        | 15.171  |
|          |       | TYP[=1   | ASPH≈S   | SOURCE=R1          |                 |         |
| SPGR     | 20    | 2.289    | 0.019    | 2.250              | 2.330           | 0.820   |
| VOID     | 20    | 5.395    | 0.786    | 3.700              | 7.000           | 14.564  |
| A.L.V    | 20    | 69.700   | 3.262    | 64.000             | 77.000          | 4.680   |
| STAB     | 20    | 2650.300 | 383.242  | 1650.000           | 3304.000        | 14.460  |
|          |       | TYPE=1   | ASPH=S   | SOURCE=R2          |                 |         |
| SPGR     | 20    | 2.273    | 0.018    | 2.230              | 2.310           | 0.772   |
| VOID     | 20    | 6.060    | 0.726    | 4.500              | 7.900           | 11.988  |
| VFA      | 20    | 67.000   | 2.938    | 60.000             | 74.000          | 4.385   |
| STAB     | 20    |          |          |                    | 2774.000        | 10.956  |
|          |       | TYPE=1   | ASPH=S   | SOURCE=R3          |                 |         |
| SPGR     | 20    | 2.279    | 0.019    | 2.250              | 2.320           | 0.829   |
| AOTO     | 20    | 5.830    | 0.776    | 4.100              | 7.000           | 13,311  |
| VIA      | 20    | 68.100   | 3.144    | 64.000             | 75.000          | 4.617   |
| STAB     | 20    | 2037.600 | 184.786  | 1695.000           | 2340.000        | 9.069   |

TABLE B-4

MIX TYPE 1 - ASPHALT T

| > 0                   |   | 0.466<br>8.665<br>2.892<br>9.013     | 1 | 0.471<br>8.670<br>2.939  | 1                      |  | 0.320 |        |  |   |       |       | 2.967  |              |   | 0.478 |       |        |          |                                 |       |       | 2.404              |   |
|-----------------------|---|--------------------------------------|---|--------------------------|------------------------|--|-------|--------|--|---|-------|-------|--------|--------------|---|-------|-------|--------|----------|---------------------------------|-------|-------|--------------------|---|
| MAX1MUM<br>VALUE      | <br>                                    | 2.320<br>6.200<br>73.000<br>2455.000 | 1 | 2.320<br>6.200<br>73.000 | 2485.000               |  | 2.340 | 77 000 | 2019.000                               |   | 2.310 | 009.9 | 71.000 | 7325.000     |   | 2.320 | 6.200 | 73.000 | 2730.000 |                                 | 2.300 | 6.600 | 70.000             |   |
| MINIMUM               | Source=D1                               | 2.280<br>4.500<br>66.000<br>1716.000 | SOURCE=D2                               | 2.280                    | 1814.000<br>SOURCE = D | -  | 2.320 | 3.700  | 1299.000                               | SOURCE=R1                               | 2.270 | 4.900 | 64.000 | 1669.000     | SOURCE=R2                               | 2.280 | 4.500 | 000.99 | 1622.000 | SOURCE=R3                       | 2.270 | 5.300 | 64.000<br>1530.000 |   |
| STANDARD<br>DEVLATION | ASPH=T                                  | 0.011<br>0.472<br>1.984<br>182.717   | ASPH≃T                                  | 0.011                    | -                      | _  | 0.007 | 0.298  | 212.459                                | ASPH=T                                  | 0.011 | 0.496 | 1.996  | 197.805      | ASPH≖T                                  | 0.011 | 0.479 | 2.116  | 240.645  | ASPH=T                          | 0.003 | 0.366 | 1.593              |   |
| mt.Att                | TYPE=1                                  | 2.297<br>5.445<br>68.600<br>2027.350 | 1 TYPE=1                                | 2.297 5.465              | 2048.100               |  | 2.326 | 4.240  | 14.300                                 | TYPE=1                                  | 2.289 | 5.821 | 67.263 | 1967.421     | TYPE=1                                  | 2.301 | 5.289 | 69.579 | 2219.684 | TYPE=1                          | 2.282 | 6.105 | 66.263<br>1700.316 |   |
|                       | 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 0000                                 | 1 | 20<br>20<br>30           | 5 C C                  | :<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>: | 20    | 20     | 0 0<br>7 0<br>7 0<br>7 0<br>7 0<br>7 0 | 1 | 61    | 19    | 9      | <del>-</del> | 1 | 19    | 19    | 49     | 19       | 1<br>1<br>2<br>3<br>4<br>7<br>7 | 19    | 6+    | <u>ტ</u> —         |   |
| VARIABLE              |   | SPGR<br>VOID<br>VFA<br>STAR          |   | SPGR<br>VOID             | VFA<br>STAB            | 1        | SPGR  | VOID   | VFA<br>STAB                            |   | SP.GR | 0107  | VFA    | STAB         | 1 | SPGR  | VOID  | VFA    | STAE     |                                 | SPGR  | VOID  | VFA<br>STAB        | 1 |

