2941

ASPHALT STABILIZATION RESEARCH

by

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ABSTRACT

This report describes the testing and evaluating of six widely differing soil materials stabilized with seven commonly used liquid asphalts. Each soil-asphalt combination was tested for density, voids, moisture and volatiles content and for compressive strength.

As a result of this work a series of asphalt factors has been developed which aid in predicting the asphalt content to use with a particular soil to obtain the maximum compressive strength. Incorporating these findings, a new tentative test procedure has been written to replace Test Method Tex-119-E, Soil Asphalt Strength Test Methods. The proposed test is listed as Tex-119-E Part II and appears in the Appendix of this report.

SUMMARY

The test method submitted as an appendix to this report is intended to supersede previous test methods. The findings herein are the results of tests upon hundreds of soil-asphalt specimens molded on the large Texas Gyratory Soils Compactor using six soils of widely varying characteristics and seven commonly used, liquid type asphaltic materials. (The devising of a test method required much, in itself, since a different compactor and methods of intermediate handling were involved.) As a result of mixing, molding, curing and testing of these soils and asphalt materials, using a wide range of percentages of asphalt with each soil, the percents of each type asphalt giving the maximum strength in each soil were found. Since these asphaltic materials have different percentages of residual asphalt the percent liquid asphalt was modified on the basis of residual in each. An asphalt factor was then determined using the relationship between the total percent of residual asphalt to produce the maximum strengths to the raw soil wet voids when gyrated in the same manner as the soil-asphalt.

While the air voids of the molded soils do not vary greatly it must be recalled that the compactive effort used is in excess of AASHTO T 180 or ASTM D 1557 and that the composition and gradation affect this a good deal. Using the maximum and minimum asphalt factors a range of asphalt percentages can be tabulated which should be entirely satisfactory for most soils encountered. The laboratory, in the use of the test, would begin at mid-range of the asphalt factors to obtain a percentage of

asphalt to use in the field. For the sake of economy the second trial should be a leaner mix. The third trial would then be leaner or richer in asphalt content depending on the result of trial number two. In all but a few cases three trials should be adequate to determine the field asphalt content to use and in some cases where the strengths are quite high, even though the strength may not be the maximum obtainable, a third trial might not be necessary.

When used in this manner these procedures should save time and money and should produce the best asphalt stabilization using a particular soil and asphalt type.

IMPLEMENTATION STATEMENT

It is recommended that the findings of this research be implemented immediately by adding the attached test method to the Manual of Testing Procedures as Part II of Test Method Tex-119-E[1] for use and trial by the Districts. Satisfactory use in the field will be cause to delete the present Test Method Tex-119-E and completely replace it with the proposed test denoted as Tex-119-E Part II in the Appendix.

I. SUBJECT

The stabilization of soils using liquid type asphalts such as cut backs, road oils, cracked fuel oils and emulsified asphalts has long been a difficult and inexact operation. The reason for this is the great variation that occurs in soil composition, asphalt properties and field placement conditions.

Test methods have changed over the years resulting in more accurate predictions of the amount of stabilizers to use with given soils. These methods have varied from the molding of small "Proctor" specimens which were punched with a blunt needle to obtain a bearing value, to the present large specimens (6-inches diameter by 6-inches high) which are tested in compression.

The present Test Method Tex-119-E, "Soil Asphalt Strength Test Method," requires that the 6-inch by 6-inch cylindrical specimen be molded, dry cured and pressure wetted in a pressure restraining vessel. This procedure has three drawbacks which adversely affect the test results:

1. The restraining vessel does not allow the specimen to expand, thus limiting the amount of water entering the soil voids.

2. The tightness of the vessel clamping bolts introduces a volume variable.

3. If the specimen is not within strict dimensional limits of being a right circular cylinder, test results are distorted.

A fresh look was desired in this work, which is so important in many areas of our State, to enable personnel to better predict the optimum percentage of liquid asphalt for the stabilization of a given soil and to do it rapidly.

II. PURPOSE

The purpose of this research was to develop data for the writing of a new or modified procedure for predetermining the amount of liquid asphalt to use in stabilizing a particular soil.

III. CONCLUSIONS AND RECOMMENDATIONS

This research project has resulted in a proposed new test method for determining the optimum percent of liquid asphalt for best soil stabilization. The test method is in the Appendix.

Certain conclusions were an outgrowth of this study:

A. All liquid asphalts do not produce the same stabilizing effects and some asphalts produce much greater compressive strengths than others.

B. The initial appearance of the soil-asphalt mixture should not be used as a strength indicator. Mixes that looked "good," often tested very weak and vice versa.

C. Emulsified asphalt specimens often gave higher strengths when on the "wet side" of optimum liquids content than when molded at maximum density and optimum liquids condition.

D. Clean sandy soils with plasticity indices of less than 5 should be given an asphalt factor in the range of 0.22 to 0.35 since these soils do not follow the usual trends. Smaller surface area may contribute to this.

E. This research tends to confirm the tenet that soils with a plasticity index greater than about 15 should be avoided for stabilization with liquid asphalt. Mixing is difficult and specimen uniformity and strength are too low for best results.

F. A means of determining a range of asphalt factors has been found which gives maximum strengths for any particular soil with any of the liquid type asphalts used herein.

G. It is recommended that the test method produced from this work be used as a tentative test and given as Part II of Test Method Tex-119-E for field trial usage with the intent that it would replace the present Tex-119-E if proven suitable.

In addition it is recommended that field forces be encouraged to use this new test method, comparing results of these techniques with those currently in use and offering pertinent comments to the Materials and Tests Division.

IV. MATERIALS

Six soils of varying percentages of soil binder (percent passing the No. 40 sieve) were used. The soil constants, and in particular the plasticity index, or P.I., covered a range of 3 to 18 percent in increments of approximately 3 percent. The soil constants, sieve and hydrometer analyses, sand equivalents, etc., were all performed according to Texas test methods and the results are shown in Table 1. A description of the point of sampling and the U. S. Department of Agriculture, Soil Conservation Service Soil Series[2] are also given.

Seven liquid and/or emulsified asphalts were used with each soil in order to find the asphalt percentage giving the best strength and the strengths at greater and lesser asphalt content than those giving maximum strengths. Table 2 shows the physical characteristics from testing according to Texas test methods. These seven asphaltic materials were the most common asphaltic materials used in soil-asphalt stabilization when this work began. Since that time the availability of cationic asphalt emulsions has increased greatly.

It is believed that cationic emulsions would be a little different from anionic emulsions in the way they mix, compact and perform. Any differences found may be in favor of cationics and this is an area worthy of further work.

V. EQUIPMENT

Performance of these tests can be done with equipment commonly in use in most of the District laboratories since all but three Districts had secured the large gyratory soils compactor as early as September, 1971. This compactor has the capability of molding specimens 6-inches in diameter by 8-inches high with a compactive effort which is in excess of AASHTO T 180 or ASTM D 1557. The use of higher compactive efforts rather than low compactive efforts enables greater reproducibility in specimens and, thus, greater uniformity of results. Specimens molded in this work were all approximately 6-inches high. Another reason which makes the use of the large gyratory soils compactor a convenient molding apparatus is that there is no reason to remove any soil particles which will pass the 1-3/4-inch sieve and thereby enabling the testing of 100 percent of the soil materials in almost all standard specifications. Additionally, this compactor is versatile and can be used to test specimens at two rates of deformation where this is desired. These rates are the 0.15 inch per minute used principally in this work and 10.0 inches per minute, both used in black base work.

A second major piece of equipment is the high pressure pycnometer used to water saturate specimens prior to testing. This equipment was already used in Texas Test Method Tex-119-E entitled, "Soil Asphalt Strength Test Methods." The principal difference in the usage is that, in the previous test mentioned above, the 6-inch by 6-inch specimens were enclosed in a pressure restrainer which allowed water to enter but no volume change of any significance to occur. This pressure wetting was done at 140 F.

The method used in this research and highly recommended is the placement of the specimen in a plastic bag in such a manner as to allow full access of water then pressure wetting the specimen in the pressure vessel at room temperature. Later the specimens are heated to 140 F to test as in the old procedure.

No other specialized equipment was used and an attempt was made to use only equipment which was already needed to perform the present test or those items commonly in use. Additional descriptions of the large gyratory soils compactor, often referred to as a motorized gyratory press, and necessary and convenient accessories can be found in McDowell and Smith's "Design, Control and Interpretation of Tests for Bituminous Hot Mix Black Base Mixtures."(6) (TP 8-71E Revised)

VI. PROCEDURE FOR ACQUIRING DATA

A. Locations within the pit area were tested for Atterberg limits in order to determine properly which parts of the pit to sample.

B. A front end loader was used to mix the soil and break up large clods.

C. When indoor storage space was not available for these large quantities of material, soils were dumped on heavy plastic sheeting on pavement and covered with sheeting to prevent contamination.

D. Soil constants and physical tests were run on all soil increments to insure uniformity.

E. Moisture vs. density curves were run on the blended raw soil using the gyratory procedures as outlined in Tex-126-E.

F. To find the percentage of liquid asphalt giving the highest strength for each soil a large number of specimens were made using asphalt contents from approximately 4 to 12 percent in increments of one or two percentage points. Data were obtained on each soil for each of the seven asphalts for molding, curing, pressure wetting, heating and testing in unconfined compression. Specimens which contained much less than 4 percent liquid asphalt and approximately 2.5 percent residual asphalt tended to disintegrate under pressure wetting.

VII. TEST DATA, RESULTS AND CALCULATIONS

The presentation of all the molding, curing, pressure wetting and testing data and calculations in this report would be counterproductive and in itself would require a huge volume of pages. The files of the Soils Section of the Materials and Tests Division, State Department of Highways and Public Transportation, contain all the data compiled in this investigation and will be available for those requiring more detailed data.

Complete laboratory data are given in the tables for one soil and one asphaltic material as an example. The total data on file is over 42 times this voluminous and includes the information reported by McDowell in LI-24-70-E entitled, "Soil Bituminous Stabilization Progress Report."[3]

Figure 1 shows the wet and dry moisture-density curves with the corresponding maximum strength after subjection to capillary wetting (Tex-117-E). Maximum unconfined compressive strength was 23 psi.

Figures 1-A through 1-H show molding; density and voids; curing, testing and drying and aeration data for the raw soil.

Figure 2 gives the moisture-density curves for 4% RC-2 asphalt content. Maximum strength was 40 psi.

Figures 2A through 2D show data for the same operations as given for Figures 1A through 1-H, Figures 3 through 3-D give similar data for this soil (72-18-3-R) and 5% RC-2. Maximum strength was 56 psi.

Figures 4 through 4-D show data for 6% RC-2. Maximum strength was 70 psi.

Figures 5 through 5-D show data for 8% RC-2. Maximum strength was 81.2 psi, the highest strength found.

Figures 6 through 6-D give data for 10% RC-2. The maximum strength has dropped to 39 psi.

Figure 7 is a graph showing air voids (rebound wet) vs. percent RC-2 and the curve showing maximum strengths of each of the percentages of RC-2 used. Note the maximum strength of Soil 72-183-R with RC-2 is 81.2 psi and uses 8% RC-2 to reach this strength. These values have been entered on Table 3 as the maximum strength for this soil with RC-2.

The gyratory molding of all specimens was accomplished according to the techniques given in Texas Test Method Tex-126-E after being mixed thoroughly in a laboratory mixer of about 20 quart size. Aeration, prior to molding to a particular moisture and/or volatiles content was accomplished using two infrared lamps of 250 watts each.

Dry curing of specimens was accomplished by drying for 5 days at 140 F.

Pressure wetting of specimens after dry curing was done at room temperature after cooling from dry curing and was done in accordance with techniques and procedures given in Texas Test Method Tex-109-E.[1] This differs from present methods given in Test Method Tex-119-E in that no pressure restrainers are used.

After pressure wetting at 1200 psi the specimens were heated to 140 F in plastic bags, encased in Texas Triaxial Cells and porous plates, then tested in unconfined compression using a rate of deformation of 0.15 inches per minute.

VIII. DISCUSSION

As the soils selected for this project were tested with various asphalts it became apparent that it was possible to select the asphalt type and content (within rather narrow limits) that would result in the optimum stabilization of subgrade soil.

The asphalt factor was calculated as follows:

Factor = (% liquid asphalt giving maximum strength with given soil) times (residual asphalt in liquid asphalt expressed as a decimal) divided by the % minimum wet soil voids when gyrated.

In the case of the RC-2 in the example above the factor is 0.48 or,

$$\frac{(8)\ (.816)}{13.6} = .48$$

The computed factor for RC-2 and this soil (72-183-R) was entered in Table 3. In like manner all the factors were determined for RC-2 and all soils. Values for all asphalts and soils except one, soil 74-152-R, which had a P.I. of 3 and a soil classification of A-3.* This soil had uniformly low asphalt factors and strengths indicating that it would be harder to stabilize with asphalt and might require another type of stabilizer altogether. It was noted that all asphalt combinations with this soil gave very low strengths with the maximum strengths varying from 18 to 27 psi.

Results of the low P.I. soil were excluded from the range of asphalt factors but the others were included. For example, the range of asphalt factors for RC-2 as seen in Table 3 ranges from 0.41 to 0.56 with the average or mid-range value being 0.49.

Soils of Class A-3 with plasticity indices below approximately 5 (by our methods) may exhibit low strength and have asphalt factors of 0.22 to 0.35. It is recognized that any soils similar to this should be tested for confirmation.

Formerly it was believed that similar liquid asphalts would give about the same results in soil-asphalt stabilization and that the one to select was one that had been used successfully before in that area. The fallacy of this belief is clearly indicated in Table 3 under the column, Maximum Compressive Strengths. Some soil and asphalt combinations using similar percentages of asphalt showed a strength variation of 400 percent.

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* See AASHTO M 145

Following is a discussion of the various steps taken in testing a particular soil-asphalt combination:

A. The raw soil was dried and prepared in accordance with Test Method Tex-101-E. This procedure calls for sieving the dried soil to obtain a tentative sieve analysis for recombining individual specimens.

B. Soil material was weighed out for individual 6-inch by 6-inch specimens. These were wet up to a known excess of water and dried back in increments under infrared lamps. This dry-back was done in controlled steps in order to obtain points for a moisture-density curve. The maximum density specimen (peak of curve) was used to determine the voids in the wet extruded specimen.

   Gyratory molding techniques usually require use of moisture-density (or asphalt-density) points taken from the loaded height of the specimen. However, the wet soil and asphalt was so compressible that considerable rebound occurred making the use of the extruded wet specimen height much more desirable. See Figures 2 and 2-B for examples and formulae.

C. Then, using slightly more water than the raw soil optimum minus the percent liquid asphalt being tried, specimens were molded with asphalt. In the case of higher percentages of asphalt some water has to be used in order to have dry-back or aeration for an asphalt-density curve. In the case of the emulsified asphalts it is necessary to use at least the amount of water to mix first with the soil to prevent "breaking" of the emulsion upon being introduced into the soil. This figure for the percent water to add to the soil to allow good mixing without emulsion breaking was determined to be 0.45 times the liquid limit of the soil. A minimum amount is desirable in order to reduce aeration or dry-back time and would be highly desirable in construction on humid and/or cloudy days where evaporation is less.

D. After mixing soil and water the asphalt was mixed in thoroughly. Then the specimen mixtures were aerated using two 250-watt infrared bulbs approximately 12 inches from the material. The heating was much like the sun on a warm day. With occasional stirring of the mixes the temperatures generated in the soil were usually slightly in excess of 100 F. Drying back in controlled increments provided data for the molding of moisture and/or volatiles-density curves for each percent asphaltic material similar to Figure 2.

E. After molding, the specimens were dry cured at 140 F for 5 days which removes the moisture and light volatiles. The heavy volatiles such as those in RO-3 and cracked fuel oil are not removed at a temperature of 140 F.

The specimens were removed from the oven and allowed to cool to room temperature.

F. Next the specimens were water saturated using the pressure vessel with no restraint for the specimen. Room temperature water at

1200 psi was used to saturate the specimens. Here it was noted that some of the soils with liquid asphalt contents under 4 percent tended to disintegrate when pressure wetted.

After wetting the specimens were sealed in plastic bags and placed in triaxial cells with top and bottom porous stones in place. This allowed them to be placed in the 140 F oven and brought to that temperature without significant loss of water. Then the specimens were tested at temperature in unconfined compression. The data resulted in curves such as the bottom curve in Figure 2.

G. During this process a great deal of weighing, measuring and handling was done to find the values calculated or recorded. Much of these data would be excessive in the everyday laboratory testing procedure for determination of percent liquid asphalt needed for stabilization but deemed useful for this research. The end result of the research was intended to produce a test procedure which was reasonably useful and sufficiently accurate for the determination of percentages of asphaltic material to use and a prediction of expected performance when placed. This has been accomplished with the recommended test procedure in the Appendix herewith.

H. Approximations of the triaxial classification of soil-asphalt stabilization may be made using results reported by Smith[5] and published in the proceedings of the 29th Annual Highway Short Course at Texas A&M University in 1955. Smith gave data which showed the rupture line from Mohr's Diagram of Stress in triaxial test results to vary from 33^o to 39.5^o. The classification should be made by drawing the zero lateral pressure (unconfined) strength circle on the classification chart given in Figure 14 of Test Method Tex-117-E. Then tangent to this strength circle draw a line making a 33^o angle with the normal stress (abscissa). Use this shear or rupture envelope to classify the material as described in Test Method Tex-117-E. It should be noted that this classification may be conservative for some soils since the minimum angle of 33^o is used. For example, an unconfined compressive strength of 50 psi will classify as class 3.0.

IX. IMPLEMENTATION AND FIELD APPLICATION

The implementation of these findings is recommended and it is anticipated that very little or no additional equipment will be needed at the District Laboratory level since the vast majority are equipped with the large gyratory soils compactor and pressure pycnometer equipment for pressure wetting. A large laboratory mixer of about 20 quart size is very convenient, but not absolutely necessary, in the mixing of specimens.

The following is a brief outline of the procedure to follow to determine the percent of stabilizing liquid asphalt and a given soil after the soil has been prepared for testing.

1. Perform the moisture-density test on the raw soil using the gyratory

compactor and determine the percent wet voids in the extruded specimen. The volume of specimen in the mold after complete molding but with the pressure completely removed from the specimen should be a sufficiently accurate volume of specimen to use in calculating the density.

2. From the range of asphalt factors in Table 3 determine or select the mid-range as the point for the first asphalt trial set of specimens. In the case of RC-2 and Soil 72-183-R, which has been used as an example herein, the mid-range asphalt factor is 0.49. Calculate the trial percent asphalt as follows:

$$\text{First \% Asphalt to try} = \frac{0.49\ (\%\ \text{raw soil "wet" voids})}{\%\ \text{residual bitumen in asphalt} \div 100}$$

In this case: soil wet voids = 13.6%
residual bitumen = 81.6%

$$\text{First \% Asphalt to try} = \frac{(0.49)\ (13.6)}{.816} = 8.2 \quad \text{(Use 8\%)}$$

Note: Table 3 confirms 8% as the percent RC-2 giving the best strength but the user will not know this nor will the soil being tried necessarily have its greatest strength at that exact factor.

Mold and test a set of specimens using this percentage of liquid asphalt.

3. In the interest of economy the second trial should be at the low range of the asphalt factors and additionally the natural soil and conditions

during construction may be such that very high percentages of asphalt are hard to properly aerate in the field. When sufficient strengths can be gained at lower asphalt content it may be worthwhile to consider their use for both these reasons.

$$\text{Second \% Asphalt to try} = \frac{0.41 \times 13.6}{.816} = 6.8$$

This trial might be at 6-1/2, 6-3/4 or, say, 7 percent as desired. Mold and test this set of specimens.

4. In the case where the low range end specimens are weaker than the mid-range specimens made first it may be desirable to mold a set of specimens at the high range end of the asphalt factors unless the strengths already obtained are satisfactory. This third trial set would be made at an asphalt content (liquid) as follows:

$$\text{Third \% Asphalt to try} = \frac{0.56 \times 13.6}{.816} = 9.3$$

Not more than 9-1/2 percent would be recommended.
From the maximum strengths obtained from each set select the percent for use.

In the application of these procedures in the field it is necessary to have the soil to be stabilized as uniform, and as uniformly wet, as possible for best results. Since the soil must be aerated (dried back) after mixing of wet soil and asphalt, in order to remove volatiles and come to the best condition of moisture and/or volatiles for compaction, enough water, but not an excess, is desired. These amounts will be easily determined in doing the laboratory testing. Formerly in mixing emulsified asphalts it was thought necessary to wet to a moisture content equal to the liquid limit in order to get good distribution and mixing. Today's emulsions allow moisture contents in the soil, at the application of the emulsion, to approximately one-half of the liquid limit of the soil without "breaking" of the emulsion.