TABLE B-5
MIX TYPE 3 - ASPHALT E

| VARIABLE | N        | MEAN            | STANDARD<br>DEVIATION |                    | MAXIMUM<br>VALUE    | C.V.   |
|----------|----------|-----------------|-----------------------|--------------------|---------------------|--------|
|          |          | TYPE=3          | ASPH=E                | SOURCE=D1          |                     |        |
| SPGR     | 13       | 2.288           | 0.018                 | 2 250              | 2.310               | 0.795  |
| AOID     | 13       | 5.046           | 0.748                 | 4 . 100            | 6,600               | 14.821 |
| VFA      | 13       | 71.154          |                       |                    | 75.000              |        |
| STAB     | 13       | 2200.692        | 377.627               | 1555.000           | 2948.000            | 17.159 |
|          |          | TYPE=3          | ASPH=E                | SOURCE=D2          |                     |        |
| SPGR     | 13       |                 | 0.026                 | 2.210              | 2.310               | 1.158  |
| A010     |          |                 |                       | 4.100              |                     | 13.641 |
| VFA      | 13       | 71.231          | 2.743                 | 65.000<br>2025.000 | 75.000              | 3.851  |
| STAB     | 13       | 2474.846        | 296.418               | 2025.000           | 2980.000            | 11.977 |
|          |          | TYPE=           | 3 ASPH=E              | SOURCE=P           |                     |        |
| SPGR     | 13       |                 | 0.006                 | 2.300              | 2.320               | 0.259  |
| VOID     | 13<br>13 | 4.015<br>75.462 | 0.258                 | 3.700              | 4.600               | 6.418  |
| VFA      |          |                 | 1.198                 | 73.000             | 4 . 600<br>77 . 000 | 1.588  |
| STAB     | 13       | 1935.308        | 248.543               | 1338.000           | 2252.000            | 12.843 |
|          |          | TYPE=3          | ASPH=E                | SOURCE=R1          |                     |        |
| SPGR     | 13       | 2.282           | 0.018<br>0.723        | 2.250              | 2.310               | 0.777  |
| AOID     | 13       | 5,331           | 0.723                 | 2.250<br>4.100     |                     | 13.557 |
| VFA      |          | 69.923 .        |                       |                    | 75.000              | 4.269  |
| STAB     | 13       | 2452,231        | 187.031               | 2115.000           | 2745.000            | 7.627  |
|          |          | TYPE=3          | ASPH≃E                | SOURCE=R2          |                     |        |
| SPGR     | 13       | 2,283           |                       |                    |                     | 0.787  |
| VOID     | 13       | 5.269           | 0.732                 | 4.100              | 6.600<br>75.000     | 13.890 |
| VFA      | 13       | 70.154          | 2 996                 | 65.000             | 75.000              | 4.270  |
| STAB     | 13       | 2556.000        | 164.039               | 2325.000           | 2850.000            | 6.418  |
|          |          | IAbE=3          | ASPH-E                | SOURCE-B3          |                     |        |
| SPGR     | 13       | 2.271           | 0.016                 | 2.250              | 2.300<br>6.600      | 0.707  |
| VOID     | 13       | 5 769           | 0.642                 | 4 600              | 6.600               | 11,130 |
| VFΛ      | 13       | 68.231          |                       |                    | 73.000              | 3,885  |
| STAB     |          |                 | 147.567               | 1740.000           | 2280.000            | 7.191  |

TABLE B-6

MIX TYPE 3 - ASPHALT L

| Z          | MEAN                                      |            | STANDARD<br>DEVIATION                              | MINIMUM<br>VALUE | MAX IMUM<br>VALUE | C . V .                                 |
|------------|---|------------|--|------------------|-------------------|---|
|            |   | TYPE=3     | ASPH≈L   | SOURCE=D1        |                   | )                                       |
|            | 20 2.327                                  | 327        | 0.011  | 2.300            | 2.340<br>300      | 0.460                                   |
|            |   | 71 V C C   | 0.420  | 69.000           | 76.000            | 2.736                                   |
| $\sim$     |   | 150        | 549.499  | 2817.000         | 4957.000          | 14.980                                  |
| - 1        | 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2   | TYPE=3     | ASPH=L   | S0URCE=D2        |                   | 1 |
|            |   | 334        | 0  | 008.6            | 2 340             | 0.488                                   |
|            |   | - 000      | ). O. O. C. T. | 007:00           | 000.4             | 11.055                                  |
|            |   | 340<br>340 | 0 . t . c  | 000 69           | 000.97            | 2.871                                   |
|            | 4015.550                                  | 550        | 648.379  | 2897.000         | 5409.000          | 16.147                                  |
|            |   | TYPE=3     | ASPH=L   | Saurce=P         |                   | 1 |
|            |   | 7.17       | 008  | 088 6            | 2.360             | 0.335                                   |
|            |   | 400        | 0.000<br>0.000                                     | 0000.0           | 4 100             | 9.252                                   |
|            |   | 500        | 1.573  | 74.000           | 80,000            | 2.029                                   |
|            | 20 2280.750                               | 750        | 289.049  | 1811.000         | 2802.000          | 12.673                                  |
|            | 1   | TYPE=3     | ASPH=L   | Source≈R1        |                   |   |
|            |   | 331        | 0.013  | 2.290            | 2.350             | 0.578                                   |
|            | 20 4.                                     | 0.45       | 0.556  | 3.300            | 5.800             | 13.741                                  |
|            |   | 350        | 2.540  | 67.000           | 78.000            | 3.416                                   |
| $\sim$     | 2971,650                                  | 650        | 183, 160   | 2574.000         | 3347.000          | 6.164                                   |
| 1          | 1 4 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 | TYPE=3     | ASPH=L   | SOURCE=R2        |                   | t<br>i<br>!<br>!<br>!<br>!              |
|            |   | 344        | 600.0  | 2.320            | 2.360             | 0.378                                   |
| ( )        |   | 520        | 0.355  | 2.900            | 4.500             | 10.080                                  |
| <i>(</i> ) |   | . 300      | 1.774  | 72.000           | 80,000            | 2.307                                   |
| 20         | 3207.050                                  | .050       | 234.401  | 2714.000         | 3643.000          | 7.309                                   |
| - 1        | 1   | TYPE=3     | ASPH=L   | SOURCE=R3        |                   | <br>                                    |
| - 0        |   | .327       | 0.011  | 2,290            | 2.340             | 0.460                                   |
| ാ          | 4,205                                     | . 205      | 0.447  | 3.700            | 5.800             | 10.621                                  |
|            | 20 73.                                    | .550       | 1.959  | 67.000           | 76.000            | 2.664                                   |
|            |   | .800       | 190.763  | 2184.000         | 2910.000          | 7.140                                   |