Since success of asphalt treated bases depends greatly upon compaction, it is necessary that proper aeration of moisture and/or volatiles just prior to compaction be determined. The following simple field test procedure to determine optimum liquid contents for compaction is recommended for use.

1. After field mixing at a liquid content above optimum has been completed, select a 90 pound sample and split into at least six portions of approximately 14 pounds each. Place portions where temperature will fluctuate very little.

2. Mold one sample, which has not been aerated, in the gyratory press and determine density and air voids as previously described.

3. Place remainder of portions on trays and aerate in the sun or by stirring under a fan or infrared lamps until various increments of water and volatiles have been removed, then compact using the gyratory compactor.

4. Repeat Step 3 for various portions until a moisture-density curve has been completed. If desired, run the unconfined compressive strength test on all specimens on the curve at room temperature. (Keep the molding temperature as uniform for all portions as is practical, i.e. ± 4 F.)

5. Plot the density and strength data as shown on the graph (Figure 8) and select the optimum liquid content.

6. Rolling or field compaction should be started no later than when the liquid content from 5, above is reached and should be completed prior to the point which is 1-1/2 percent below the optimum from above. Best results should be obtained usually when compaction is completed at the optimum liquid content.

Note: In emulsified liquid asphalt usage it has been determined that better strengths can be achieved when compaction is completed at liquid contents (moisture and/or volatiles) as much as 1-1/2 percent on the wet side of the curve regardless of density.

7. After the field mixture is compacted to maximum density, the roadway in-place density can be determined by Test Method Tex-115-E or other approved methods.

8. Density control should be based on obtaining a suggested minimum of 95% of the density on road mixes when compacted as outlined herein.

However, on using emulsified asphalts it has been demonstrated by these data that higher compressive strengths can occur as high as 1-1/2 percent on the wet side of the optimum of moisture and/or volatiles content regardless of densities.

All test methods referred to herein refer to the "Manual of Testing Procedures," Volume 1, State Department of Highways and Public Transportation.

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3. "Soil Bituminous Stabilization Progress Report" by Chester McDowell, Texas Highway Department, 1971, LI-24-70-E. This progress report shows the photographs of the equipment used in this work.

4. Texas Highway Department 1972 Standard Specifications for Construction of Highways, Streets and Bridges.

5. "Development of Soils-Asphalt Stabilization" by Avery W. Smith presented at the 29th Annual Highway Short Course, Texas A&M University, 1955. Published in Proceedings.

6. "Design, Control, and Interpretation of Tests for Bituminous Hot Mix Black Base Mixtures" by McDowell and Smith. Presented at 1971 Annual Meeting of the Association of Asphalt Paving Technologists in Oklahoma City, Oklahoma. Published in proceedings.

ACKNOWLEDGEMENT

The assistance given by personnel of Districts 14 and 17 in securing the large soil samples is gratefully acknowledged.

Texas Highway Department
Form 409

SOILS AND BASE MATERIALS WORK SHEET

Control No. ______ Section No. ______ Job No. ______

Federal Project No. ______ IPE No. ______ Req. No. ______

County BASTROP

Soil Constants	Screen Anal.	Hyd. Anal.

Lab. No.	LL	PI	SL	LS	SR	Class	Soil Binder	W B M % Loss	% Moisture	Sand Equiv.
70-442-R	25	6	21	2	1.67		99			14
LOCATION OF THIS SOIL MATERIAL - H. G. LEHMAN PIT 195 FT. NORTH OF STA. 910 + 75										
HWY. U. S. 290, BASTROP COUNTY, DISTRICT 14										
SAMPLES FROM EAST SIDE OF PIT.										

PERCENT RETAINED ON

Laboratory No.	Square Mesh Sieves: Opening in Inches								Square Mesh Sieves: Sieve Numbers							Grain Diam. In Millimeters			Spec. Grav.	Material
	3	2½	2	1¾	1¼	7/8	5/8	3/8	4	10	20	40	60	100	200	.05	.005	.001		
70-442-R											0	1	7	53	74	76	80	83	2.65	SAND CLAY

LAKELAND - TABOR - LUVERNE SOIL SERIES TRIAXIAL CLASS 4.1*

* 3-05-72-035 (SEE BIBLIOGRAPHY)

TABLE 1

Texas Highway Department
Form 409

SOILS AND BASE MATERIALS WORK SHEET

Control No. ________ Section No. ________ Job No. ________

County BASTROP

Federal Project No. ________ IPE No. ________ Req. No. ________

Soil Constants	Screen Anal.	Hyd. Anal.

Lab. No.	LL	PI	SL	LS	SR	Class	Soil Binder	W B M % Loss	% Moisture	Sand Equiv.
71-319-R	26	9	19	4	1.73		100			11

LOCATION OF THIS SOIL MATERIAL - H. G. LEHMAN PIT 195 FT. NORTH OF STA. 910 + 75,
HWY. U.S. 290, BASTROP COUNTY, DISTRICT 14,
SAMPLED FROM SOUTHWEST CORNER OF PIT

PERCENT RETAINED ON

Laboratory No.	Square Mesh Sieves: Opening in Inches 3	2½	2	1¾	1¼	7/8	5/8	3/8	Sieve Numbers 4	10	20	40	60	100	200	Grain Diam. In Millimeters .05	.005	.001	Spec. Grav.	Material
71-319-R												0	3	43	69	70	74	77	2.66	SAND CLAY

LAKELAND - TABOR - LUVERNE SOIL SERIES TRIAXIAL CLASS 4.1*

* 3-05-72-035 (SEE BIBLIOGRAPHY)

TABLE 1 (Cont'd.)

Texas Highway Department
Form 409

SOILS AND BASE MATERIALS WORK SHEET

Control No.   Section No.   Job No.

Federal Project No.   IPE No.   Req. No.

County JASPER

Soil Constants	Screen Anal.	Hyd. Anal.

Lab. No.	LL	PI	SL	LS	SR	Class	Soil Binder	W B M % Loss	% Moisture	Sand Equiv.
72-183-R	24	12	15	4.7	1.84		59			20

LOCATION OF THIS SOIL MATERIAL - COUNTY PIT NO. 1 NORTH OF JASPER, TEXAS
HWY. U.S. 96 JASPER COUNTY, DISTRICT 20

PERCENT RETAINED ON

Laboratory No.	Square Mesh Sieves – Opening in Inches: 3	2½	2	1¾	1¼	7/8	5/8	3/8	Sieve Numbers: 4	10	20	40	60	100	200	Grain Diam. In Millimeters: .05	.005	.001	Spec. Grav.	Material
72-183-R									0	2	11	41	69	79	82	82	86	88	2.65	RED SAND-CLAY GRAVEL

LAKELAND - RUSTON SOIL SERIES TRIAXIAL CLASS 4.8*

* 3-05-72-035 (SEE BIBLIOGRAPHY)

TABLE 1 (Cont'd.)

Texas Highway Department
Form 409

SOILS AND BASE MATERIALS WORK SHEET

Control No. | Section No. | Job No.

Federal Project No. | IPE No. | Req. No.

County GRIMES

Soil Constants | Screen Anal. | Hyd. Anal.

Lab. No.	LL	PI	SL	LS	SR	Class	Soil Binder	WBM % Loss	% Moisture	Sand Equiv.
73-87-R	35	18	18	8.0	1.72		68			19

LOCATION OF THIS SOIL MATERIAL - NORTH ROADWAY DITCH TWO MILES EAST OF NAVASOTA, TEXAS
STA. 114 + 00, HWY. S.H. 105, GRIMES COUNTY DISTRICT 17

PERCENT RETAINED ON

Laboratory No.	Square Mesh Sieves: Opening in Inches 3	2½	2	1¾	1¼	7/8	5/8	3/8	Sieve Numbers 4	10	20	40	60	100	200	Grain Diam. In Millimeters .05	.005	.001	Spec. Grav.	Material
73-87-R										0	4	32	65	75	78	78	83	85	2.64	RED SAND CLAY

SAWYER - EDGE - TABOR SOIL SERIES TRIAXIAL CLASS 3.9 *

* 3-05-72-035 (SEE BIBLIOGRAPHY)

TABLE 1 (Cont'd.)

Texas Highway Department
Form 409

SOILS AND BASE MATERIALS WORK SHEET

Control No. ______ Section No. ______ Job No. ______

Federal Project No. ______ IPE No. ______ Req. No. ______

County Leon

Soil Constants	Screen Anal.	Hyd. Anal.

Lab. No.	LL	PI	SL	LS	SR	Class	Soil Binder	W B M % Loss	% Moisture	Sand Equiv.
74-150-R	30	16	18	6.4	1.78		95			7

LOCATION OF THIS SOIL MATERIAL - FACE OF R.O.W. CUT 1.4 MILES NORTH OF FLYNN, TEXAS
ON HWY. F.M. 39, LEON COUNTY DISTRICT 17

PERCENT RETAINED ON

Laboratory No.	Square Mesh Sieves															Grain Diam.			Spec. Grav.	Material
	Opening in Inches								Sieve Numbers							In Millimeters				
	3	2½	2	1¾	1¼	7/8	5/8	3/8	4	10	20	40	60	100	200	.05	.005	.001		
74-150-R											0	5	16	41	65	71	79	82	2.68	SAND CLAY

LAKELAND SOIL SERIES TRIAXIAL CLASS 4.2*
*(3-05-72-035) (SEE BIBLIOGRAPHY)

TABLE 1 (Cont'd.)

Texas Highway Department
Form 409

SOILS AND BASE MATERIALS WORK SHEET

Control No. ______ Section No. ______ Job No. ______

Federal Project No. ______ IPE No. ______ Req. No. ______

County TRAVIS & BRAZOS
(ADMIXTURE)

Soil Constants	Screen Anal.	Hyd. Anal.

Lab. No.	LL	PI	SL	LS	SR	Class	Soil Binder	W B M % Loss	% Moisture	Sand Equiv.
Admix. 74-152-R	23	3	21	1.5	1.62		66			57
(74-151-R) - LOCATION OF THIS SOIL MATERIAL - OLD BOLM PIT ON WEBBERVILLE ROAD, AUSTIN,										
2 PARTS OF THIS SOIL TEXAS, TRAVIS COUNTY, DISTRICT 14										
(74-149-R) - LOCATION OF THIS SOIL MATERIAL - SAUNDER'S PIT 11 MILES NORTHWEST OF BRYAN,										
1 PART OF THIS SOIL TEXAS, BRAZOS COUNTY, DISTRICT 17										
74-151-R	24	4	22	.6	1.62		93			
74-149-R	18	2	17	.5	1.63		20			

PERCENT RETAINED ON

Laboratory No.	Square Mesh Sieves — Opening in Inches: 3	2½	2	1¾	1¼	7/8	5/8	3/8	Sieve Numbers: 4	10	20	40	60	100	200	Grain Diam. In Millimeters: .05	.005	.001	Spec. Grav.	Material
Admix 74-152-R									0	8	18	34	52	69	90	93	97	97	2.65	Admix.
74-151-R*										0	1	7	25	51	84	90	95	98	2.66	Sandy Loam
74-149-R**								0	1	30	55	80	94	98	99	99	100	100	2.65	Sand
BERGSTROM - NORWOOD SOIL ASSOCIATION TRIAXIAL CLASS 5.2*																				
*(3-05-72-035) (SEE BIBLIOGRAPHY)																				
SILICIOUS RIVER, CONCRETE SAND**																				

TABLE 1 (Cont'd.)

Texas Highway Department
Form 409

SOILS AND BASE MATERIALS WORK SHEET

Control No.	Section No.	Job No.
Federal Project No.	IPE No.	Req. No.

County..

Soil Constants X	Screen Anal. X	Hyd. Anal. X

Lab. No.	LL	PI	SL	LS	SR	Class	Soil Binder	W B M % Loss	% Moisture	Sand Equiv.
70-442-R	25	6	21	2	1.67	A-2	99			14
71-319-R	26	9	19	4	1.73	A-2	100			11
72-183-R	24	12	15	4.7	1.84	A-2	59			20
73-87-R	35	18	18	8.0	1.72	A-6-2	68			19
74-152-R	23	3	21	1.5	1.62	A-3	66			57
74-150-R	30	16	18	6.4	1.78	A-2-6	95			7

PERCENT RETAINED ON

Laboratory No.	Square Mesh Sieves															Grain Diam. In Millimeters			Spec. Grav.	Material
	Opening in Inches								Sieve Numbers											
	3	2½	2	1¾	1¼	7/8	5/8	3/8	4	10	20	40	60	100	200	.05	.005	.001		
70-442-R											0	1	7	53	74	76	80	83	2.65	
71-319-R												0	3	43	69	70	74	77	2.66	
72-183-R									0	2	11	41	69	79	82	82	86	88	2.65	
73-87-R										0	4	32	65	75	78	78	83	85	2.64	
74-152-R									0	8	18	34	52	69	90	93	97	97	2.65	
74-150-R											0	5	16	41	65	71	79	82	2.68	

TABLE 1 (Cont'd.)

TABLE 2

ASPHALT STABILIZERS FOR SOIL-ASPHALT STABILIZATION

TYPE - GRADE		PERCENT RESIDUAL ASPHALT	SPECIFIC GRAVITY	TYPE VOLATILES
RC-2	(RAPID CURING - 2)	81.6	1.014	LIGHT VOLATILES (GASOLINE, NAPHTHA, KEROSENE)
MC-30	(MEDIUM CURING - 1 OR 30)	63.9	1.012	MORE MEDIUM LIGHT VOLATILES (KEROSENE)
MC-800	(MEDIUM CURING - 3 OR 800)	86.9	1.016	LESS MEDIUM LIGHT VOLATILES (KEROSENE)
RO-3	(ROAD OIL - 3)	75.0	1.033	LESS HEAVY VOLATILES (LUBE OIL, DIESEL OIL, WAX
C.F.O.	(CRACKED FUEL OIL)	69.1	1.057	MORE HEAVY VOLATILES (LUBE OIL, DIESEL OIL, WAX
EA-11M	(EMULSIFIED ASPHALT - 11 SLOW SET)	64.8	1.038	ANIONIC EMULSION
HVMS	(HIGH VISCOSITY MEDIUM SET) . . .	68.5	1.014	ANIONIC EMULSION

ASPHALT STABILIZERS USED MEET REQUIREMENTS OF ITEM 300, ASPHALTS, OILS AND EMULSIONS.

1972 STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREETS AND BRIDGES.

(TEXAS HIGHWAY DEPARTMENT 1972).

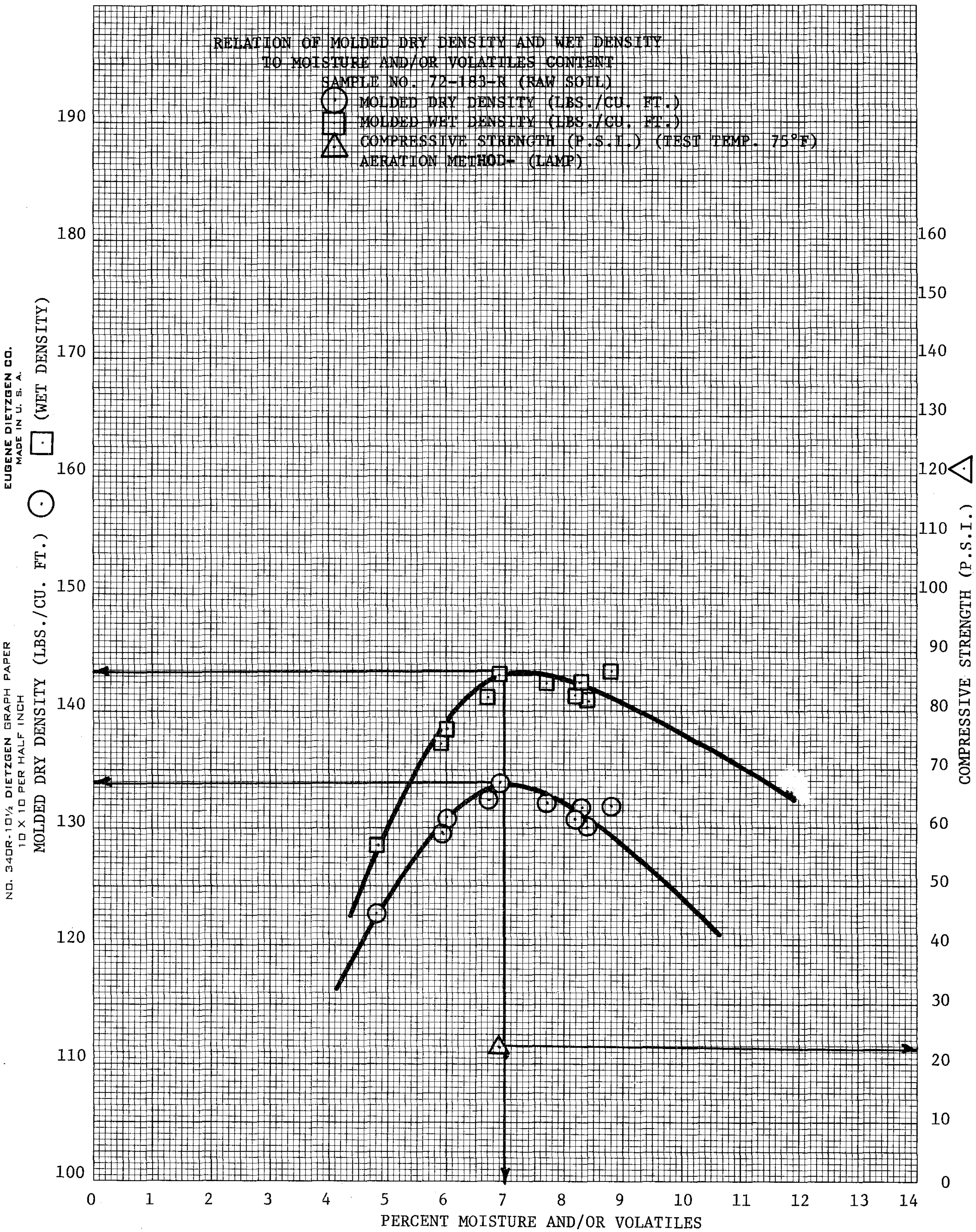
TABLE 3

Relationship of Gyratory Voids, Percent Liquid Asphalt and Maximum Compressive Strengths for Use in Determining Asphalt Factors

	AVERAGE % RESIDUAL ASPHALT	(@ Max. Strength) % LIQUID ASPHALT						MAX. COMPRESSIVE STRENGTH-PSI						ASPHALT FACTOR						Asphalt Factor Excluding Soil b (Range)	Mid Point Excluding Soil b
		a	b	c	d	e	f	a	b	c	d	e	f	a	b	c	d	e	f		
RC-2	81.6	8.0	5.0	12.0	9.0	8.0	9.0	81.2	22.0	40.0	81.0	27.0	27.0	.48	.23	.56	.45	.41	.46	.41 - .56	.49
MC-30	63.9	7.9	6.9	10.0	10.0	12.0	9.0	66.8	17.7	36.0	47.0	18.0	36.0	.37	.25	.37	.39	.48	.36	.35 - .48	.42
MC-800	86.9	8.0	7.1	10.0	12.0	10.0	12.0	92.2	19.8	100.0	188.0	39.0	150.1	.51	.35	.51	.63	.54	.65	.51 - .65	.58
RO-3	75.0	8.0	6.8	10.0	12.0	9.0	12.0	76.0	25.6	66.0	156.0	44.0	129.0	.44	.29	.44	.55	.42	.56	.42 - .55	.48
C.F.O.	69.1	7.1	7.7	10.0	12.0	10.0	10.0	67.0	24.1	49.0	150.0	44.0	90.8	.36	.30	.41	.50	.43	.43	.36 - .50	.43
EA-11M	64.8	6.3	6.0	12.0	10.0	8.0	8.0	61.0	22.6	64.0	91.0	27.0	115.5	.30	.22	.46	.39	.32	.32	.30 - .46	.38
HVMS	68.5	6.0	7.2	10.0	9.0	8.0	8.0	52.5	25.0	86.0	114.0	17.0	81.5	.30	.28	.40	.37	.34	.34	.30 - .40	.35

Soil Legend

Soil Designation	Lab. No.	Plasticity Index	Percent Gyratory Voids
a	72-183-R	12	13.6
b	74-152-R	3	17.7
c	70-442-R	6	17.0
d	71-319-R	9	16.5
e	73-87-R	18	16.1
f	74-150-R	16	16.0



RELATION OF MOLDED DRY DENSITY AND WET DENSITY
TO MOISTURE AND/OR VOLATILES CONTENT
SAMPLE NO. 72-183-R (RAW SOIL)
MOLDED DRY DENSITY (LBS./CU. FT.)
MOLDED WET DENSITY (LBS./CU. FT.)
COMPRESSIVE STRENGTH (P.S.I.) (TEST TEMP. 75°F)
AERATION METHOD- (LAMP)
MOLDED DRY DENSITY (LBS./CU. FT.)
(WET DENSITY)
COMPRESSIVE STRENGTH (P.S.I.)
PERCENT MOISTURE AND/OR VOLATILES
EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
190
180
170
160
150
140
130
120
110
100
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14

Fig. 1

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 1
MOLDING DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	1	2	3	4	5	6
Date Molded	7-24-72	7-25-72	7-25-72	7-25-72	7-26-72	7-26-72
% Stabilizer (Raw Soil)	0	0	0	0	0	0
% Hygro. Moist.	1.0	1.0	1.0	1.0	1.0	1.0
Lbs. Material + Hygro.	12.500	12.500	12.500	12.500	12.500	12.500
Wt. Hygro. Moist.	.124	.124	.124	.124	.124	.124
Dry Wt. Material	12.376	12.376	12.376	12.376	12.376	12.376
Lbs. Stabilizer	0	0	0	0	0	0
% Water Added	12.0	12.0	12.0	12.0	12.0	12.0
Lbs. Water Added	1.485	1.485	1.485	1.485	1.485	1.485
Tare Wt. Jar	.600	.600	.600	.600	.600	.600
Wt. Water + Jar	2.085	2.085	2.085	2.085	2.085	2.085
Temp. Mix in Mold	84°	72°	74°	77°	74°	79°
Mold No.	3	3	3	3	3	3
Time @ 20 psi.	2'	2'	2'	2'	2'	2'
Time @ 40 psi.	2'	2'	2'	2'	2'	2'
Time @ 60 psi.	5'	16'	15'	5'	12'	16'
Time @ 500 psi.	10'	10'	10'	10'	10'	10'
Ht. Specimen + Plates	5.752	5.718	5.717	5.749	5.674	5.746
Thickness of Plates	.090	.090	.090	.090	.090	.090
Ht. Specimen (Loaded)	5.662	5.628	5.627	5.659	5.584	5.656
Ht. Specimen (Rebound)	5.829	5.756	5.747	5.802	5.731	5.722
Molded Wt. of Specimen	13.414	13.401	13.463	13.391	13.332	13.200
Vol. per Linear Inch	.016315	.016315	.016315	.016315	.016315	.016315
Vol. of Specimen (Rebound)	.095100	.093909	.093762	.094660	.093501	.093354
Wt. of Bitumen in Spec.						
Dry Wt. of Soil in Spec.	12.376	12.376	12.376	12.376	12.376	12.376
Calc. Dry Wt. of Specimen	12.376	12.376	12.376	12.376	12.376	12.376
Calc. Dry Density of Spec. (Rebound)	130.14	131.79	131.99	130.74	132.36	132.57
Calc. Dry Density of Soil	"	"	"	"	"	"
Calc. % Moist. & Volatiles	8.4	8.3	8.8	8.2	7.7	6.7
Time Aerated (Minutes)	100'	70'	53'	91'	106'	181'

Fig. 1-A

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 2
DENSITY AND VOIDS DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	1	2	3	4	5	6
% Stabilizer (Raw Soil)	0	0	0	0	0	0
% Bitumen in Stabilizer	-	-	-	-	-	-
% Bitumen in Mix *	-	-	-	-	-	-
Sp. Gr. of Bitumen	-	-	-	-	-	-
Sp. Gr. of Soil	2.657	2.657	2.657	2.657	2.657	2.657
Combined Sp. Gr. **	-	-	-	-	-	-
Molded Wet Wt. of Specimen	13.414	13.401	13.463	13.391	13.332	13.200
Molded Dry Wt. of Specimen	12.376	12.376	12.376	12.376	12.376	12.376
Loaded Vol. of Specimen	.092376	.091821	.091805	.092327	.091103	.092278
Loaded Dry Density	133.97	134.78	134.81	134.05	135.85	134.12
Loaded Wet Density	145.21	145.95	146.65	145.04	146.34	143.05
Rebound Vol. of Specimen	.095100	.093909	.093762	.094660	.093501	.093354
Rebound Dry Density	130.14	131.79	131.99	130.74	132.36	132.57
Rebound Wet Density	141.05	142.70	143.59	141.46	142.59	141.40
Zero Air Voids Density ***	165.78	165.78	165.78	165.78	165.78	165.78
% Voids Loaded (Dry) ****	19.2	18.7	18.7	19.1	18.1	19.1
% Voids Loaded (Wet) ****	12.4	12.0	11.5	12.5	11.7	13.7
% Voids Rebound (Dry) ****	21.5	20.5	20.4	21.1	20.2	20.0
% Voids Rebound (Wet) ****	14.9	13.9	13.4	14.7	14.0	14.7

FORMULAS

* Percent Bitumen in Mix $= \dfrac{\text{\% Bitumen x \% Stabilizer Added}}{(\text{\% Bitumen x \% Stabilizer Added}) + 100}$

** Combined Sp. Gr. $= \dfrac{100}{\dfrac{\text{\% Soil}}{\text{Ab.Sp.Gr. of Soil}} + \dfrac{\text{\% Bitumen in Mix}}{\text{Ab.Sp.Gr. of Bitumen}}}$

*** Zero Air Voids Density = 62.4 x Combined Sp. Gr.

**** Percent Voids $= \left(1 - \dfrac{\text{Density of Specimen}}{\text{Zero Air Voids Density}}\right) \text{X } 100$

Fig. 1-B

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 3
CURING, TESTING AND DRYING DATA
FOR SOIL-ASPHALT MIXES
(M. - D. CURVE SPECIMENS)

Sample No. 72-183-R	1	2	3	4	5	6
Percent Stabilizer (Raw Soil)	0	0	0	0	0	0
Date Molded	7-24-72	7-25-72	7-25-72	7-25-72	7-26-72	7-26-72
Date in Oven						
Date out Oven						
Date Tested						
Ht. before Wetting & Heating						
Ht. after Wetting & Heating						
Difference in Height						
% Swell (Vertical)						
Cir. before Wetting & Heating						
Cir.after Wetting & Heating						
Cured Dry Wt. Specimen						
Oven Dry Wt. Specimen						
Wt. Moisture in Specimen						
% Moisture before Wetting						
Wt. after Wetting						
Oven Dry Wt. of Specimen						
Wt. Moisture in Specimen						
% Moisture after Wetting						
Dry Wt. Pan + Specimen	16.278	16.790	16.097	16.539	16.600	16.889
Tare Wt. Pan	3.932	4.503	3.819	4.171	4.242	4.529
Oven Dry Wt. Specimen	12.346	12.287	12.278	12.368	12.358	12.360
Molded Wet Wt. Specimen	13.414	13.401	13.463	13.391	13.332	13.200
Wt. H_2O & or Volatiles	1.068	1.114	1.185	1.023	.974	.840
% H_2O (& or Volatiles) on Total	8.7	9.1	9.7	8.3	7.9	6.8
Oven Dry Density Specimen	129.82	130.84	130.95	130.66	132.17	132.40
Loading - Rate (In./Min.)						
Total Load - Comp.						
Comp. Strength (psi)						
Testing Temp. ^oF						

Fig. 1-C

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 4
AERATION DATA FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	1	2	3	4	5	6
Date Aerated	7-24-72	7-25-72	7-25-72	7-25-72	7-25-72	7-26-72
Percent Stabilizer (Raw Soil)	0	0	0	0	0	0
Aeration Method	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)
% M. or V. Aerated	3.0	2.0	1.0	4.0	4.0	6.0
Wt. M. or V. Aerated	.371	.248	.124	.495	.495	.743
M. or V. Loss After Mixing						
Wt. Pan + S.A. after mixing	18.969	19.341	19.115	19.161	19.385	19.382
Wt. M. or V. Aerated	.371	.248	.124	.495	.495	.743
Wt. Pan + S.A.after Aerating	18.598	19.093	18.991	18.666	18.890	18.639
Time Aerated	67'	70'	53'	43'	106'	122'
Wt. Pan + Soil-Asphalt	18.728	19.040	18.882	18.939	18.818	18.878
Time Aerated	33'			48'	Room	42'
Wt.Pan + Soil-Asphalt	18.580			18.660	18.807	18.728
Time Aerated						17'
Wt. Pan + Soil-Asphalt						18.660
Time Aerated						Room
Wt. Pan + Soil-Asphalt						18.618
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Total Time Aerated(Minutes)	100'	70'	53'	91'	106'	181'
Wt. M. & or V. Aerated	.389	.301	.233	.501	.578	.764
Corrected %M.& or V.Aerated	3.1	2.4	1.9	4.0	4.7	6.2
Total Wt. H_2O in Mix	1.609	1.609	1.609	1.609	1.609	1.609
Wt. Molding Moist.	1.220	1.308	1.376	1.108	1.031	.845
% Molding Moist.	9.9	10.6	11.1	9.0	8.3	6.8

Fig. 1-D

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 1
MOLDING DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	7	8	9	10		
Date Molded	7-27-72	7-27-72	7-27-72	7-27-72		
% Stabilizer (Raw Soil)	0	0	0	0		
% Hygro. Moist.	1.0	1.0	1.0	1.0		
Lbs. Material + Hygro.	13.000	13.000	13.000	13.000		
Wt. Hygro. Moist.	.129	.129	.129	.129		
Dry Wt. Material	12.871	12.871	12.871	12.871		
Lbs. Stabilizer	0	0	0	0		
% Water Added	8.0	8.0	8.0	8.0		
Lbs. Water Added	1.030	1.030	1.030	1.030		
Tare Wt. Jar	.600	.600	.600	.600		
Wt. Water + Jar	1.630	1.630	1.630	1.630		
Temp. Mix in Mold	77°	76°	76°	77°		
Mold No.	3	3	3	3		
Time @ 20 psi. (Min.)	2'	2'	2'	2'		
Time @ 40 psi. (Min.)	2'	2'	2'	2'		
Time @ 60 psi. (Min.)	25'	21'	16'	15'		
Time @ 500 psi. (Min.)	10'	10'	10'	10'		
Ht. Specimen + Plates	6.435	6.107	5.916	6.054		
Thickness of Plates	.090	.090	.090	.090		
Ht. Specimen (Loaded)	6.345	6.017	5.826	5.964		
Ht. Specimen (Rebound)	6.429	6.084	5.887	6.028		
Molded Wt. of Specimen	13.494	13.634	13.762	13.642		
Vol. per Linear Inch	.016315	.016315	.016315	.016315		
Vol. of Specimen (Rebound)	.104889	.099260	.096046	.098347		
Wt. of Bitumen in Spec.						
Dry Wt. of Soil in Spec.	12.871	12.871	12.871	12.871		
Calc. Dry Wt. of Specimen	12.871	12.871	12.871	12.871		
Calc. Dry Density of Spec. (Rebound)	122.71	129.67	134.01	130.87		
Calc. Dry Density of Soil	"	"	"	"		
Calc. % Moist. & Volatiles	4.8	5.9	6.9	6.0		
Time Aerated (Minutes)	131'	91'	56'	58'		

Fig. 1-E

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 2
DENSITY AND VOIDS DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	7	8	9	10		
% Stabilizer (Raw Soil)	0	0	0	0		
% Bitumen in Stabilizer	-	-	-	-		
% Bitumen in Mix *	-	-	-	-		
Sp. Gr. of Bitumen	-	-	-	-		
Sp. Gr. of Soil	2.657	2.657	2.657	2.657		
Combined Sp. Gr. **	-	-	-	-		
Molded Wet Wt. of Specimen	13.494	13.634	13.762	13.642		
Molded Dry Wt. of Specimen	12.871	12.871	12.871	12.871		
Loaded Vol. of Specimen	.103519	.098167	.095051	.097303		
Loaded Dry Density	124.33	131.11	135.41	132.28		
Loaded Wet Density	130.35	138.89	144.79	140.20		
Rebound Vol. of Specimen	.104889	.099260	.096046	.098347		
Rebound Dry Density	122.71	129.67	134.01	130.87		
Rebound Wet Density	128.65	137.36	143.29	138.71		
Zero Air Voids Density ***	165.80	165.80	165.80	165.80		
% Voids Loaded (Dry) ****	25.0	20.9	18.3	20.2		
% Voids Loaded (Wet) ****	21.4	16.2	12.7	15.4		
% Voids Rebound (Dry) ****	26.0	21.8	19.2	21.1		
% Voids Rebound (Wet) ****	22.4	17.2	13.6	16.3		

FORMULAS

* Percent Bitumen in Mix $= \dfrac{\text{\% Bitumen x \% Stabilizer Added}}{\text{(\% Bitumen x \% Stabilezer Added) + 100}}$

** Combined Sp. Gr. $= \dfrac{100}{\dfrac{\text{\% Soil}}{\text{Ab.Sp.Gr. of Soil}} + \dfrac{\text{\% Bitumen in Mix}}{\text{Ab.Sp.Gr. of Bitumen}}}$

*** Zero Air Voids Density = 62.4 x Combined Sp. Gr.

**** Percent Voids $= (1 - \dfrac{\text{Density of Specimen}}{\text{Zero Air Voids Density}}) \times 100$

Fig. 1-F

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 6
CAPILLARY WETTING, CURING, TESTING AND DRYING DATA
FOR SOIL OR SOIL-ASPHALT MIXES
(COMPRESSION TEST SPECIMENS)

Sample No. 72-183-R	7	8	9	10		
Percent Stabilizer(Raw Soil)	0	0	0	0		
Cell No.	30	83	61	76		
Lbs. of Added Surcharge	10	10	10	10		
Date in Oven	7-28-72	7-28-72	7-28-72	7-28-72		
Date out Oven (6 Hrs.)	7-28-72	7-28-72	7-28-72	7-28-72		
Date in Capillarity	7-31-72	7-31-72	7-31-72	7-31-72		
Date out Capillarity (10 Days)	8-10-72	8-10-72	8-10-72	8-10-72		
Ht. in Capillarity - Stones	6.430	6.082	5.882	6.013		
Ht. out Capillarity - Stones	6.432	6.082	5.886	6.013		
% Swell (Vertical)	Nil	Nil	Nil	Nil		
Cir. in Capillarity	18.8	18.8	18.8	18.8		
Cir. out Capillarity	18.8	18.8	18.8	18.8		
Cured Dry Wt. Spec. + Stones	22.112	22.161	22.207	22.172		
Dry Weight Stones	8.911	8.913	8.922	8.925		
Cured Dry Wt. Specimen	13.201	13.248	13.285	13.247		
Wt. H_2O(& or Volatiles)in Spec.	.379	.418	.464	.429		
% H_2O(& or Volatiles)in Spec.	2.96	3.26	3.62	3.35		
Wt. after Capillarity	23.776	23.631	23.461	23.568		
Wet Wt. Stones	9.657	9.683	9.655	9.661		
Wet Wt. Specimen	14.119	13.948	13.806	13.907		
Oven Dry Wt. Specimen	12.822	12.830	12.821	12.818		
Wt. H_2O(& or Volatiles)inSpec.	1.297	1.118	.985	1.089		
% H_2O (& or Volatiles)after Cap.	10.12	8.71	7.68	8.50		
Dry Wt. Pan + Specimen	16.641	16.765	16.731	16.989		
Tare Wt. Pan	3.819	3.935	3.910	4.171		
Oven Dry Wt. Specimen	12.822	12.830	12.821	12.818		
Oven Dry Density Specimen	122.24	129.26	133.49	130.33		
Loading-Rate (In./Minute)	0.15"	0.15"	0.15"	0.15"		
Total Load-Comp.	129.65	309.65	656.70	361.39		
Comp. Strength (P.S.I.)	4.61	11.01	23.35	12.85		
Testing Temp. ^{o}F	75^o	75^o	75^o	75^o		

Fig. 1-G

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 4
AERATION DATA FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	7	8	9	10		
Date Aerated	7-27-72	7-27-72	7-27-72	7-28-72		
Percent Stabilizer (Raw Soil)	0	0	0	0		
Aeration Method	(Lamp)	(Lamp)	(Lamp)	(Lamp)		
% M. or V. Aerated	4.0	3.0	2.0	3.0		
Wt. M. or V. Aerated	.515	.386	.257	.386		
M. or V. Loss after Mixing						
Wt. Pan + S.A. after Mixing	19.439	19.208	19.167	19.372		
Wt. M. or V. Aerated	.515	.386	.257	.386		
Wt. Pan + S.A. after Aerating	18.924	18.822	18.910	18.986		
Time Aerated	41'	47'	56'	58'		
Wt. Pan + Soil-Asphalt	19.308	19.040	18.938	19.052		
Time Aerated	30'	34'	Room	Room		
Wt. Pan + Soil-Asphalt	19.180	18.889	18.900	18.995		
Time Aerated	26'	10'				
Wt. Pan + Soil-Asphalt	19.080	18.842				
Time Aerated	14'	Room				
Wt. Pan + Soil-Asphalt	19.027	18.822				
Time Aerated	20'					
Wt. Pan + Soil-Asphalt	18.935					
Time Aerated	Room					
Wt. Pan + Soil-Asphalt	18.910					
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Total Time Aerated (Minutes)	131'	91'	56'	58'		
Wt. M.& V. Aerated	.529	.386	.267	.377		
Corrected % M. & or V. Aerated	4.1	3.0	2.1	2.9		
Total Wt. H_2O in Mix	1.159	1.159	1.159	1.159		
Wt. Molding Moist.	.630	.773	.892	.782		
% Molding Moist.	4.9	6.0	6.9	6.1		

Fig. 1-H

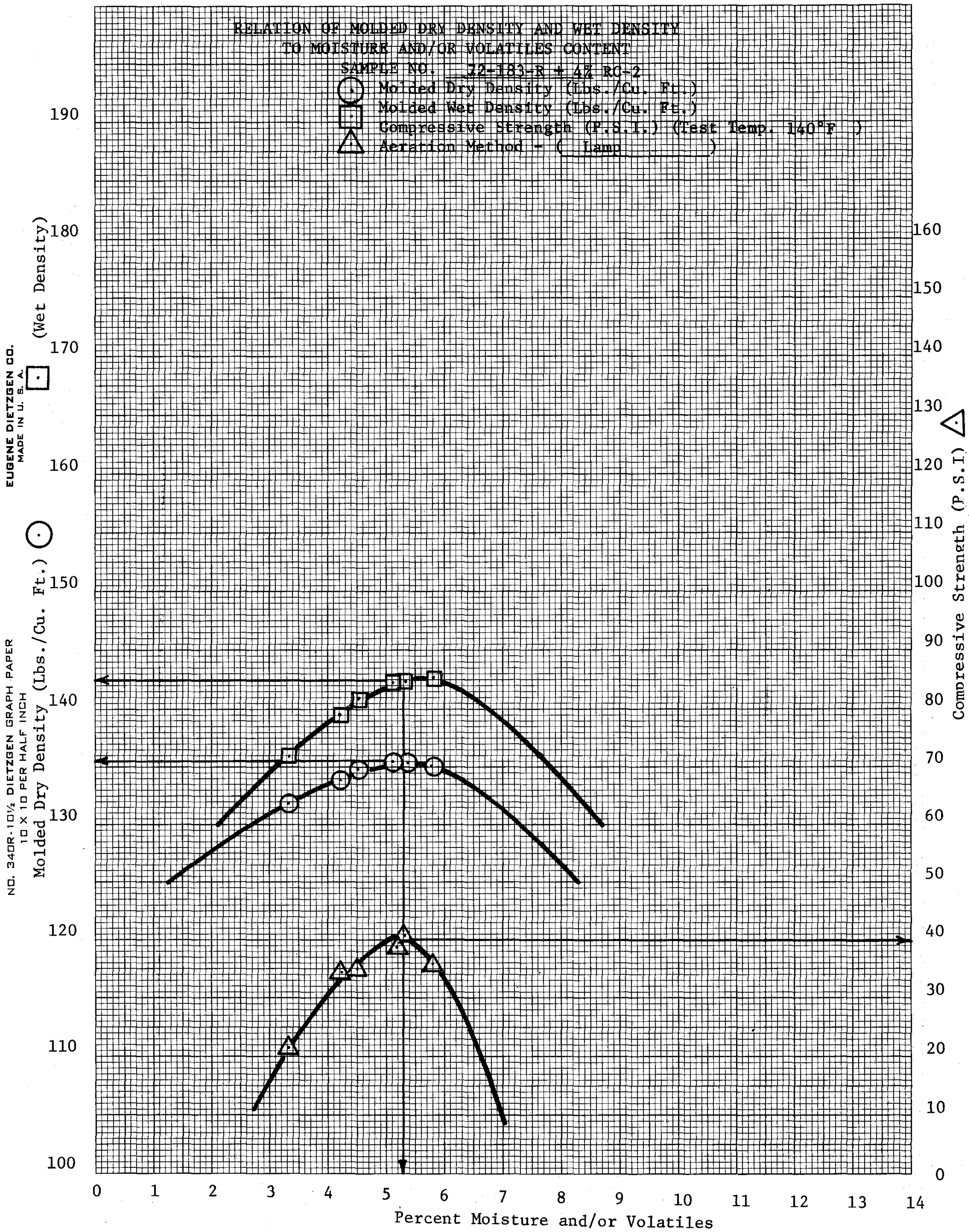

RELATION OF MOLDED DRY DENSITY AND WET DENSITY
TO MOISTURE AND/OR VOLATILES CONTENT
SAMPLE NO. 72-183-R + 4% RC-2
Molded Dry Density (Lbs./Cu. Ft.)
Molded Wet Density (Lbs./Cu. Ft.)
Compressive Strength (P.S.I.) (Test Temp. 140°F)
Aeration Method - (Lamp)
Molded Dry Density (Lbs./Cu. Ft.)
(Wet Density)
Compressive Strength (P.S.I.)
Percent Moisture and/or Volatiles
100
110
120
130
140
150
160
170
180
190
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