TABLE B-7
MIX TYPE 3 - ASPHALT S

| VARIABLE | И                                     |          | STANDARD<br>DEVIATION | MINIMUM<br>VALUE        | MAXIMUM<br>VALUE    | C.V.   |
|----------|---------------------------------------|----------|-----------------------|-------------------------|---------------------|--------|
|          |                                       | TYPE=3   | ASPH=S                | SOURCE = D1             |                     |        |
| SPGR     | 21                                    | 2.293    | 0.009                 |                         | 2.310               | 0.398  |
| VOID     | 21                                    | 5.629    | 0.406                 | 4.900                   | 6.600               | 7.220  |
| VFA      | 21                                    | 66.762   | 1.640                 | 63.000                  | 70.000<br>3206.000  | 2.457  |
| STAB     | 21                                    | 2775.857 | 278.863               | 63.000<br>2104.000      | 3206.000            | 10.046 |
|          |                                       | TYPE=3   | ASPH=S                | SOURCE=D2               |                     |        |
| SPGR     | 21                                    | 2.291    | 0.007                 | 2.280                   | 2.310               | 0.306  |
| VOID     | 2.1                                   | 5 743    | 0.314                 | 4 900                   | 6.200               | 5.467  |
| VFA      | 21                                    | 66.333   | 1.197                 |                         | 70.000              | 1.805  |
| STAB     | 21                                    | 2716.095 | 193.392               | 2252.000                | 3096.000            | 7.120  |
|          |                                       | TYPE=3   | ASPH=S                | SOURCE=P                |                     |        |
| SPGR     | 21                                    | 2.331    | 0.009                 | 2.310                   | 2.340               | 0.405  |
| V01D     | 21                                    | 4.062    | 0.377                 |                         | 4.900               | 9.293  |
| VFA      | 21                                    | 74.190   | 1.887                 | 70.000                  | 76.000              | 2.544  |
| STAG     | 21                                    |          | 331.470               | 1512.000                | 76.000<br>2661.000  | 14.527 |
|          |                                       | TYPE=3   | ASPH~S                | SOURCE=R1               |                     |        |
| SPGR     | 21                                    | 2.293    | 0.010                 | 2.280                   | 2.310               | 0.443  |
| VOID     | 21                                    | 5.624    | 0.452                 | 4.900                   | 6 . 200<br>70 . 000 | 8.029  |
| VFA      | 21                                    | 67.524   | 1.806                 | 4.900<br><b>6</b> 5.000 | 70.000              | 2.675  |
| STAB     | 21                                    | 2441.286 | 238.460               | 2100.000                | 2855.000            | 9.768  |
|          |                                       | TYPE=3   | ASPH=S                | SOURCE=R2               |                     |        |
| SPGR     | 21                                    | 2.271    | 0.012                 | 2.250                   | 2.290               | 0.519  |
| VOID     | 21                                    | 6.562    | 0.472                 | 2.250<br>5.800          | 7.400               | 7.188  |
| VEA      | 21                                    | 63.810   | 1.940                 | 60.000                  | 67.000              | 3.040  |
| STAB     | 21                                    | 2015.619 | 174.047               | 1755.000                | 2355.000            | 8.635  |
|          | · · · · · · · · · · · · · · · · · · · | TYPE=3   | ASPH=S                | SOURCE=R3               |                     |        |
| SPGR     | 21                                    | 2.287    | 0.011                 | 2.270                   | 2.300               | 0.462  |
| VOID     | 21                                    | 5.886    | 0.460                 | 5.300                   | 6.600               | 7.810  |
| VFA      | 21                                    | 66.571   | 1.886                 |                         | 69.000              | 2.833  |
| STAB     | 21                                    | 2065.143 | 227.501               | 64.000<br>1665.000      | 2496.000            | 11.016 |

TABLE B-8

MIX TYPE 3 - ASPHALT T

| MUM C.V.              |           |       | 500 12.145 |        |          |   |       |       |              | 7.957    | ;<br>;<br>;<br>;<br>;<br>;<br>;<br>;<br>;<br>;<br>;<br>; |        |       | 2.293  |          |   | 320 0.537 |       |        |          |   |       | 10.597       |        |          |   |       |       | 3.306            |   |
|-----------------------|-----------|-------|------------|--------|----------|---|-------|-------|--------------|----------|--|--------|-------|--------|----------|---|-----------|-------|--------|----------|---|-------|--------------|--------|----------|---|-------|-------|------------------|---|
| MAXIMUM<br>VALUE      |           | 2.3   | 6.600      | 74.(   | 2933.(   |   | 6     |       | 70.000       | 3034.000 | 1                  | 2.3    | 4     | 78.000 | 2056.0   | 1 1 1 1                                 | 2.320     | 7.(   | 70.0   | 2880.0   |   |       | 7.0          | 72.0   | 3026.000 | 1 | 2.3   | 7     | 69.000           | ! |
| MINIMUM               | SOURCE=D1 | 2.280 | 4.100      | 64.000 | 2192.000 | SOURCE=D2                               | 2.280 | 0000  | 64 000       | 2028.000 | SOURCE=P   | 2.330  | 3.300 | 72.000 | 1498.000 | SOURCE=R1                               | 2.270     | 4.900 | 62.000 | 1607.000 | SOURCE=R2                               | 076.6 | 4.500        | 62.000 | 2293.000 | SOURCE=R3                               | 2.260 | 5.300 | 61.000           | ) |
| STANDARD<br>DEVIATION | ASPH=T    | 0.016 | 0.637      | 2.471  | 162.104  | ASPH=T                                  | 010   | 0.00  | ٠- ۲.<br>د م | 198.820  | ASPH=T   | 000.00 | 0.346 | 1.729  | 133.343  | ASPH=T                                  | 0.012     | 0.527 | 1.943  | 316,449  | ASPH=T                                  | 0     | 0.556        | 2.174  | 241.259  | ASPH=T                                  | 0.014 | 0.588 | 2.164<br>189 695 | ) |
| MEAN                  | TYPE=3    | 2.311 | 5.245      | 69.000 | 2504.250 | TYPE=3                                  | 308   |       | . ας<br>ΑΟΟ  | 2498.600 |  | 2.347  | 3.820 | 75.400 | 1729.500 | TYPE=3                                  | 2.294     | 5.965 | 66.250 | 2276.200 | TYPE=3                                  | 2 341 | N 1 2 2 4 51 | 006.89 | 2752.500 | TYPE=3                                  | 2.289 | 6.160 | 65.450           | ) |
| Z                     |           | 20    | 30<br>20   | 20     | 20       | 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | C     | 0 0   | 20           | 20       | 1 1 1  | 00     | 20    | 20     | 20       |   | 20        | 20    | 20     | 20       | 1 | CC    | 200          | 200    | 20       | 1 | 20    | 20    | 200              | ) |
| VARIABLE              | 1 1 1 1 1 | 8598  | VOID       | VFA    | STAB     | 1 1 1 1                                 | 0000  | 20.00 | VO.10        | STAB     |  | 8598   | VOID  | VFA    | STAE     | 1 | SPGR      | VOID  | VFA    | STAB     | 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 0000  | VOID         | VEA    | STAB     | )<br> <br>                              | SPGR  | VOID  | VFA              | 2 |