Fig. 2

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 1
MOLDING DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	61	62	63	64	65	66
Date Molded	9-22-72	9-22-72	9-22-72	9-22-72	9-22-72	9-22-72
% Stabilizer (RC-2)	4	4	4	4	4	4
% Hygro. Moist.	1.0	1.0	1.0	1.0	1.0	1.0
Lbs. Material + Hygro.	12.750	12.750	12.750	12.750	12.750	12.750
Wt. Hygro. Moist.	.126	.126	.126	.126	.126	.126
Dry Wt. Material	12.624	12.624	12.624	12.624	12.624	12.624
Lbs. Stabilizer	.505	.505	.505	.505	.505	.505
% Water Added	5.0	5.0	5.0	5.0	5.0	5.0
Lbs. Water Added	.631	.631	.631	.631	.631	.631
Tare Wt. Jar	.600	.600	.600	.600	.600	.600
Wt. Water + Jar	1.231	1.231	1.231	1.231	1.231	1.231
Temp. Mix in Mold	72°	73°	73°	76°	76°	76°
Mold No.	3	3	3	3	3	3
Time @ 20 psi.	2'	2'	2'	2'	2'	2'
Time @ 40 psi.	2'	2'	2'	2'	2'	2'
Time @ 60 psi.	14'	12'	10'	11'	10'	9'
Time @ 500 psi.	10'	10'	10'	10'	10'	15'
Ht. Specimen + Plates	6.086	5.990	5.919	5.955	5.925	5.925
Thickness of Plates	.088	.088	.088	.088	.088	.088
Ht. Specimen (Loaded)	5.998	5.902	5.831	5.867	5.837	5.837
Ht. Specimen (Rebound)	6.065	5.970	5.913	5.934	5.912	5.921
Molded Wt. of Specimen	13.469	13.586	13.732	13.629	13.722	13.788
Vol. per Linear Inch	.016315	.016315	.016315	.016315	.016315	.016315
Vol. of Specimen (Rebound)	.098950	.097401	.096471	.096813	.096454	.096601
Wt. of Bitumen in Spec.	.414	.414	.414	.414	.414	.414
Dry Wt. of Soil in Spec.	12.624	12.624	12.624	12.624	12.624	12.624
Calc. Dry Wt. of Specimen	13.038	13.038	13.038	13.038	13.038	13.038
Calc. Dry Density of Spec. (Rebound)	131.76	133.86	135.15	134.67	135.17	134.97
Calc. Dry Density of Soil	127.58	129.61	130.86	130.40	130.88	130.68
Calc. % Moist. & Volatiles	3.3	4.2	5.3	4.5	5.2	5.8
Time Aerated (Minutes)	114'	67'	37'	60'	30'	17'

FIG. 2-A

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 2
DENSITY AND VOIDS DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	61	62	63	64	65	66
% Stabilizer (RC-2)	4	4	4	4	4	4
% Bitumen in Stabilizer	82.0	82.0	82.0	82.0	82.0	82.0
% Bitumen in Mix*	3.2	3.2	3.2	3.2	3.2	3.2
Sp. Gr. of Bitumen	1.014	1.014	1.014	1.014	1.014	1.014
Sp. Gr. of Soil	2.660	2.660	2.660	2.660	2.660	2.660
Combined Sp. Gr.**	2.529	2.529	2.529	2.529	2.529	2.529
Molded Wet Wt. of Specimen	13.469	13.586	13.732	13.629	13.722	13.788
Molded Dry Wt. of Specimen	13.038	13.038	13.038	13.038	13.038	13.038
Loaded Vol. of Specimen	.097857	.096291	.095133	.095720	.095231	.095231
Loaded Dry Density	133.24	135.40	137.05	136.21	136.91	136.91
Loaded Wet Density	137.64	141.09	144.35	142.38	144.09	144.78
Rebound Vol. of Specimen	.098950	.097401	.096471	.096813	.096454	.096601
Rebound Dry Density	131.76	133.86	135.15	134.67	135.17	134.97
Rebound Wet Density	136.12	139.49	142.34	140.78	142.26	142.73
Zero Air Voids Density***	157.81	157.81	157.81	157.81	157.81	157.81
% Voids Loaded (Dry)****	15.6	14.2	13.2	13.7	13.2	13.2
% Voids Loaded (Wet)****	12.8	10.6	8.5	9.8	8.7	8.3
% Voids Rebound (Dry)****	16.5	15.2	14.4	14.7	14.3	14.5
% Voids Rebound (Wet)****	13.7	11.6	9.8	10.8	9.9	9.6

FORMULAS

* Percent Bitumen in Mix = $\dfrac{\text{\% Bitumen x \% Stabilizer Added}}{\text{(\% Bitumen x \% Stabilizer Added) + 100}}$

** Combined Sp. Gr. = $\dfrac{100}{\dfrac{\text{\% Soil}}{\text{Ab.Sp.Gr. of Soil}} + \dfrac{\text{\% Bitumen in Mix}}{\text{Ab.Sp.Gr. of Bitumen}}}$

*** Zero Air Voids Density = 62.4 x Combined Sp. Gr.

**** Percent Voids = $\left(1 - \dfrac{\text{Density of Specimen}}{\text{Zero Air Voids Density}}\right) \times 100$

FIG. 2-B

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 3
CURING, TESTING AND DRYING DATA
FOR SOIL-ASPHALT MIXES

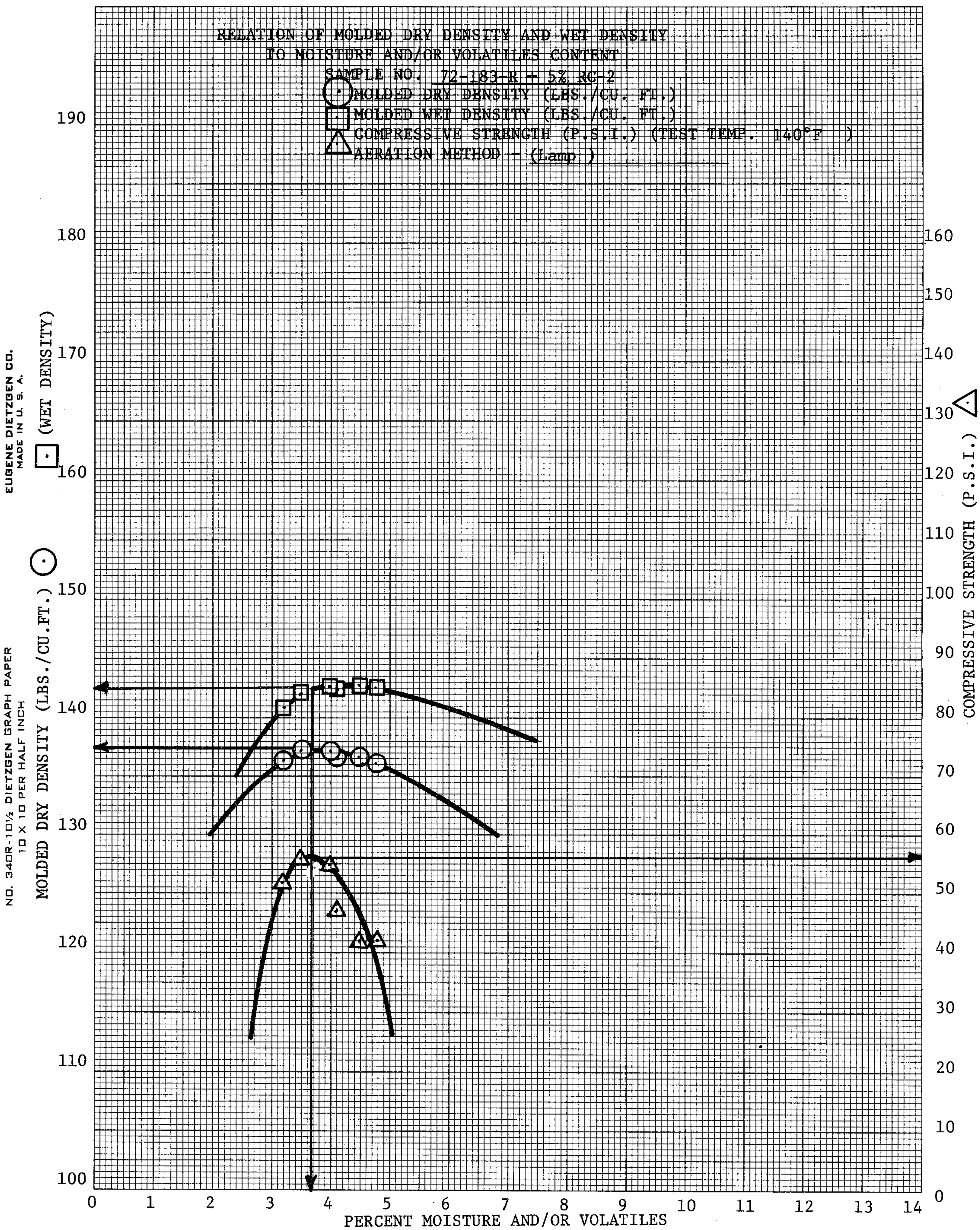
Sample No. 72-183-R	61	62	63	64	65	66
Percent Stabilizer (RC-2)	4	4	4	4	4	4
Date Molded	9-22-72	9-22-72	9-22-72	9-22-72	9-22-72	9-22-72
Date in Oven	9-22-72	9-22-72	9-22-72	9-22-72	9-22-72	9-22-72
Date out Oven	9-27-72	9-27-72	9-27-72	9-27-72	9-27-72	9-27-72
Date Tested	9-29-72	9-29-72	9-29-72	9-29-72	9-29-72	9-29-72
Ht. before Wetting & Heating	6.061	5.962	5.899	5.929	5.901	5.903
Ht. after Wetting & Heating	6.170	6.035	5.944	5.994	5.950	5.930
Difference in Height	.109	.073	.045	.065	.049	.027
% Swell (Vertical)	1.8	1.2	0.8	1.1	0.8	0.5
Cir. before Wetting & Heating	18.85	18.85	18.80	18.80	18.80	18.85
Cir. after Wetting & Heating	19.15	19.10	19.00	19.10	19.00	19.00
Cured Dry Wt. Specimen	13.094	13.098	13.112	13.106	13.112	13.113
Oven Dry Wt. Specimen	13.057	13.062	13.059	13.068	13.070	13.066
Wt. Moisture in Specimen	.037	.036	.053	.038	.042	.047
% Moisture before Wetting	0.3	0.3	0.4	0.3	0.3	0.4
Wt. after Wetting	14.040	13.900	13.843	13.897	13.848	13.807
Oven Dry Wt. of Specimen	13.057	13.062	13.059	13.068	13.070	13.066
Wt. Moisture in Specimen	.983	.838	.784	.829	.778	.741
% Moisture after Wetting	7.5	6.4	6.0	6.3	6.0	5.7
Dry Wt. Pan + Specimen	17.249	16.881	16.969	17.239	17.338	16.988
Tare Wt. Pan	4.192	3.819	3.910	4.171	4.268	3.922
Oven Dry Wt. Specimen	13.057	13.062	13.059	13.068	13.070	13.066
Molded Wet Wt. Specimen	13.469	13.586	13.732	13.629	13.722	13.788
Wt. H_2O	.412	.524	.673	.561	.652	.722
% H_2O(& or Volatiles)on Total	3.2	4.0	5.2	4.3	5.0	5.5
Oven Dry Density Specimen	131.96	134.11	135.37	134.98	135.51	135.26
Loading-Rate (In/Min.)	.15	.15	.15	.15	.15	.15
Total Load - Comp.	627	990	1,160	999	1,099	1,023
Comp. Strength (psi)	21.5	34.1	40.4	34.4	38.3	35.6
Testing Temp. °F.	137°	137°	140°	139°	139°	140°

FIG. 2-C

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 4
AERATION DATA FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	61	62	63	64	65	66
Date Aerated	9-21-72	9-21-72	9-21-72	9-22-72	9-22-72	9-22-72
Percent Stabilizer (RC-2)	4	4	4	4	4	4
Aeration Method	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)
% M. or V. Aerated	3.0	2.0	1.0	1.5	1.0	0.5
Wt. M. or V. Aerated	.391	.261	.130	.196	.130	.065
M. or V. Loss after Mixing	.046	.037	.036	.035	.037	.042
Wt. Pan + S. A. after Mixing	18.942	18.832	19.013	18.947	18.839	19.018
Wt. M. or V. Aerated	.345	.224	.094	.161	.093	.023
Wt. Pan + S.A. after Aerating	18.597	18.608	18.919	18.786	18.746	18.995
Time Aerated	48'	60'	27'	60'	30'	17'
Wt. Pan + Soil-Asphalt	18.820	18.640	18.947	18.795	18.762	18.985
Time Aerated	60'	7'	5'			Room
Wt. Pan + Soil-Asphalt	18.623	18.615	18.938			18.977
Time Aerated	6'	Room	2'			
Wt. Pan + Soil-Asphalt	18.602	18.608	18.930			
Time Aerated	Room		3'			
Wt. Pan + Soil-Asphalt	18.597		18.920			
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Total Time Aerated (Minutes)	114'	67'	37'	60'	30'	17'
Corrected % M. & or V. Aerated	x	x	x	1.4	0.9	0.6

FIG. 2-D


RELATION OF MOLDED DRY DENSITY AND WET DENSITY
TO MOISTURE AND/OR VOLATILES CONTENT
SAMPLE NO. 72-183-R + 5% RC-2
MOLDED DRY DENSITY (LBS./CU. FT.)
MOLDED WET DENSITY (LBS./CU. FT.)
COMPRESSIVE STRENGTH (P.S.I.) (TEST TEMP. 140°F)
AERATION METHOD - (Lamp)
MOLDED DRY DENSITY (LBS./CU.FT.)
(WET DENSITY)
COMPRESSIVE STRENGTH (P.S.I.)
PERCENT MOISTURE AND/OR VOLATILES
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.
100
110
120
130
140
150
160
170
180
190
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
0
1
2
3
4
5
6
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12
13
14

Fig. 3

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 1
MOLDING DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R2	79	80	81	82	83	84
Date Molded	10-4-72	10-4-72	10-4-72	10-4-72	10-4-72	10-4-72
% Stabilizer (RC-2)	5	5	5	5	5	5
% Hygro. Moist.	0.6	0.6	0.6	0.6	0.6	0.6
Lbs. Material + Hygro.	12.750	12.750	12.750	12.750	12.750	12.750
Wt. Hygro. Moist.	.076	.076	.076	.076	.076	.076
Dry Wt. Material	12.674	12.674	12.674	12.674	12.674	12.674
Lbs. Stabilizer	.634	.634	.634	.634	.634	.634
% Water Added	5.0	5.0	5.0	5.0	5.0	5.0
Lbs. Water Added	.634	.634	.634	.634	.634	.634
Tare Wt. Jar	.600	.600	.600	.600	.600	.600
Wt. Water + Jar	1.234	1.234	1.234	1.234	1.234	1.234
Temp. Mix in Mold	73°	73°	73°	75°	75°	76°
Mold No.	3	3	3	3	3	3
Time @ 20 psi.	2'	2'	2'	2'	2'	2'
Time @ 40 psi.	2'	2'	2'	2'	2'	2'
Time @ 60 psi.	13'	11'	9'	12'	11'	10'
Time @ 500 psi.	10'	10'	10'	10'	10'	10'
Ht. Specimen + Plates	5.948	5.914	5.957	5.911	5.927	5.935
Thickness of Plates	.088	.088	.088	.088	.088	.088
Ht. Specimen (Loaded)	5.860	5.826	5.869	5.823	5.839	5.847
Ht. Specimen (Rebound)	5.931	5.900	5.946	5.890	5.920	5.922
Molded Wt. of Specimen	13.611	13.727	13.827	13.658	13.737	13.785
Vol. per Linear Inch	.016315	.016315	.016315	.016315	.016315	.016315
Vol. of Specimen (Rebound)	.096764	.096259	.097009	.096095	.096585	.096617
Wt. of Bitumen in Spec.	.520	.520	.520	.520	.520	.520
Dry Wt. of Soil in Spec.	12.674	12.674	12.674	12.674	12.674	12.674
Calc. Dry Wt. of Specimen	13.194	13.194	13.194	13.194	13.194	13.194
Calc. Dry Density of Spec. (Rebound)	136.35	137.07	136.01	137.30	136.61	136.56
Calc. Dry Density of Soil	130.98	131.67	130.65	131.89	131.22	131.18
Calc. % Moist. & Volatiles	3.2	4.0	4.8	3.5	4.1	4.5
Time Aerated (Minutes)	86'	50'	25'	76'	50'	47'

Fig. 3-A

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 2
DENSITY AND VOIDS DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R2	79	80	81	82	83	84
% Stabilizer (RC-2)	5	5	5	5	5	5
% Bitumen in Stabilizer	82.0	82.0	82.0	82.0	82.0	82.0
% Bitumen in Mix*	3.9	3.9	3.9	3.9	3.9	3.9
Sp. Gr. of Bitumen	1.014	1.014	1.014	1.014	1.014	1.014
Sp. Gr. of Soil	2.65	2.65	2.65	2.65	2.65	2.65
Combined Sp. Gr.**	2.493	2.493	2.493	2.493	2.493	2.493
Molded Wet Wt. of Specimen	13.611	13.727	13.827	13.658	13.737	13.785
Molded Dry Wt. of Specimen	13.194	13.194	13.194	13.194	13.194	13.194
Loaded Vol. of Specimen	.095606	.095051	.095753	.095002	.095263	.095394
Loaded Dry Density	138.00	138.81	137.79	138.88	138.50	138.31
Loaded Wet Density	142.37	144.42	144.40	143.77	144.20	144.51
Rebound Vol. of Specimen	.096764	.096259	.097009	.096095	.096585	.096617
Rebound Dry Density	136.35	137.07	136.01	137.30	136.61	136.56
Rebound Wet Density	140.66	142.60	142.53	142.13	142.23	142.68
Zero Air Voids Density***	155.56	155.56	155.56	155.56	155.56	155.56
% Voids Loaded (Dry)****	11.3	10.8	11.4	10.7	11.0	11.1
% Voids Loaded (Wet)****	8.5	7.2	7.2	7.6	7.3	7.1
% Voids Rebound (Dry)****	12.3	11.9	12.6	11.7	12.2	12.2
% Voids Rebound (Wet)****	9.6	8.3	8.4	8.6	8.6	8.3
		x		x		

FORMULAS

* Percent Bitumen in Mix $= \dfrac{\text{\% Bitumen x \% Stabilizer Added}}{(\text{\% Bitumen x \% Stabilizer Added}) + 100}$

** Combined Sp. Fr. $= \dfrac{100}{\dfrac{\text{\% Soil}}{\text{Ab.Sp.Gr. of Soil}} + \dfrac{\text{\% Bitumen in Mix}}{\text{Ab.Sp.Gr. of Bitumen}}}$

*** Zero Air Voids Density = 62.4 x Combined Sp. Gr.

**** Percent Voids $= \left(1 - \dfrac{\text{Density of Specimen}}{\text{Zero Air Voids Density}}\right) \text{ X } 100$

Fig. 3-B

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 3
CURING, TESTING AND DRYING DATA
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R2	79	80	81	82	83	84
Percent Stabilizer (RC-2)	5	5	5	5	5	5
Date Molded	10-4-72	10-4-72	10-4-72	10-4-72	10-4-72	10-4-72
Date in Oven	10-5-72	10-5-72	10-5-72	10-5-72	10-5-72	10-5-72
Date out Oven	10-10-72	10-10-72	10-10-72	10-10-72	10-10-72	10-10-72
Date Tested	10-12-72	10-12-72	10-12-72	10-12-72	10-12-72	10-12-72
Ht. before Wetting & Heating	5.925	5.892	5.933	5.885	5.906	5.912
Ht. after Wetting & Heating	5.955	5.913	5.950	5.910	5.930	5.936
Difference in Height	.030	.021	.017	.025	.024	.024
% Swell (Vertical)	0.5	0.4	0.3	0.4	0.4	0.4
Cir. before Wetting & Heating	18.80	18.80	18.80	18.85	18.80	18.80
Cir. after Wetting & Heating	18.95	18.90	18.90	18.95	18.95	18.90
Cured Dry Wt. Specimen	13.249	13.257	13.250	13.255	13.247	13.249
Oven Dry Wt. Specimen	13.192	13.197	13.197	13.189	13.183	13.196
Wt. Moisture in Specimen	.057	.060	.053	.066	.064	.053
% Moisture before Wetting	0.4	0.5	0.4	0.5	0.5	0.4
Wt. after Wetting	13.840	13.843	13.878	13.822	13.852	13.854
Oven Dry Wt. of Specimen	13.192	13.197	13.197	13.189	13.183	13.196
Wt. Moisture in Specimen	.648	.646	.681	.633	.669	.658
% Moisture after Wetting	4.9	4.9	5.2	4.8	5.1	5.0
Dry Wt. Pan + Specimen	17.501	17.209	17.136	17.121	17.420	17.552
Tare Wt. Pan	4.309	4.012	3.939	3.932	4.237	4.356
Oven Dry Wt. Specimen	13.192	13.197	13.197	13.189	13.183	13.196
Molded Wet Wt. Specimen	13.611	13.727	13.827	13.658	13.737	13.785
Wt. H_2O	.419	.530	.630	.469	.554	.589
% H_2O(& or Volatiles)on Total	3.2	4.0	4.8	3.6	4.2	4.5
Oven Dry Density Specimen	136.33	137.10	136.04	137.25	136.49	136.58
Loading - Rate (In./Min/)	.15	.15	.15	.15	.15	.15
Total Load - Comp.	1,470	1,540	1,190	1,585	1,346	1,181
Comp. Strength (psi)	51.4	54.2	41.9	55.5	47.1	41.5
Testing Temp. °F.	143°	142°	140°	143°	142°	142°

Fig. 3-C

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 4
AERATION DATA FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R2	79	80	81	82	83	84
Date Aerated	10-3-72	10-3-72	10-3-72	10-4-72	10-4-72	10-4-72
Percent Stabilizer (RC-2)	5	5	5	5	5	5
Aeration Method	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)
% M. or V. Aerated	3.0	2.0	1.0	2.5	2.0	1.5
Wt. M. or V. Aerated	.396	.264	.132	.330	.264	.198
M. or V. Loss after Mixing	.039	.039	.039	.036	.041	.037
Wt. Pan + S.A. after Mixing	19.389	19.109	19.349	18.953	19.135	19.382
Wt. M. or V. Aerated	.357	.225	.093	.294	.223	.161
Wt. Pan + S.A. after Aerating	19.032	18.884	19.256	18.659	18.912	19.221
Time Aerated	52'	45'	25'	56'	50'	37'
Wt. Pan + Soil-Asphalt	19.132	18.905	19.233	18.759	18.965	19.259
Time Aerated	Room	5'		Room	Room	10'
Wt. Pan + Soil-Asphalt	19.127	18.886		18.715	18.915	19.216
Time Aerated	24'			20'		
Wt. Pan + Soil-Asphalt	19.061			18.661		
Time Aerated	10'					
Wt. Pan + Soil-Asphalt	19.058					
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Total Time Aerated (Minutes)	86'	50'	25'	76'	50'	47'
Corrected % M. & or V. Aerated	x	x	1.3	x	x	x

Fig. 3-D

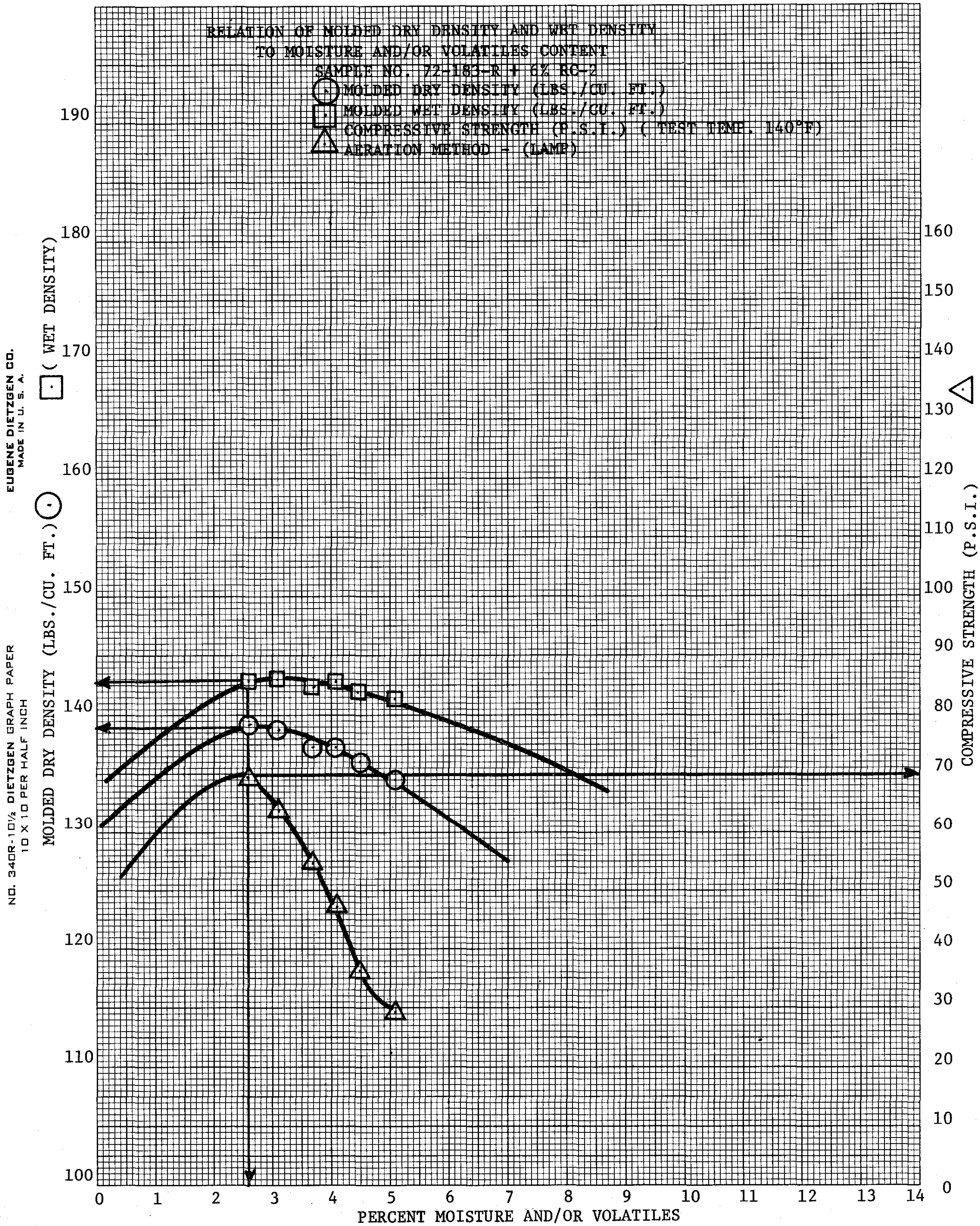

RELATION OF MOLDED DRY DENSITY AND WET DENSITY
TO MOISTURE AND/OR VOLATILES CONTENT
SAMPLE NO. 72-183-R + 6% RC-2
MOLDED DRY DENSITY (LBS./CU. FT.)
MOLDED WET DENSITY (LBS./CU. FT.)
COMPRESSIVE STRENGTH (P.S.I.) (TEST TEMP. 140°F)
AERATION METHOD - (LAMP)
MOLDED DRY DENSITY (LBS./CU. FT.)
(WET DENSITY)
COMPRESSIVE STRENGTH (P.S.I.)
PERCENT MOISTURE AND/OR VOLATILES
EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
100
110
120
130
140
150
160
170
180
190
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14

Fig. 4

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 1
MOLDING DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	55	56	57	58	59	60
Date Molded	9-19-72	9-19-72	9-19-72	9-21-72	9-21-72	9-21-72
% Stabilizer (RC-2)	6	6	6	6	6	6
% Hygro. Moist.	1.0	1.0	1.0	1.0	1.0	1.0
Lbs. Material + Hygro.	12.750	12.750	12.750	12.750	12.750	12.750
Wt. Hygro. Moist.	.126	.126	.126	.126	.126	.126
Dry Wt. Material	12.624	12.624	12.624	12.624	12.624	12.624
Lbs. Stabilizer	.757	.757	.757	.757	.757	.757
% Water Added	5.0	5.0	5.0	5.0	5.0	5.0
Lbs. Water Added	.631	.631	.631	.631	.631	.631
Tare Wt. Jar	.600	.600	.600	.600	.600	.600
Wt. Water + Jar	1.231	1.231	1.231	1.231	1.231	1.231
Temp. Mix in Mold	76°	77°	76°	76°	75°	79°
Mold No.	3	3	3	3	3	3
Time @ 20 psi.	2'	2'	2'	2'	2'	2'
Time @ 40 psi.	2'	2'	2'	2'	2'	2'
Time @ 60 psi.	10'	8'	6'	14'	13'	9'
Time @ 500 psi.	10'	10'	10'	10'	10'	10'
Ht. Specimen + Plates	5.929	5.980	6.038	5.865	5.876	5.928
Thickness of Plates	.088	.088	.088	.088	.088	.088
Ht. Specimen (Loaded)	5.841	5.892	5.950	5.777	5.788	5.840
Ht. Specimen (Rebound)	5.913	5.976	6.039	5.832	5.848	5.918
Molded Wt. of Specimen	13.733	13.846	13.927	13.589	13.652	13.789
Vol. per Linear Inch	.016315	.016315	.016315	.016315	.016315	.016315
Vol. of Specimen (Rebound)	.096471	.097498	.098526	.095149	.095410	.096552
Wt. of Bitumen in Spec.	.621	.621	.621	.621	.621	.621
Dry Wt. of Soil in Spec.	12.624	12.624	12.624	12.624	12.624	12.624
Calc. Dry Wt. of Specimen	13.245	13.245	13.245	13.245	13.245	13.245
Calc. Dry Density of Specimen (Rebound)	137.30	135.85	134.43	139.20	138.82	137.18
Calc. Dry Density of Soil	130.86	129.48	128.13	132.68	132.31	130.75
Calc. % Moist. & Volatiles	3.7	4.5	5.1	2.6	3.1	4.1
Time Aerated (Minutes)	100'	56'	36'	140'	118'	72'

Fig. 4-A

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 2
DENSITY AND VOIDS DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	55	56	57	58	59	60
% Stabilizer (RC-2)	6	6	6	6	6	6
% Bitumen in Stabilizer	82.0	82.0	82.0	82.0	82.0	82.0
% Bitumen in Mix *	4.7	4.7	4.7	4.7	4.7	4.7
Sp. Gr. of Bitumen	1.014	1.014	1.014	1.014	1.014	1.014
Sp. Gr. of Soil	2.660	2.660	2.660	2.660	2.660	2.660
Combined Sp. Gr. **	2.472	2.472	2.472	2.472	2.472	2.472
Molded Wet Wt. of Specimen	13.733	13.846	13.927	13.589	13.652	13.789
Molded Dry Wt. of Specimen	13.245	12.245	13.245	13.245	13.245	13.245
Loaded Vol. of Specimen	.095296	.096128	.097074	.094252	.094431	.095280
Loaded Dry Density	138.99	137.79	136.44	140.53	140.26	139.01
Loaded Wet Density	144.11	144.04	143.47	144.18	144.57	144.72
Rebound Vol. of Specimen	.096471	.097498	.098526	.095149	.095410	.096552
Rebound Dry Density	137.30	135.85	134.43	139.20	138.82	137.18
Rebound Wet Density	142.35	142.01	141.35	142.82	143.09	142.81
Zero Air Voids Density ***	154.25	154.25	154.25	154.25	154.25	154.25
% Voids Loaded (Dry) ****	9.9	10.7	11.5	8.9	9.1	9.9
% Voids Loaded (Wet) ****	6.6	6.6	7.0	6.5	6.3	6.2
% Voids Rebound (Dry) ****	11.0	11.9	12.8	9.8	10.0	11.1
% Voids Rebound (Wet) ****	7.7	7.9	8.4	7.4	7.2	7.4

FORMULAS

* Percent Bitumen in Mix $= \dfrac{\text{\% Bitumen} \times \text{\% Stabilizer Added}}{(\text{\% Bitumen} \times \text{\% Stabilizer Added}) + 100}$

** Combined Sp. Gr. $= \dfrac{100}{\dfrac{\text{\% Soil}}{\text{Ab.Sp.Gr. of Soil}} + \dfrac{\text{\% Bitumen in Mix}}{\text{Ab.Sp.Gr. of Bitumen}}}$

*** Zero Air Voids Density = 62.4 x Combined Sp. Gr.

**** Percent Voids $= \left(1 - \dfrac{\text{Density of Specimen}}{\text{Zero Air Voids Density}}\right) \times 100$

Fig. 4-B

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 3
CURING, TESTING AND DRYING DATA
FOR SOIL-ASPHALT MIXES

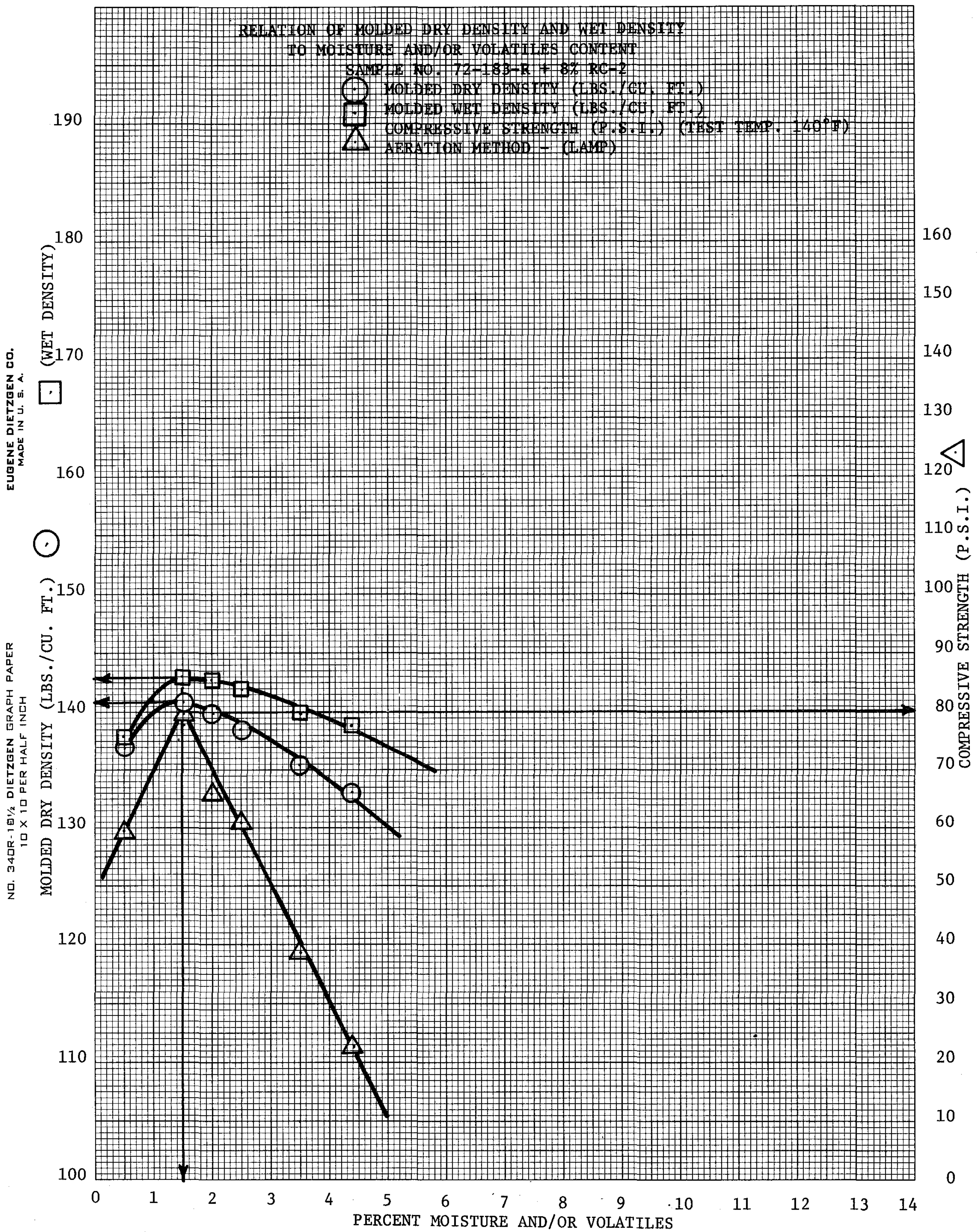
Sample No. 72-183-R	55	56	57	58	59	60
Percent Stabilizer (RC-2)	6	6	6	6	6	6
Date Molded	9-19-72	9-19-72	9-19-72	9-21-72	9-21-72	9-21-72
Date in Oven	9-22-72	9-22-72	9-22-72	9-22-72	9-22-72	9-22-72
Date out Oven	9-27-72	9-27-72	9-27-72	9-27-72	9-27-72	9-27-72
Date Tested	9-28-72	9-28-72	9-28-72	9-28-72	9-28-72	9-28-72
Ht. before Wetting & Heating	5.900	5.953	6.012	5.830	5.845	5.904
Ht. after Wetting & Heating	5.907	5.968	6.025	5.855	5.859	5.918
Difference in Height	Nil	.015	.013	.025	.014	.014
% Swell (Vertical)	Nil	0.3	0.2	0.4	0.2	0.2
Cir.before Wetting & Heating	18.85	18.85	18.85	18.80	18.85	18.85
Cir.after Wetting & Heating	18.90	18.90	18.90	18.90	18.90	18.90
Cured Dry Wt. Specimen	13.361	13.336	13.332	13.346	13.359	13.364
Oven Dry Wt. Specimen	13.269	13.270	13.269	13.271	13.274	13.271
Wt. Moisture in Specimen	.092	.066	.063	.075	.085	.093
% Moisture before Wetting	0.7	0.5	0.5	0.6	0.6	0.7
Wt. after Wetting	13.838	13.900	13.939	13.758	13.780	13.849
Oven Dry Wt. of Specimen	13.269	13.270	13.269	13.271	13.274	13.271
Wt. Moisture in Specimen	.569	.630	.670	.487	.506	.578
% Moisture after Wetting	4.3	4.7	5.0	3.7	3.8	4.4
Dry Wt. Pan + Specimen	17.561	17.282	17.249	17.178	17.213	17.108
Tare Wt. Pan	4.292	4.012	3.980	3.907	3.939	3.837
Oven Dry Wt. Specimen	13.269	13.270	13.269	13.271	13.274	13.271
Molded Wet Wt. Specimen	13.733	13.846	13.927	13.589	13.652	13.789
Wt. H_2O & or Volatiles	.464	.576	.658	.318	.378	.518
% H_2O (& or Volatiles)on Total	3.5	4.3	5.0	2.4	2.8	3.9
Oven Dry Density Specimen	137.54	136.11	134.68	139.48	139.13	137.45
Loading - Rate (In./Min.)	.15"	.15"	.15"	.15"	.15"	.15"
Total Load - Comp.	1,555	1,020	825	1,975	1,815	1,340
Comp. Strength (psi)	54.7	35.9	29.0	69.5	63.9	47.1
Testing Temp. ^{o}F	141^{o}	140^{o}	142^{o}	141^{o}	140^{o}	139^{o}