TABLE B-9

ALL TYPE 1 MIX

| VARÍABLE                                | z                                       | MEAN                                    | STANDARD<br>DEVIATION | MINIMUM<br>VALUE | MAXIMUM<br>VALUE |   |
|---|---|---|-----------------------|------------------|------------------|---|
|   |   | 1 | TYPE=1 SOURCE=D       |                  |                  | [<br>]<br>]<br>]<br>!<br>!              |
| SPGR<br>VOID                            | 76                                      | 2.310                                   | 0.025                 | 2.250            | 2.360            | 1.102                                   |
| VFA                                     | 76                                      | 70.632                                  | 3,525                 | 64.000           | 79.000           | 4.990                                   |
| STAB                                    | 92                                      | 2128.474                                | 406.190               | 1316.000         | 3203.000         | 19.084                                  |
|   | 1 |   | TYPE=1 SOURCE=D       | .D2              |                  | 1 |
| SPGR                                    | 16                                      | 2.312                                   | 0.025                 | 2.260            | 2.360            | 1.080                                   |
| VOID                                    | 76                                      | 4.847                                   | 0.853                 | 3.300            | 6.600            | 17.607                                  |
| VFA                                     | 97                                      | 71.039                                  | 3.384                 | 65.000           | 77.000           | 4.764                                   |
| STAB                                    | 16                                      | 2181.579                                | 383.569               | 1558.000         | 2939.000         | 17.582                                  |
|   | 1                                       |   | TYPE=1 SOURCE=        | d:               |                  | ;<br>;<br>;<br>;<br>;<br>;              |
| SPGR                                    | 16                                      | 2.333                                   | 0.023                 | 2.270            | 2.380            | 0.965                                   |
| V01D                                    | 76                                      | 3,993                                   | 0.691                 | 2.500            | 6.200            | 17.293                                  |
| VFA                                     | 76                                      | 75.079                                  | 2.794                 | 000.99           | 82.000           | 3.722                                   |
| STAB                                    | 76                                      | 1702.000                                | 289.749               | 1118.000         | 2506.000         | 17.024                                  |
|   | 1 1 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 |   | TYPE=1 SOURCE=        | -R1              |                  |   |
| SPGR                                    | 75                                      | 2.306                                   | 0.026                 | 2.250            | 2.370            | 1.144                                   |
| VOID                                    | 75                                      | 5.091                                   | 0.912                 | 2.900            | 7.000            | 17.920                                  |
| VFA                                     | 7.5                                     | 70.040                                  | 3.535                 | 62.000           | 79.000           | 5.048                                   |
| STAB                                    | 75                                      | 2039.920                                | 460.403               | 1357.000         | 3304.000         | 22.570                                  |
|   | 1 | 1<br>1<br>1<br>1<br>1<br>1<br>2<br>1    | TYPE=1 SOURCE=R2      | :R2              |                  | 1<br>3<br>1<br>1<br>1<br>1<br>1<br>1    |
| SPGR                                    | 75                                      | 2.311                                   | 0.034                 | 2.230            | 2.380            | 1.451                                   |
| V01D                                    | 75                                      | 4.895                                   | 1,127                 | 2.500            | 7.900            | 23.024                                  |
| VFA                                     | 7.5                                     | 71.107                                  | 4.330                 | 000.09           | 82.000           | 6.089                                   |
| STAB                                    | -12                                     | 2089.760                                | 292.360               | 1607.000         | 2774,000         | 13.890                                  |
| 1 | 1 | 1                                       | TYPE=1 SOURCE=R3      | .R3              |                  | [                                       |
| SPGR                                    | 75                                      | 2.299                                   | 0.028                 | 2.250            | 2.370            | 1.199                                   |
| 0100                                    | 7.5                                     | 5.385                                   | 0.936                 | 2.900            | 7.000            | 17.389                                  |
| VFA                                     | 75                                      | 68.823                                  | 3.416                 | 64.000           | 79.000           | 4.961                                   |
| STAB                                    | 7.5                                     | 1690.067                                | 283,888               | 1170.000         | 2340.000         | 16.797                                  |