Fig. 4-C

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 4
AERATION DATA FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	55	56	57	58	59	60
Date Aerated	9-19-72	9-19-72	9-19-72	9-20-72	9-20-72	9-20-72
Percent Stabilizer (RC-2)	6	6	6	6	6	6
Aeration Method	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)
% M. or V. Aerated	3.0	2.0	1.0	4.0	3.5	2.5
Wt. M. or V. Aerated	.397	.265	.132	.530	.464	.331
M. or V. Loss after Mixing	.069	.046	.052	.056	.053	.055
Wt. Pan + S.A. after Mixing	19.198	19.192	19.076	19.068	19.252	19.183
Wt. M. or V. Aerated	.328	.219	.080	.474	.411	.276
Wt. Pan + S.A. after Aerating	18.870	18.973	18.996	18.594	18.841	18.907
Time Aerated	45'	48'	36'	60'	60'	60'
Wt. Pan + Soil-Asphalt	19.048	19.015	18.940	18.859	19.061	18.956
Time Aerated	45'	8'		60'	30'	Room
Wt. Pan + Soil-Asphalt	18.905	18.980		18.655	18.937	18.935
Time Aerated	10'			Room	Room	12'
Wt. Pan + Soil-Asphalt	18.871			18.640	18.913	18.890
Time Aerated				10'	25'	
Wt. Pan + Soil-Asphalt				18.612	18.853	
Time Aerated				10'	3'	
Wt. Pan + Soil-Asphalt				18.590	18.840	
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Total Time Aerated (Minutes)	100'	56'	36'	140'	118'	72'
Corrected %M.& or V. Aerated	x	1.9	1.4	x	x	2.6

Fig. 4-D


RELATION OF MOLDED DRY DENSITY AND WET DENSITY
TO MOISTURE AND/OR VOLATILES CONTENT
SAMPLE NO. 72-183-R + 8% RC-2
MOLDED DRY DENSITY (LBS./CU. FT.)
MOLDED WET DENSITY (LBS./CU. FT.)
COMPRESSIVE STRENGTH (P.S.I.) (TEST TEMP. 140°F)
AERATION METHOD - (LAMP)
MOLDED DRY DENSITY (LBS./CU. FT.)
(WET DENSITY)
COMPRESSIVE STRENGTH (P.S.I.)
PERCENT MOISTURE AND/OR VOLATILES
100
110
120
130
140
150
160
170
180
190
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
0
1
2
3
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5
6
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10
11
12
13
14
EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

Fig. 5

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 1
MOLDING DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R2	67	68	69	70	71	72
Date Molded	9-27-72	9-27-72	9-27-72	9-29-72	9-28-72	9-28-72
% Stabilizer (RC-2)	8	8	8	8	8	8
% Hygro. Moist	0.6	0.6	0.6	0.6	0.6	0.6
Lbs. Material + Hygro	12.750	12.750	12.750	12.750	12.750	12.750
Wt. Hygro. Moist.	.076	.076	.076	.076	.076	.076
Dry Wt. Material	12.674	12.674	12.674	12.674	12.674	12.674
Lbs. Stabilizer	1.014	1.014	1.014	1.014	1.014	1.014
% Water Added	5.0	5.0	5.0	5.0	5.0	5.0
Lbs. Water Added	.634	.634	.634	.634	.634	.634
Tare Wt. Jar	.600	.600	.600	.600	.600	.600
Wt. Water + Jar	1.234	1.234	1.234	1.234	1.234	1.234
Temp. Mix in Mold	77°	76°	76°	74°	80°	81°
Mold No.	3	3	3	3	3	3
Time @ 20 psi.	2'	2'	2'	2'	2'	2'
Time @ 40 psi.	2'	2'	2'	2'	2'	2'
Time @ 60 psi.	10'	8'	6'	17'	12'	11'
Time @ 500 psi.	10'	10'	10'		10'	10'
Ht. Specimen + Plates	5.964	6.095	6.202	6.058	5.896	5.928
Thickness of Plates	.088	.088	.088	.088	.088	.088
Ht. Specimen (Loaded)	5.876	6.007	6.114	5.970	5.808	5.840
Ht. Specimen (Rebound)	5.953	6.088	6.195	6.010	5.852	5.894
Molded Wt. of Specimen	13.839	13.972	14.099	13.572	13.701	13.770
Vol. per Linear Inch	.016315	.016315	.016315	.016315	.016315	.016315
Vol. of Specimen (Rebound)	.097123	.099326	.101071	.098053	.095475	.096161
Wt. of Bitumen in Spec.	.831	.831	.831	.831	.831	.831
Dry Wt. of Soil in Spec.	12.674	12.674	12.674	12.674	12.674	12.674
Calc. Dry Wt. of Specimen	13.505	13.505	13.505	13.505	13.505	13.505
Calc. Dry Density of Spec. (Rebound)	139.05	135.97	133.62	137.73	141.45	140.44
Calc. Dry Density of Soil	130.49	127.60	125.40	129.35	132.74	131.79
Calc. % Moist. & Volatiles	2.5	3.5	4.4	0.5	1.5	2.0
Time Aerated (Minutes)	154'	106'	65'	303'	206'	176'

Fig. 5-A

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 2
DENSITY AND VOIDS DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R2	67	68	69	70	71	72
% Stabilizer (RC-2)	8	8	8	8	8	8
% Bitumen in Stabilizer	82.0	82.0	82.0	82.0	82.0	82.0
% Bitumen in Mix *	6.2	6.2	6.2	6.2	6.2	6.2
Sp. Gr. of Bitumen	1.014	1.014	1.014	1.014	1.014	1.014
Sp. Gr. of Soil	2.65	2.65	2.65	2.65	2.65	2.65
Combined Sp. Gr. **	2.409	2.409	2.409	2.409	2.409	2.409
Molded Wet Wt. of Specimen	13.839	13.972	14.099	13.572	13.701	13.770
Molded Dry Wt. of Specimen	13.505	13.505	13.505	13.505	13.505	13.505
Loaded Vol. of Specimen	.095867	.098004	.099750	.097401	.094758	.095280
Loaded Dry Density	140.87	137.80	135.39	138.65	142.52	141.74
Loaded Wet Density	144.36	142.57	141.34	139.34	144.59	144.52
Rebound Vol.of Specimen	.097123	.099326	.101071	.098053	.095475	.096161
Rebound Dry Density	139.05	135.97	133.62	137.73	141.45	140.44
Rebound Wet Density	142.49	140.67	139.50	138.41	143.50	143.20
Zero Air Voids Density ***	150.32	150.32	150.32	150.32	150.32	150.32
% Voids Loaded (Dry) ****	6.3	8.3	9.9	7.8	5.2	5.7
% Voids Loaded (Wet) ****	4.0	5.2	6.0	7.3	3.8	3.9
% Voids Rebound (Dry) ****	7.5	9.5	11.1	8.4	5.9	6.6
% Voids Rebound (Wet) ****	5.2	6.4	7.2	7.9	4.5	4.7

FORMULAS

* Percent Bitumen in Mix = $\dfrac{\text{\% Bitumen} \times \text{\% Stabilizer Added}}{(\text{\% Bitumen} \times \text{\% Stabilizer Added}) + 100}$

** Combined Sp. Gr. = $\dfrac{100}{\dfrac{\text{\% Soil}}{\text{Ab.Sp.Gr. of Soil}} + \dfrac{\text{\% Bitumen in Mix}}{\text{Ab.Sp.Gr. of Bitumen}}}$

*** Zero Air Voids Density = 62.4 x Combined Sp. Gr.

**** Percent Voids = $\left(1 - \dfrac{\text{Density of Specimen}}{\text{Zero Air Voids Density}}\right) \times 100$

Fig. 5-B

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 3
CURING, TESTING AND DRYING DATA
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R2	67	68	69	70	71	72
Percent Stabilizer (RC-2)	8	8	8	8	8	8
Date Molded	9-27-72	9-27-72	9-27-72	9-29-72	9-28-72	9-28-72
Date in Oven	9-29-72	9-29-72	9-29-72	9-29-72	9-29-72	9-29-72
Date out Oven	10-4-72	10-4-72	10-4-72	10-4-72	10-4-72	10-4-72
Date Tested	10-5-72	10-5-72	10-5-72	10-5-72	10-5-72	10-5-72
Ht. before Wetting & Heating	5.943	6.071	6.168	6.006	5.854	5.891
Ht. after Wetting & Heating	5.938	6.070	6.170	6.023	5.867	5.893
Difference in Height	Nil	Nil	Nil	.017	.013	Nil
% Swell (Vertical)	Nil	Nil	Nil	0.3	0.2	Nil
Cir.before Wetting & Heating	18.85	18.85	18.80	18.80	18.80	18.80
Cir.After Wetting & Heating	18.85	18.85	18.85	18.90	18.85	18.85
Cured Dry Wt. Specimen	13.663	13.693	13.734	13.542	13.618	13.643
Oven Dry Wt. Specimen	13.503	13.514	13.494	13.507	13.509	13.512
Wt. Moisture in Specimen	.160	.179	.240	.035	.109	.131
% Moisture before Wetting	1.2	1.3	1.8	0.3	0.8	1.0
Wt. after Wetting	13.876	13.997	14.098	13.291	13.805	13.833
Oven Dry Wt. of Specimen	13.503	13.514	13.494	13.507	13.509	13.512
Wt. Moisture in Specimen	.373	.483	.604	.384	.296	.321
% Moisture after Wetting	2.8	3.6	4.5	2.8	2.2	2.4
Dry Wt. Pan + Specimen	17.761	18.017	17.413	17.847	17.751	17.468
Tare Wt. Pan	4.258	4.503	3.919	4.340	4.242	3.956
Oven Dry Wt. Specimen	13.503	13.514	13.494	13.507	13.509	13.512
Molded Wet Wt. Specimen	13.839	13.972	14.099	13.572	13.701	13.770
Wt. H_2O & or Volatiles	.336	.458	.605	.065	.192	.258
% H_2O (& or Volatiles)on Total	2.7	3.4	4.5	0.5	1.4	1.9
Oven Dry Density Specimen	139.03	136.06	133.51	137.75	141.49	140.51
Loading - Rate (In./Min.)	.15	.15	.15	.15	.15	.15
Total Load - Comp.	1,750	1,122	665	1,724	2,295	1,895
Comp. Strength (PSI)	61.9	39.7	23.5	60.7	81.2	67.0
Testing Temp. °F.	137°	136°	139°	139°	139°	139°

Fig. 5-C

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 4
AERATION DATA FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R2	67	68	69	70	71	72
Date Aerated	9-27-72	9-27-72	9-27-72	9-28-72	9-28-72	9-28-72
Percent Stabilizer (RC-2)	8	8	8	8	8	8
Aeration Method	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)
% M. or V. Aerated	4.0	3.0	2.0	6.0	5.0	4.5
Wt. M. or V. Aerated	.540	.405	.270	.810	.675	.608
M. or V. Loss after Mixing	.052	.051	.057	.054	.061	.048
Wt. Pan + S.A. after mixing	19.513	19.339	19.441	19.751	19.439	19.340
Wt. M. or V. Aerated	.488	.354	.213	.756	.614	.560
Wt. Pan + S.A. after Aerating	19.025	18.985	19.228	18.995	18.825	18.780
Time Aerated	60'	60'	60'	80'	60'	62'
Wt. Pan + Soil-Asphalt	19.323	19.138	19.242	19.438	19.261	19.127
Time Aerated	60'	30'	3'	30'	66'	61'
Wt. Pan + Soil-Asphalt	19.132	19.034	19.235	19.365	19.033	18.918
Time Aerated	30'	14'	2'	62'	42'	8'
Wt. Pan ± Soil-Asphalt	19.038	18.992	19.229	19.192	18.911	18.899
Time Aerated	4'	2'		43'	Room	Room
Wt. Pan + Soil-Asphalt	19.027	18.985		19.111	18.872	18.861
Time Aerated				Room	15'	30'
Wt. Pan + Soil-Asphalt				19.082	18.862	18.807
Time Aerated				43'	23'	15'
Wt. Pan + Soil-Asphalt				19.048	18.818	18.778
Time Aerated				45'		
Wt. Pan + Soil-Asphalt				18.988		
Time Aerated						
Wt. Pan + Soil-Asphalt						
Total Time Aerated (Minutes)	154'	106'	65'	303'	206'	176'
				.817	.682	
Corrected % M. & or V. Aerated	x	x	x	6.05	5.05	x

Fig. 5-D

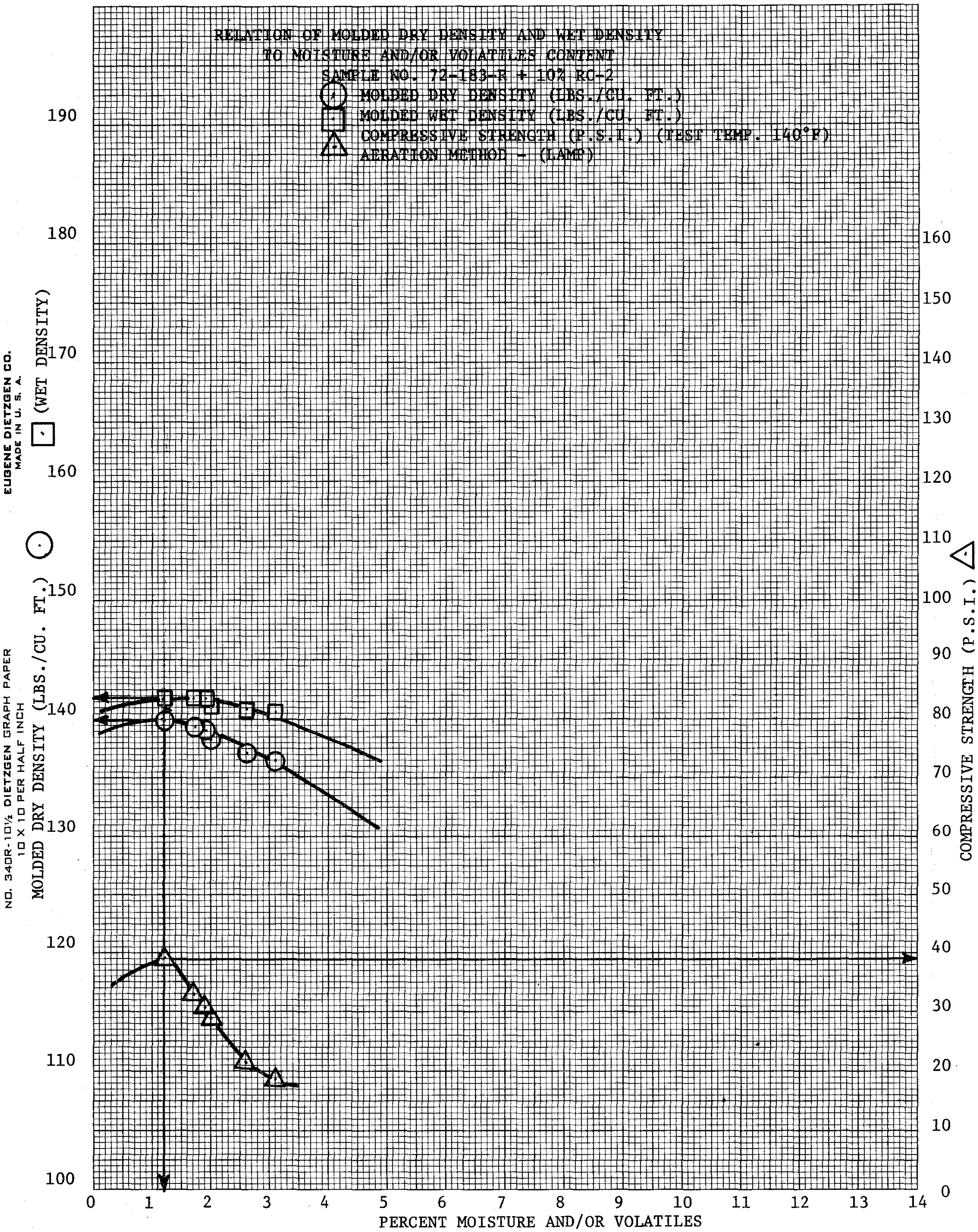

RELATION OF MOLDED DRY DENSITY AND WET DENSITY
TO MOISTURE AND/OR VOLATILES CONTENT
SAMPLE NO. 72-183-R + 10% RC-2
MOLDED DRY DENSITY (LBS./CU. FT.)
MOLDED WET DENSITY (LBS./CU. FT.)
COMPRESSIVE STRENGTH (P.S.I.) (TEST TEMP. 140°F)
AERATION METHOD - (LAMP)
MOLDED DRY DENSITY (LBS./CU. FT.)
(WET DENSITY)
COMPRESSIVE STRENGTH (P.S.I.)
PERCENT MOISTURE AND/OR VOLATILES
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.

Fig. 6

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 1
MOLDING DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R2	73	74	75	76	77	78
Date Molded	10-2-72	10-2-72	10-3-72	10-3-72	10-3-72	10-3-72
% Stabilizer (RC-2)	10	10	10	10	10	10
% Hygro. Moist.	0.6	0.6	0.6	0.6	0.6	0.6
Lbs. Material + Hygro.	12.750	12.750	12.750	12.750	12.750	12.750
Wt. Hygro. Moist.	.076	.076	.076	.076	.076	.076
Dry Wt. Material	12.674	12.674	12.674	12.674	12.674	12.674
Lbs. Stabilizer	1.267	1.267	1.267	1.267	1.267	1.267
% Water Added	4.0	4.0	4.0	4.0	4.0	4.0
Lbs. Water Added	.507	.507	.507	.507	.507	.507
Tare Wt. Jar	.600	.600	.600	.600	.600	.600
Wt. Water + Jar	1.107	1.107	1.107	1.107	1.107	1.107
Temp. Mix in Mold	79°	82°	73°	79°	76°	76°
Mold No.	3	3	3	3	3	3
Time @ 20 psi.	2'	2'	2'	2'	2'	2'
Time @ 40 psi.	2'	2'	2'	2'	2'	2'
Time @ 60 psi.	10'	7'	5'	11'	8'	10'
Time @ 500 psi.	10'	10'	10'	10'	10'	10'
Ht. Specimen + Plates	6.070	6.177	6.225	6.012	6.107	6.086
Thickness of Plates	.088	.088	.088	.088	.088	.088
Ht. Specimen (Loaded	5.982	6.089	6.137	5.924	6.019	5.998
Ht. Specimen (Rebound)	6.024	6.124	6.154	5.998	6.072	6.035
Molded Wt. of Specimen	13.948	14.069	14.132	13.884	13.992	13.975
Vol. per Linear Inch	.016315	.016315	.016315	.016315	.016315	.016315
Vol. of Specimen (Rebound)	.098282	.099913	.100403	.097857	.099065	.098461
Wt. of Bitumen in Spec.	1.039	1.039	1.039	1.039	1.039	1.039
Dry Wt. of Soil in Spec.	12.674	12.674	12.674	12.674	12.674	12.674
Calc. Dry Wt. of Specimen	13.713	13.713	13.713	13.713	13.713	13.713
Calc. Dry Density of Spec. (Rebound)	139.53	137.25	136.58	140.13	138.42	139.27
Calc. Dry Density of Soil	128.96	126.85	126.23	129.52	127.94	128.72
Calc. % Moist. & Volatiles	1.7	2.6	3.1	1.2	2.0	1.9
Time Aerated (Minutes)	148'	96'	69'	180'	130'	165'