TABLE B-10
ALL TYPE 3 MIX

| VARIABLE | N   | MEAN     | STANDARD<br>DEVIATION | MINIMUM<br>VALUE | MAXIMUM<br>VALUE | C.V.            |
|----------|-----|----------|-----------------------|------------------|------------------|-----------------|
|          |     |          | - TYPE=3 SOURC        | E=D1~            |                  |                 |
| SPGR     | 74  | 2.307    | 0.020                 | 2.250            | 2.340            | 0.874           |
| dtov     | 74  | 5.036    | 0.771                 | 3.700<br>63.000  | 6.600            | 15.315<br>4.928 |
| VFA      |     | 69.973   |                       |                  |                  | 4.928           |
| STAB     | 74  | 2842.568 | 650.324               | 1555.000         | 4957.000         | . 22.878        |
|          |     |          | TYPE=3 SOURCE         | E=D2             |                  |                 |
| SPGR     | 74  | 2.305    | 0.023                 | 2.210            | 2.340            | 1.006           |
| DIOV     | 74  | 5.058    | 0.807<br>3.671        | 3.700            | 6.600            | 15.958          |
| VFA      | 74  | 69.919   | 3.671                 | 64.000           |                  | 5.250           |
| STAB     | 74  | 2966.135 | 752.974               | 2025.000         | 5409.000         | 25.386          |
|          |     |          | - TYPE=3 SOURCE       | E=P              |                  |                 |
| SPGR     |     |          | 0.016                 | 2.300            | 2.360            | 0.666           |
| VOID     | 74  | 3.809    | 0.423                 | 2.900            | 4.900            | 11.096          |
| VFA      | 74  | 75.635   | 2.051                 | 70.000           | 80.000           | 2.712           |
| STAB     | 74  | 2071.378 | 2.051<br>355.946      | 1338.000         | 2802.000         | 17.184          |
|          |     |          | - TYPE=3 SOURCE       | E=R1             |                  | ·               |
| SPGR     | 74  | 2.302    | 0.023                 | 2.250            | 2.350            | 0.990           |
| VOID     | 74  | 5.238    | 0.935<br>3.938        | 3.300            | 7.000            | 17.845          |
| VFA      | 74  | 69.446   | 3.938                 |                  |                  | 5.671           |
| STAB     | 74  | 2541.932 | 361.122               | 1607.000         | 3347.000         | 14.207          |
|          |     |          | - TYPE=3 SOURCE       | E=R2             |                  |                 |
| SPGR     | 74  | 2.304    | 0.032                 | 2.250            | 2.360            | 1.383           |
| VOID     | 74  |          | 1.252                 | 2.900            |                  | 24.287          |
| VFA      | 74  | 69.838   | 5.379<br>497.062      | 60.000           | 80.000           | 7.702           |
| STAB     | 74  | 2631.716 | 497.062               | 1755.000         | 3643.000         | 18.887          |
|          |     |          | TYPE=3 SOURCE         | E=B3             |                  |                 |
| SPGR     | 7.4 | 2.296    | 0.024                 | 2.250            | 2.340            | 1.040           |
| VOID     | 74  | 5 485    |                       | 3.700            | 7.400            | 17.313          |
| VFA      | 14  | 68.446   | 3.868                 | 3.700<br>61.000  | 76.000           | 5.651           |
| STAB     | 74  | 2149.851 | 390.381               | 1440.000         | 2910.000         | 18.159          |

# TABLE B-11

# AUTOMATIC VERSUS MANUAL COMPACTION TYPE 1 AND TYPE 3 MIX

# TYPE 1 MIX

| VARIABLE | N  | MEAN        | STANDARD<br>DEVIATION | MINIMUM<br>VALUE | MAXIMUM<br>VALUE | C.V.   |
|----------|----|-------------|-----------------------|------------------|------------------|--------|
|          |    |             | METHOD=A              |                  |                  |        |
| SPGR     | 75 | 2.30213333  | 0.02969636            | 2.23000000       | 2.37000000       | 1.290  |
| AOTD     | 75 | 5.26800000  | 1.00312485            | 2.90000000       | 7.9000000        | 19.042 |
| VFA      | 75 | 69.32000000 | 3.73138624            | 60.00000000      | 79.0000000       | 5.383  |
| STA      | 75 | 1.94880000  | 0.31794530            | 1.35700000       | 2.77400000       | 16.315 |
|          |    |             | METHOD=H              |                  |                  |        |
| SPGR     | 75 | 2.31546667  | 0.02933006            | 2.25000000       | 2.3800000        | 1.267  |
| VOID     | 75 | 4.71733333  | 0.98067452            | 2.50000000       | 7.00000000       | 20.789 |
| VEA      | 75 | 71.82666667 | 3.83572585            | 64.00000000      | 82.0000000       | 5.340  |
| STA      | 75 | 2.18088000  | 0.41269817            | 1.60700000       | 3.30400000       | 18.923 |

# TYPE 3 MIX

| VARIABLE | 14           | MEAN        | STANDARD<br>DEVIATION | MINIMUM<br>VALUE | MAXIMUM<br>VALUE | C.V.   |
|----------|--------------|-------------|-----------------------|------------------|------------------|--------|
|          |              |             | METHOD=A              |                  |                  |        |
| SPGR     | 74           | 2.29540541  | 0.02720743            | 2.25000000       | 2.35000000       | 1.185  |
| VOID     | 74           | 5.50405405  | 1.12620580            | 3.30000000       | 7 . 40000000     | 20.461 |
| VEA      | 7.4          | 68.39189189 | 4.75370819            | 60.00000000      | 78.00000000      | 6.951  |
| STA      | 7.4          | 2.42113514  | 0.43024390            | 1.60700000       | 3.34700000       | 17.770 |
|          | <del>-</del> |             | METHOD=H              |                  |                  |        |
| SPGR     | 74           | 2.31027027  | 0.02616978            | 2.25000000       | 2.36000000       | 1.133  |
| VOID     | 7.4          | 4.89054054  | 0.99315037            | 2.90000000       | 7.0000000        | 20.308 |
| VFA      | 7.4          | 70.89189189 | 4.33073618            | 62.00000000      | 80.0000000       | 6.109  |
| STA      | 74           | 2.75251351  | 0.37523009            | 2.10000000       | 3.64300000       | 13.632 |

# APPENDIX C

# t-TEST ANALYSIS

| Table No. |                           | Page No. |
|-----------|---------------------------|----------|
| C-1       | Stability                 | 65       |
| C-2       | Specific Gravity          | 66       |
| C-3       | Air Voids                 | 67       |
| C-4       | Voids Filled With Asphalt | 68       |

TABLE C-1 STABILITY

| A/H                            |             | ļ<br>ļ  | -       |         | -3.8579    |        |         | l<br>ţ  | 1       | 1       | -4.9934    |
|--------------------------------|-------------|---------|---------|---------|------------|--------|---------|---------|---------|---------|------------|
| P/R3                           | 2.4064      | 0.4230  | -0.8767 | -0.1542 | 0.2556     |        | -1.4566 | -5.0497 | 2.4697  | -0.9817 | -1.2778    |
| D1/R1                          | -0.1454     | 4.3762  | -1.5048 | 0.9835  | 1.2527     |        | -2.1522 | 5.3776  | 4.1786  | 2.8684  | 3.4767     |
| D1/D2                          | -1.5356     | -0.4689 | -0.4134 | -0.3456 | -0.8287    |        | -2.0590 | -1.8280 | 0.8070  | 0.0985  | -1.0684    |
| P/R1                           | -2.0426     | -3.1672 | -6.2730 | -4.1882 | -5.3897    |        | -5.9919 | -9.0294 | -1.7897 | -7.1198 | -7.9830    |
| P/D1                           | 1.7430      | 6.1637  | 5.9011  | 5.3559  | 7.4516     |        | 2.1166  | 9.9932  | 5.2266  | 16.5068 | 8.9484     |
| Source<br>Mix Type/<br>Asphalt | Type 1<br>E | L       | Ø       | E       | All Type 1 | Type 3 | ſ́⊒     | I       | Ω       | E-1     | All Type 3 |

Note: Italicized numbers indicate significant t values.