Fig. 6-A

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 2
DENSITY AND VOIDS DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R2	73	74	75	76	77	78
% Stabilizer (RC-2)	10	10	10	10	10	10
% Bitumen in Stabilizer	82.0	82.0	82.0	82.0	82.0	82.0
% Bitumen in Mix*	7.6	7.6	7.6	7.6	7.6	7.6
Sp. Gr. of Bitumen	1.014	1.014	1.014	1.014	1.014	1.014
Sp. Gr. of Soil	2.65	2.65	2.65	2.65	2.65	2.65
Combined Sp. Gr. **	2.361	2.361	2.361	2.361	2.361	2.361
Molded Wet Wt. of Specimen	13.948	14.069	14.132	13.884	13.992	13.975
Molded Dry Wt. of Specimen	13.713	13.713	13.713	13.713	13.713	13.713
Loaded Vol. of Specimen	.097596	.099342	.100125	.096650	.098200	.097857
Loaded Dry Density	140.51	138.04	136.96	141.88	139.64	140.13
Loaded Wet Density	142.92	141.62	141.14	143.65	142.48	142.81
Rebound Vol. of Specimen	.098282	.099913	.100403	.097857	.099065	.098461
Rebound Dry Density	139.53	137.25	136.58	140.13	138.42	139.27
Rebound Wet Density	141.92	140.81	140.75	141.88	141.24	141.93
Zero Air Voids Density***	147.33	147.33	147.33	147.33	147.33	147.33
% Voids Loaded (Dry)****	4.6	6.3	7.0	3.7	5.2	4.9
% Voids Loaded (Wet)****	3.0	3.9	4.2	2.5	3.3	3.1
% Voids Rebound (Dry)****	5.3	6.8	7.3	4.9	6.0	5.5
% Voids Rebound (Wet)****	3.7	4.4	4.5	3.7	4.1	3.7

FORMULAS

* Percent Bitumen in Mix $= \dfrac{\text{\% Bitumen x \% Stabilizer Added}}{(\text{\% Bitumen x \% Stabilizer Added}) + 100}$

** Combined Sp. Gr. $= \dfrac{100}{\dfrac{\text{\% Soil}}{\text{Ab.Sp. Gr. of Soil}} + \dfrac{\text{\% Bitumen in Mix}}{\text{Ab.Sp.Gr. of Bitumen}}}$

*** Zero Air Voids Density = 62.4 x Combined Sp. Gr.

**** Percent Voids $= \left(1 - \dfrac{\text{Density of Specimen}}{\text{Zero Air Voids Density}}\right) \times 100$

Fig. 6-B

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 3
CURING, TESTING AND DRYING DATA
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R2	73	74	75	76	77	78
Percent Stabilizer (RC-2)	10	10	10	10	10	10
Date Molded	10-2-72	10-2-72	10-3-72	10-3-72	10-3-72	10-3-72
Date in Oven	10-5-72	10-5-72	10-5-72	10-5-72	10-5-72	10-5-72
Date out Oven	10-10-72	10-10-72	10-10-72	10-10-72	10-10-72	10-10-72
Date Tested	10-11-72	10-11-72	10-11-72	10-11-72	10-11-72	10-11-72
Ht. before Wetting & Heating	6.003	6.057	6.142	5.975	6.052	6.015
Ht. after Wetting & Heating	5.971	6.042	6.122	5.947	6.053	6.000
Difference in Height	0	0	0	0	0	0
% Swell (Vertical)	0	0	0	0	0	0
Cir. before Wetting & Heating	19.05	19.10	19.10	18.95	19.00	19.00
Cir. after Wetting & Heating	19.00	19.05	19.00	18.95	19.00	19.00
Cured Dry Wt. Specimen	13.893	13.921	13.942	13.852	13.887	13.895
Oven Dry Wt. Specimen	13.714	13.718	13.712	13.714	13.706	13.723
Wt. Moisture in Specimen	.179	.203	.230	.138	.181	.172
% Moisture before Wetting	1.31	1.48	1.68	1.01	1.32	1.25
Wt. after Wetting	13.968	14.098	14.147	13.913	14.012	13.991
Oven Dry Wt. of Specimen	13.714	13.718	13.712	13.714	13.706	13.723
Wt. Moisture in Specimen	.254	.380	.435	.199	.306	.268
% Moisture after Wetting	1.85	2.77	3.17	1.45	2.23	1.95
Dry Wt. Pan + Specimen	17.621	17.889	17.531	17.531	17.686	18.015
Tare Wt. Pan	3.907	4.171	3.819	3.837	3.980	4.292
Oven Dry Wt. Specimen	13.714	13.718	13.712	13.714	13.706	13.723
Molded Wet Wt. Specimen	13.948	14.069	14.132	13.884	13.992	13.975
Wt. H_2O & or Volatiles	.234	.351	.420	.170	.286	.252
% H_2O (& or Volatiles) on Total	1.71	2.56	3.06	1.24	2.04	1.84
Oven Dry Density Specimen	137.54	137.30	136.57	140.14	138.35	139.37
Loading-Rate (In./Min.)	.15	.15	.15	.15	.15	.15
Total Load - Comp.	950	620	532	1,114	834	888
Comp. Strength (psi)	33.1	21.5	18.5	39.0	29.0	30.9
Testing Temp. °F.	141°	141°	141°	141°	142°	141°

Fig. 6-C

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 4
AERATION DATA FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R2	73	74	75	76	77	78
Date Aerated	10-2-72	10-2-72	10-2-72	10-3-72	10-3-72	10-3-72
Percent Stabilizer (RC-2)	10	10	10	10	10	10
Aeration Method	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)
% M. or V. Aerated	4.0	3.0	2.0	4.5	3.5	4.0
Wt. M. or V. Aerated	.549	.411	.274	.617	.480	.549
M. or V. Loss after Mixing	.078	.074	.071	.080	.069	.076
Wt. Pan + S.A. after Mixing	19.832	19.421	19.532	19.608	19.422	19.545
Wt. M. or V. Aerated	.471	.337	.203	.537	.411	.473
Wt. Pan + S.A. after Aerating	19.361	19.084	19.329	19.071	19.011	19.072
Time Aerated	60'	51'	24'	60'	60'	60'
Wt. Pan + Soil-Asphalt	19.625	19.242	19.446	19.405	19.262	19.342
Time Aerated	38'	45'	45'	60'	60'	60'
Wt. Pan + Soil-Asphalt	19.523	19.078	19.262	19.208	19.052	19.190
Time Aerated	45'			40'	10'	40'
Wt. Pan + Soil-Asphalt	19.378			19.135	19.013	19.097
Time Aerated	5'			15'		5'
Wt. Pan + Soil-Asphalt	19.366			19.088		19.077
Time Aerated				5'		
Wt. Pan + Soil-Asphalt				19.076		
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Total Time Aerated (Minutes)	148'	96'	69'	180'	130'	165'
Corrected % M.& or V.Aerated	x	x	2.5	x	x	x

Fig. 6-D

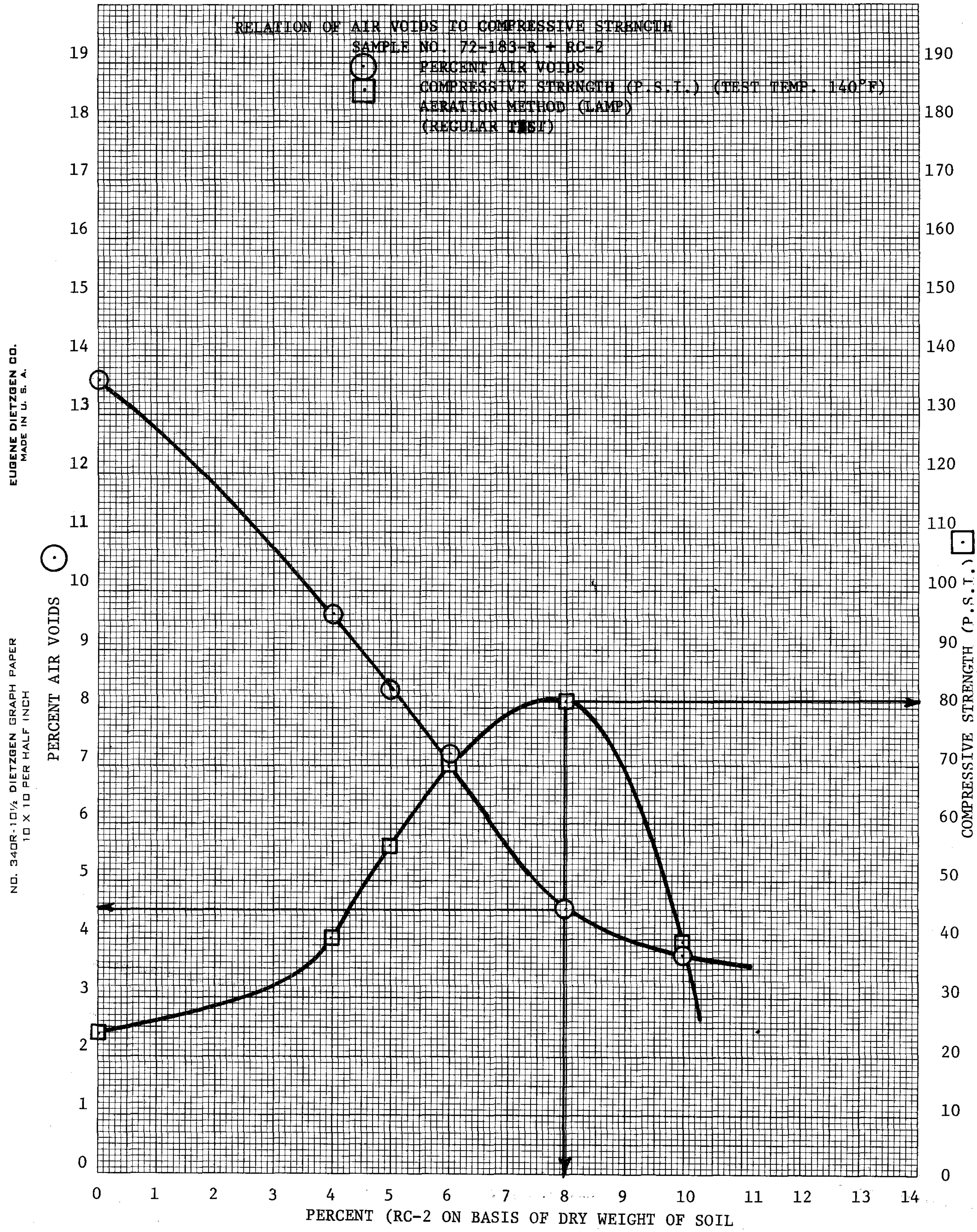

RELATION OF AIR VOIDS TO COMPRESSIVE STRENGTH
SAMPLE NO. 72-183-R + RC-2
PERCENT AIR VOIDS
COMPRESSIVE STRENGTH (P.S.I.) (TEST TEMP. 140°F)
AERATION METHOD (LAMP)
(REGULAR TEST)
PERCENT AIR VOIDS
COMPRESSIVE STRENGTH (P.S.I.)
PERCENT (RC-2 ON BASIS OF DRY WEIGHT OF SOIL
EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

Fig. 7

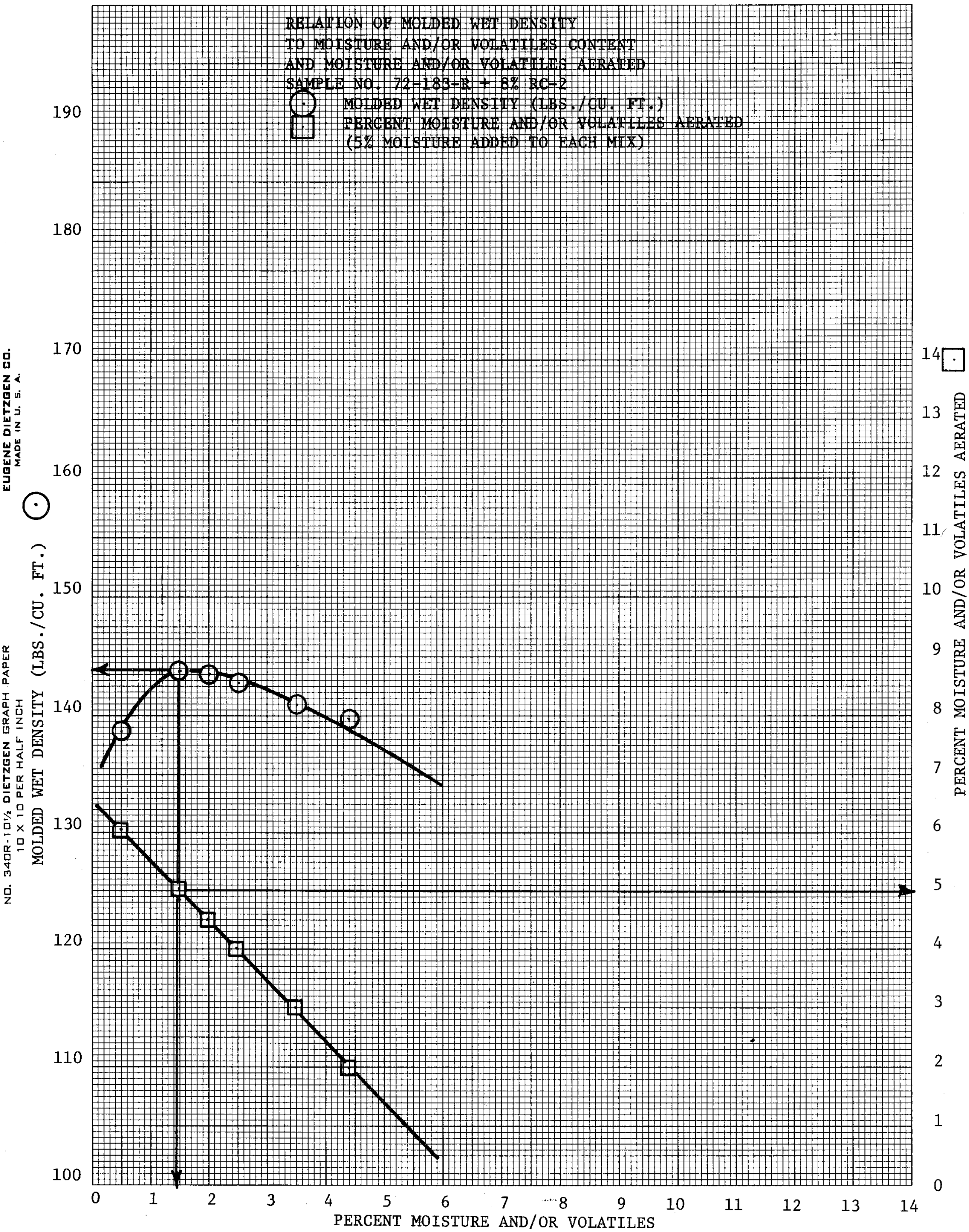

RELATION OF MOLDED WET DENSITY
TO MOISTURE AND/OR VOLATILES CONTENT
AND MOISTURE AND/OR VOLATILES AERATED
SAMPLE NO. 72-183-R + 8% RC-2
MOLDED WET DENSITY (LBS./CU. FT.)
PERCENT MOISTURE AND/OR VOLATILES AERATED
(5% MOISTURE ADDED TO EACH MIX)
MOLDED WET DENSITY (LBS./CU. FT.)
PERCENT MOISTURE AND/OR VOLATILES AERATED
PERCENT MOISTURE AND/OR VOLATILES
100
110
120
130
140
150
160
170
180
190
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.

Fig. 8

APPENDIX

STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION
MATERIALS AND TESTS DIVISION

SOIL ASPHALT STRENGTH TEST METHODS
PART II

Scope

This test method describes the procedure for determining the percent of liquid asphalt that should be used with a soil material in order to give it maximum strength qualities. Essential to this strength is waterproofing of the soil. Also described is the method for molding, dry curing, pressure wetting and testing of the soil and liquid asphalt mixtures. The relationship of the total wet voids in the raw soil (based on the wet density of the molded specimen) to the residual asphalt of the stabilizer being used to give maximum strength has been determined as an asphalt factor.

Definitions

1. Maximum Density: The highest value for density calculated on the basis of dry weight or wet weight of material per cubic foot.

2. Actual Percent Density: The quotient (times 100) obtained from the density of the compacted roadway divided by the density of the same roadway mix gyrated in the motorized gyratory press.

3. Combined Specific Gravity: The theoretical calculated gravity of the mixture of soil and residual asphalt based on their actual absolute specific gravities and their respective percentages in the mix.

4. Percent Total Voids: The calculated percent voids in a specimen of a given wet or dry density when compared with the zero air voids density for that particular mix.

5. Optimum Liquid Asphalt Content: The percent liquid asphalt recommended for use from these procedures. The recommended percent liquid asphalt is taken as the percentage giving the maximum unconfined compressive strength.

6. Optimum Liquid Content: The percent moisture and or volatiles content recommended for use from these procedures.

Apparatus

1. Apparatus listed in Items 1, 2, 3, 4 and 6 of Test Method Tex-101-E. A mechanical shaker will be convenient for sieving the large size samples.

2. All equipment listed in Part I, Test Method Tex-109-E, except Item 2. A pycnometer barrel length of 18 inches is convenient.

3. All equipment listed in Items 3 through 22 except Items 8 and 9 of Test Method Tex-126-E. It is preferable that the 6-inch metal disks listed in Item 13 be made of No. 18 gauge stainless steel.

4. A supply of plastic bags having flat dimensions approximately 18 inches long by 10-1/2 inches wide. The 6-inch plastic disks also required may be cut from these bags.

5. A bank of two 250 watt infrared lamps for aeration of soil-asphalt materials. (Figure 1)

Test Record Forms

1. Record molding data on "Compressive Strength Test Work Sheet No. 1"

(Figure 2) and "Gyratory Molding Data Sheet" (Figure 3).

2. Record density and voids data on "Compressive Strength Test Work Sheet No. 2" (Figure 4).

3. Record curing, wetting, testing and drying data on "Compressive Strength Test Work Sheet No. 3" (Figure 5).

4. Record aeration data on "Compressive Strength Test Work Sheet No. 4" (Figure 6).

5. Record quick test data on "Compressive Strength Test Work Sheet No. 5" (Figure 7).

6. Record capillary wetting, curing, testing and drying data for raw soil on "Compressive Strength Test Work Sheet No. 6 (Figure 8).

7. Record specific gravity data and pycnometer data on Pressure Pycnometer Work Sheet. (Figure 9)

Calibration of Equipment

1. Calibrate the 6-inch by 12-inch mold using Test Method Tex-905-K.

2. Calibrate the gyratory press using Test Method Tex-916-K.

3. Calibrate the triaxial press, if used for testing, and the proving ring according to Test Methods Tex-117-E and Tex-902-K respectively.

Procedure for Preparation of Sample

Prepare the material as follows:

1. Select a 400-pound representative soil sample for each asphalt to be used.

2. The material should be prepared according to Part II, Test Method Tex-101-E.

A. Procedure for Weight Batching of Materials to be Mixed

1. Estimate the weight of air-dry material that will form a 6-inch diameter by 6-inch high specimen when wetted and compacted. Calculate and weigh out each size and combine as given in Test Method Tex-113-E.

Note: It is intended that specimens be 6 inches $\pm$ 1/4 inch high when molded. In case the estimated weight for the first specimen is not within this tolerance after molding, then adjust the weight to meet the height tolerance before weighing out other specimens.

B. Procedure for Determining Specific Gravity

Determine the specific gravity of the raw soil, using a representative sample of the gradation to be used in the soil asphalt base according to Part I of Test Method Tex-109-E. The specific gravity of the residual asphalt to be used should be determined by using Test Method Tex-508-C, if an asphalt test report giving this value is unavailable.

Record the specific gravity data for the soil on the Pressure Pycnometer Work Sheet. (Figure 9)

C. Procedure for Mixing and Molding Raw Soil Specimens and Determination of Percent Air Voids. Use Work Sheets Nos. 1 and 2 (Figures 2 and 4).

Determine the Moisture-Density Curve for the raw soil by the Aeration and Gyratory Molding Method, as given below.

1. Weigh out six specimens of air-dry soil at estimated weight for a 6 x 6-inch specimen.

2. Add approximately 3 percent more water than estimated optimum moisture to each specimen and mix well.

3. After mixing, place the six pans of wetted soil under the infrared lamps for aeration of moisture (Figure 1). Use Compressive Strength Test Work Sheet No. 4 (Figure 6). Aerate and stir until various increments of water and/or volatiles have been removed.

Note 1: An alternate method may be used instead of infrared aeration. Determine the hygroscopic moisture of the soil and prepare mixes at a known moisture content for gyrating a moisture-density curve. Thoroughly mix soil and water according to the techniques given in Test Method Tex-113-E if using this alternate.

4. Cool specimens to room temperature and mold in gyratory compactor. Record molding data on "Gyratory Molding Data Sheet" and Compressive Strength Test Work Sheet No. 1. (Figures 3 and 2). Keep the molding temperature as uniform for all specimens as is practical, i.e. $\pm$ 4 F.