TABLE C-2 SPECIFIC GRAVITY

| 5780       -0.7716       -0.8310       5.4054          9409       -1.1305       -0.8146       5.8883          1676       0.1470       2.4064       17.3119          6737       -0.5790       0.8532       8.2189       -2.766         9300       0.7785       0.9830       8.7408          4290       0.9483       0.0       14.1790          7555       0.8414       3.9300       15.9881          8294       0.4919       1.3760       12.2780       -3.387 | P/D1. |
|---|-------|
| -1.1305 -0.8146 5.8883<br>0.1470 2.4064 17.3119<br>-0.5790 0.8532 8.2189<br>0.7785 0.9830 8.7408<br>-1.1459 -1.0392 6.7360<br>0.9483 0.0 14.1790<br>0.8414 3.9300 15.9881<br>0.4919 1.3760 12.2780  | v 4   |
| 0.1470 2.4064 17.3119<br>-0.5790 0.8532 8.2189 -2<br>0.7785 0.9830 8.7408<br>-1.1459 -1.0392 6.7360<br>0.9483 0.0 14.1790<br>0.8414 3.9300 15.9881<br>0.4919 1.3760 12.2780 -3  | 63    |
| 0.7785       0.9830       8.7408         -1.1459       -1.0392       6.7360         0.9483       0.0       14.1730         0.8414       3.9300       15.9881         0.4919       1.3760       12.2780       -3.  | 72.   |
| 0.7785 0.9830 8.7408<br>-1.1459 -1.0392 6.7360<br>0.9483 0.0 14.1790<br>0.8414 3.9300 15.9881<br>0.4919 1.3760 12.2780 -3.  |       |
| 838       -1.1459       -1.0392       6.7360         290       0.9483       0.0       14.1790         555       0.8414       3.9300       15.9881         294       0.4919       1.3760       12.2780       -3.   | ć     |
| 290       0.9483       0.0       14.1790         555       0.8414       3.9300       15.9881         294       0.4919       1.3760       12.2780       -3.  | 4.    |
| 555       0.8414       3.9300       15.9881         294       0.4919       1.3760       12.2780       -3.   | 12.   |
| 294 0.4919 1.3760 12.2780 -3.   | 15.   |
|   | 10.   |

Note: Italicized numbers indicate significant t values.

3.3995 I I 1 A/H 1 1 -8.6950 -5.4054 -5.9015 -10.3841 -9.1395 -6.5905 -17.4961 P/R30.8503 0.9882 -2.4262 -1.0154 -0.8310 -0.9867 -3.1497 D1/R1 0.1094 0.6875 1.1459 0.1668 0.7716 1.1154 -0.1338 TABLE C-3 AIR VOIDS D1/D2 -5.5612 -4.5780 -3.9195 -12.1352 -8.3251 -6.1812 14.5166 P/R11.7526 5.4939 5.2915 9.6563 7.4617 6.7360 4.6981 P/D1 All Type 1 Mix Type/ Asphalt Source Type 3 Type 1  $\vdash$ Ч 闰 П  $\Omega$ 

Note: Italicized numbers indicate significant t values.

3.5148

-13.8673

-1.4293

-0.1666

-11.9782

12.0006

All Type 3

-15.3420

-3.8935

-0.8223

-15.2100

8.7924

 $\vdash$ 

i

-14.0519

0.0359

-1.0198

-12.1615

12.9443

 $\Omega$ 

TABLE C-4

# VOIDS FILLED WITH ASPHALT

| A/H                            | }           | <br> }  | !       | !<br>}   | -4.0567    |        | 1       | }       | }        | ļ       | -3.3443    |
|--------------------------------|-------------|---------|---------|----------|------------|--------|---------|---------|----------|---------|------------|
| P/R3                           | 9.2958      | 5.3861  | 5.6664  | 16.2776  | 12.2498    |        | 8.9625  | 7.0305  | 13.0858  | 16.0661 | 14.1248    |
| D1/R1                          | 3.2226      | -0.8310 | -0.8289 | 2.0972   | 1.0297     |        | 1.0397  | -1.1041 | -1.4311  | 3.9123  | 0.8661     |
| D1./D2                         | 0.0         | -0.7716 | -1.1785 | 0.1582   | -0.7278    |        | -0.0676 | -1.2196 | 0.9671   | 0.9167  | 0.0923     |
| P/R1                           | 5.6995      | 4.5792  | 3.8899  | 12.5201  | 9.7088     |        | 6.2083  | 4.7158  | 11.6951  | 15.7317 | 11.9899    |
| P/D1                           | -1.3707     | -5.4753 | -5.0975 | -10.2724 | -8.6202    |        | -4.7385 | -6.9162 | -13,6142 | -9.4907 | -12.1401   |
| Source<br>Mix Type/<br>Asphalt | Type 1<br>E | L       | Ø       | H        | All Type 1 | Type 3 | ᅜᅺ      | Ľ       | Ø        | T       | All Type 3 |

Note: Italicized numbers indicate significant t values.