5. Prepare dolly and mold assembly for loading mixture. Begin loading by placing approximately 2 inches of loose material in the mold and tamp lightly with finishing tool that covers the cross-section of the mold. Repeat procedure until mixture is loaded in mold. When the mold is loaded, level top of specimen, insert a thermometer and record the temperature on the data sheet.

6. Remove the thermometer, place a 6-inch stainless steel disk on top of the specimen. Move the dolly with mold to the gyratory press.

7. Slide the mold, with base plate, onto the platen of the compactor. The platen must have a generous coat of good lubricant or the platen and base plate can be damaged. Center the mold, lower the compactor head on the material, and turn the lift cam down to give the mold its 5^{o} lift angle.

8. In gyrating the specimen follow Steps 9 through 16 of Part II, Test Method Tex-126-E.

9. With the specimen height measuring device in position, hold the load on the specimen until the rate of consolidation is 0.005 inches or less in 5 minutes.

10. Observe the dial reading, and record the net (loaded) height of specimen only, making allowance for thickness of the metal disks.

11. Release all load on the specimen and let set for at least 3 minutes. Observe the dial reading, and record the net (rebound) height of the specimen.

12. Remove the measuring device. Raise the ram out of the mold, and remove the mold from the machine platen to the dolly.

13. Slide the mold with base plate on the platen of the ejection press and eject the specimen up and out of the mold.

14. Remove the top and bottom metal disks, weigh the specimen to the nearest estimated 0.001 pound. (Clean any material adhering to the disks that was included in the measured height, and weigh this with the specimen.)

15. Place the specimen in a drying pan, break up and place in hot drying (230 F) oven for oven dry weight. Repeat for all the specimens on the moisture-density curve. Record drying data on Work Sheet No. 3 (Figure 5).

16. Calculate loaded and rebound, dry and wet moisture-density relations. Record on "Work Sheets No. 1 and 2" (Figures 2 and 4). (For calculation formulas refer to calculations, Part 4, Tex-113-E).

17. Calculate the percent wet rebound voids. (Refer to calculation Formulas on Work Sheet No. 2.) (Figure 4)

18. Plot both dry and wet (rebound) moisture-density relation curves (as shown on graph). (Figure 10)

D. Determination of First Trial Percentage of a Given Liquid Asphalt

This test method is intended to be a shorter method in the selection of percentages of asphalt for maximum strength with a given soil. In choosing the first percentage of liquid asphalt with a soil whose minimum wet voidage has been determined as above proceed as follows to select the first trial asphalt percentage.

1. Determine the residual asphalt percentage in that particular liquid asphalt by approved methods.

2. From Table 1 select the mid-range asphalt factor. Example: RC-2 mid-range factor = 0.49.

3. The percent liquid asphalt for the first trial will be determined using the formula:

$$\text{Percent Liquid Asphalt} = \frac{\text{(Asphalt Factor) (\% Wet Raw Soil Voids)}}{\text{\% Residual Asphalt} \div 100}$$

For example, assume a raw soil voids = 13.6% and % residual asphalt in RC-2 = 81.6%.

$$\text{\% Liquid Asphalt to try} = \frac{(0.49)(13.6)}{.816} = 8.17\%$$

Use 8% liquid RC-2 asphalt for the first set of specimens.

Note: In the interest of economy the second trial set should be made at the low end of the asphalt factor range with the third set at the high end of the range. In wet areas high asphalt percentages may be more difficult to aerate back in the field.

E. Determination of the Moisture and/or Volatiles Density Curves for the Soil-Asphalt Materials by the Aeration and Gyratory Molding Method.

1. Weigh out six specimens of air-dry soil for 6 x 6-inch specimens.

2. Add approximately 3 percent more water than the estimated optimum moisture and/or volatiles content to each specimen and mix well.*

3. Place the pan of wetted soil on scales and weigh in the desired type and percent of liquid asphalt. Mix until a uniform mixture is obtained.

4. Record the mixing data on Work Sheet No. 1 and on Gyratory Molding Data Sheet. See Figures 2 and 3.

5. Using the aeration method of drying back techniques, proceed to aerate and then mold the set of specimens according to Steps 4 through 15 under "Mixing and Molding Raw Soil Procedure."

6. Protect the specimens after molding by placing a 6-inch porous stone on top and bottom until ready for dry curing.

7. Using Work Sheets 1 and 2 calculate voids and densities, then plot graphs as desired.

F. Procedure for Dry Curing and Pressure Wetting of Soil-Asphalt Specimens

1. Dry Curing of Specimens (Use Work Sheet No. 3). (Figure 5)

a. When the entire set of specimens has been molded remove the triaxial cells and place in the 140 F air drying oven for 5 days to cure.

b. At the end of the dry curing period remove the specimens from the oven, cool, measure, weigh and record. Always allow the specimens to cool to room temperature before pressure wetting.

*Water Factor Formula for adding water to Soil-Emulsified Asphalt Mixtures before Mixing and Aerating. Percent Water = 45% X Liquid Limit of Soil.

2. Moist Curing Specimens

a. Moist cure the specimens by pressurization in the pressure pycnometer using the techniques in Part IV, "Pressure Wetting of Black Base Specimens" of Test Method Tex-109-E except that pressurization water should be used at a temperature of 70 F $\pm$ 5 F.

Note: Restrainers are never used. The specimens are placed in plastic bags in the pycnometer for ease of handling but completely open for thorough wetting. If pressurization equipment is not available specimens may be wetted by placing in plastic bags (for easy handling) and immersing the open-ended bag in a suitable water tank for a minimum of 30 days. In any case all soils with plasticity indices above 20 should be wetted by immersion.

b. In pressure wetting according to Test Method Tex-109-E it will be necessary to release the 1200 psi pressure by valving at a slow, uniform rate. (Use approximately 30 seconds to return to zero.) If the pressure is suddenly released the absorbed air is given up rapidly in the specimen and may tend to destroy its structure.

c. Remove the specimen from the pressure vessel and immerse it in a water tank or bath containing cold tap water and allow it to remain for at least 15 minutes.

d. Remove the specimen from the water tank, carefully set on stone and remove plastic bag. Blot any excess moisture from the surface of the specimen and weigh to the nearest estimated 0.001 pound. Record on Work Sheet No. 3 (Figure 5). Carefully replace specimen in plastic bag with plastic disks on each end. Fold plastic bag over top and bottom of specimen. Place in a preheated triaxial cell, with top and bottom heated porous stones in place. Place in a 140° oven for approximately 24 hours. Follow this procedure for all specimens.

G. Procedure for Testing Soil-Asphalt Base Specimens in Unconfined Compression

Six specimens should be tested in unconfined compression at 140 F (± 5 F) after pressure wetting in cold tap water. All specimens should be tested at 0.15 inches per minute deformation.

Both the triaxial testing press and the gyratory compactor have the capacity to perform the test. However, any testing press meeting ASTM Designation D 1633 requirements and having the deformation rate capabilities may be used.

Proceed to test as follows:

1. When the triaxial press is used to determine compressive strength use the procedure as described in Section F, Testing Specimens, in Test Method Tex-117-E for the unconfined test.

   a. Remove the specimen from the 140 F oven, remove the cell and plastic bag, obtain the height and circumference. Record these data on Work Sheet No. 3 (Figure 5).

b. Set up the unconfined specimen for testing as described in Test Method Tex-117-E and test. It will not be necessary to take any readings on the proving ring except the maximum readings. No area corrections are made.

c. When the test is completed, remove the specimen from the press and place in a drying pan, check temperature by inserting a thermometer in top of the specimen, then break up the specimen and place in a hot drying (230 F) oven for oven dry weight. Calculate the unconfined compressive strength as follows:

$$\text{Unconfined strength, psi} = \frac{\text{Total Load in Pounds}}{\text{Original Area in Sq. In.}}$$

d. Record this strength (psi) and drying data on Work Sheet No. 3 (Figure 5).

2. Most large gyratory soils compactors have the capability of performing both the slow and fast tests (0.15 in./min. and 10.0 in./min.). When this machine is used for testing, proceed as follows:

a. Prepare the specimens for testing as described in Paragraph 1-a above.

b. Place one of the 18 gauge metal disks on the platen to protect the surface from abrasion. Center the specimen, with top and bottom porous stones in place, on the disk in the machine. Place a thin metal disk on the top of the top stone.

c. Bring the top head down to just make contact with the specimen. Turn the machine off.

d. Set the controls on the machine for 0.15 in. per minute.

e. Check the drag hands on the pressure gauges to see that they are out of the way.

f. Start the machine and read the maximum reading on the gauge at failure. Record this value.

g. Since the ratio of the area of the specimen to the ram of the pump is 1.73 to 1 for a 6-inch diameter specimen, calculate the strength of the specimen as follows:

$$\text{Strength, psi} = \frac{\text{Gauge Reading, psi}}{1.73}$$

Note: The cross sectional area of the ram of the gyratory press is 16.349 square inches (diameter = 4-9/16 inch). For diameters of specimens other than 6 inches use a factor equal to the specimen diameter squared divided by the ram diameter squared.

When the specimen swells significantly during pressure wetting or subsequently, it is desirable to use oversize top and bottom stones for testing which fit the specimen.

h. When the test is completed, remove the specimen from the press and place in drying pan, check the temperature by inserting thermometer in top of specimen, then break up specimen and place in hot drying (230 F) oven for oven dry weight.

i. Record this strength (psi) and drying data on Work Sheet No. 3 (Figure 5).

j. Plot the strengths (psi) of all specimens as shown on graph (Figure 11).

3. Mix, mold, dry cure, pressure wet and test other percentages of asphalt stabilizer to obtain the percentage desired giving the maximum or desired strength. Refer to the note under "Determination of First Trial Percentage of a Given Liquid Asphalt," D, above.

4. From the laboratory mixes giving the best or satisfactory strengths with a given liquid asphalt choose the percentage to be tried in the field.

5. In the use of a given liquid asphalt, when several trial percentages have been molded and tested, the selection of the percentage to use in the field may be accomplished as follows:

a. Plot the relationship of the maximum compressive strength (psi) to the total percent air voids (rebound, wet) for the various percentages of liquid asphalt as shown on the graph (Figure 12). It may be useful to plot the relationship of the maximum compressive strength (psi) to the maximum molded dry density and wet density (rebound, dry and wet) for the various percentages of liquid asphalt as shown on the graph (Figure 13).

b. Evaluate the plotted data and select the percent liquid asphalt for field mixture. For the selected percent liquid asphalt plot the relationship of the molded wet density to moisture and/or volatiles content and the moisture and/or volatiles aerated as shown on the graph (Figure 14). Evaluate the plotted data and select the percent moisture and/or volatiles to be aerated out of the field mixture.

H. Quick Determination of Field Density (Optimum Liquid Content), Compressive Strength, Percent Total Voids, Minimum Allowable and Optimum Liquid Content for Field Control.

Since success of asphalt treated bases depends greatly upon compaction, it is necessary that proper aeration of moisture and/or volatiles just prior to compaction be achieved. Use the following simple field test procedure to determine optimum liquid contents for compaction.

1. After field mixing at a liquid content above optimum has been completed, select a 90-pound sample and split into portions of approximately 14 pounds each. Place portions where temperature will fluctuate very little (6-in. by 6-in. specimen desired).

2. Mold one sample, which has not been aerated, in the gyratory press and determine density and voids as previously described. Record data on Work Sheets No. 5 and No. 2 (Figures 7 and 4).

3. Place remainder of portions on trays and aerate in the sun or by stirring under a fan or infrared lamps until various increments of water and volatiles have been removed, record data on Work Sheet No. 4 (Figure 6) than compact in gyratory compactor. (Keep the molding temperature as uniform for all portions as is practical i.e. $\pm$ 4 F.)

4. Repeat Step 3 for various portions until a wet moisture-density curve has been completed. If desired, run an unconfined compressive strength test on all specimens on the curve at room temperature.

5. Plot the densities as shown on the graph, Figure 11, and select the optimum liquid content.

6. Rolling or field compaction should be started no later than when the liquid content from Step 5, above is approached and should be completed prior to the point which is 1-1/2 percent below the optimum from Step 5 above. Best results should be obtained when compaction is completed at the optimum liquid content.

Note: In emulsified liquid asphalt usage it has been determined that better strengths may be achieved when compaction is completed at liquid contents (moisture and/or volatiles) as much as 1-1/2 percent on the wet side of the curve regardless of density.

7. After the field mixture is compacted, the roadway in-place density can be determined by Test Method Tex-115-E.

8. Density control should be based on obtaining a minimum of 95% of the density on road mixes when compacted as outlined above.

I. Triaxial Classification of Soil-Asphalt Stabilization

Triaxial tests performed on blocks of soil-asphalt stabilized bases, which had been removed from the roadway and trimmed into cylinders, shows that the rupture lines from Mohr's Diagram of stress vary from 33 degrees to 39.5 degrees with the horizontal axis.

1. Classify the Soil-Asphalt Materials as Follows:

   a. Using the strength circle from the zero lateral pressure test of the specimen at optimum conditions and strength, draw the strength circle on Mohr's Diagram as described in Part I, Test Method Tex-117-E (Example on Figure 13 of that test method).

   b. Tangent to this strength circle, construct a line making an angle of 33 degrees with the normal stress axis.

   c. Transfer this line, as the rupture line for the material, to the classification chart (see Figure 14, Test Method Tex-117-E) and classify as in that test method.

Note: Since 33 degrees is the least angle encountered this type of classification should give a conservative estimate of the suitability of the material to perform in a pavement structure.

GENERAL NOTES

1. Porous stones should be protected when possible from asphalt. Porous stones which have been soiled with asphalt should never be used as

bottom stones on other tests when put to capillarity for the porosity may be seriously or totally reduced.

2. A silicone spray will help prevent the sticking of the soil-asphalt material to the disks when molding specimens. Lightly spray the disks.

3. Since the dry density of soil asphalt specimens is determined from the dry weights of material going into the specimen it will not be necessary to dry out the specimens after testing unless desired.

4. The use of the pressure pycnometer for wetting soil asphalt mixes should be limited to soils having a P.I. of 20 or less. Soil asphalt mixes where the P.I. of the raw soil exceeds 20 should be wetted by immersion for a minimum of 30 days.

5. In the field when the soil to be treated is very wet and when drying is difficult due to high humidity and/or rain, it may be impossible to use higher percentages of liquid asphalt because proper moisture and/or volatiles contents for compaction may be difficult to obtain.

GYRATORY NOTES

Some of the large gyratory compactors have been modified with a different height measuring device. This device is front mounted at the bottom of the cover bonnet and has a steel strap mounted perpendicular to the machine platen to support the measuring dial. The magnetic height measuring yoke is provided with a flat smooth surface to make contact with the dial stem when the yoke is in position. The "zero" setting for this new device is the same as that described under Calibration of Equipment. The advantage of the new device is that it is placed in position as soon as the loose material has been shortened enough by gyration to place the measuring yoke on top of the top gyrating head. This is usually no later than the end of the first two minutes of gyration at 35 psi gauge pressure.

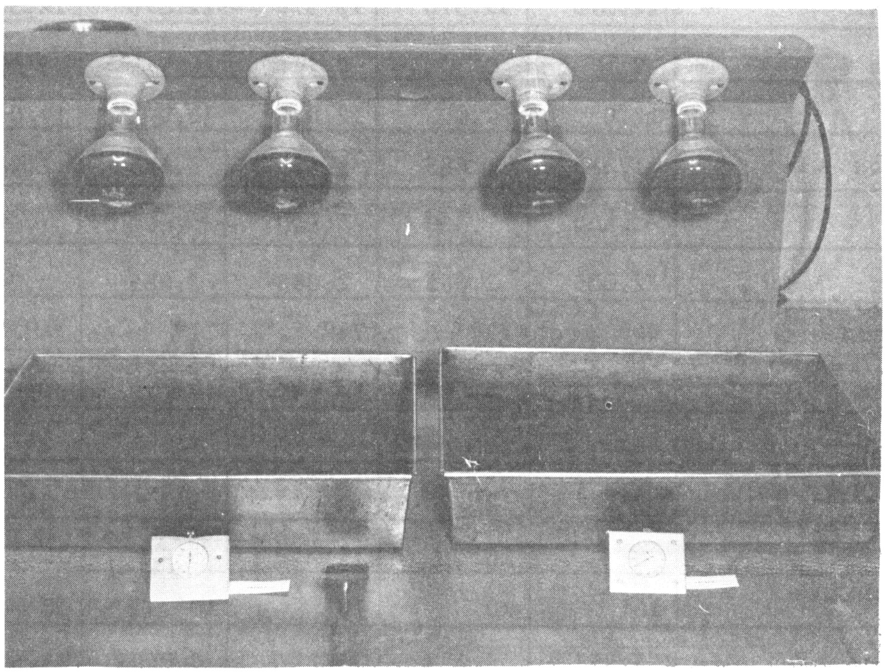
The height of specimen can be read directly at any desired time and a time - density curve can be calculated and plotted.

The procedure for gyration is the same as described in Part II, Test Method Tex-126-E, paragraphs 10 through 16 except that the new measuring device is placed in position as described above, and the end point as described in paragraph 13 is reached when the rate of dial decrease is not greater than one division (.001") in 5 revolutions of the platen. From the beginning, all dial readings are decreasing values until the end point is reached. It should be noted that during gyration the dial needle will fluctuate during the latter stages of gyration but as the gyration nears the end (density nearing the maximum) the minimum reading of the dial needle approaches the same reading. This end point is easier to recognize by the operator and may save gyration time. After the 500 psi static load has been placed on the specimen and its end point determined then continue the procedure as described beginning with Part II, paragraph 18. (Test Method Tex-126-E).

A new accuracy feature, a gauge check valve, has been approved and installed on all large gyratory soil presses. This valve is particularly useful in that the follower hand is not used and when the gauge check valve operates, it keeps the gauge needle at the indicated pressure until released. It operates as follows:

For gyrating purposes the gauge check valve should be turned all the way in (clockwise). This allows a free flow of oil to and from the gauges.

For testing purposes the gauge check valve should be turned all the way out (counter-clockwise). This allows oil to enter the gauge, register the pressure and hold it till released by turning the valve all the way in.



INFRARED LAMP AERATION SETUP

FIG. 1

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 1
MOLDING DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	1	2	3	4	5	6
Date Molded	7-24-72	7-25-72	7-25-72	7-25-72	7-26-72	7-26-72
% Stabilizer (Raw Soil)	0	0	0	0	0	0
% Hygro. Moist.	1.0	1.0	1.0	1.0	1.0	1.0
Lbs. Material + Hygro.	12.500	12.500	12.500	12.500	12.500	12.500
Wt. Hygro. Moist.	.124	.124	.124	.124	.124	.124
Dry Wt. Material	12.376	12.376	12.376	12.376	12.376	12.376
Lbs. Stabilizer	0	0	0	0	0	0
% Water Added	12.0	12.0	12.0	12.0	12.0	12.0
Lbs. Water Added	1.485	1.485	1.485	1.485	1.485	1.485
Tare Wt. Jar	.600	.600	.600	.600	.600	.600
Wt. Water + Jar	2.085	2.085	2.085	2.085	2.085	2.085
Temp. Mix in Mold	84°	72°	74°	77°	74°	79°
Mold No.	3	3	3	3	3	3
Time @ 20 psi.	2'	2'	2'	2'	2'	2'
Time @ 40 psi.	2'	2'	2'	2'	2'	2'
Time @ 60 psi.	5'	16'	15'	5'	12'	16'
Time @ 500 psi.	10'	10'	10'	10'	10'	10'
Ht. Specimen + Plates	5.752	5.718	5.717	5.749	5.674	5.746
Thickness of Plates	.090	.090	.090	.090	.090	.090
Ht. Specimen (Loaded)	5.662	5.628	5.627	5.659	5.584	5.656
Ht. Specimen (Rebound)	5.829	5.756	5.747	5.802	5.731	5.722
Molded Wt. of Specimen	13.414	13.401	13.463	13.391	13.332	13.200
Vol. per Linear Inch	.016315	.016315	.016315	.016315	.016315	.016315
Vol. of Specimen (Rebound)	.095100	.093909	.093762	.094660	.093501	.093354
Wt. of Bitumen in Spec.						
Dry Wt. of Soil in Spec.	12.376	12.376	12.376	12.376	12.376	12.376
Calc. Dry Wt. of Specimen	12.376	12.376	12.376	12.376	12.376	12.376
Calc. Dry Density of Spec. (Rebound)	130.14	131.79	131.99	130.74	132.36	132.57
Calc. Dry Density of Soil	"	"	"	"	"	"
Calc. % Moist. & Volatiles	8.4	8.3	8.8	8.2	7.7	6.7
Time Aerated (Minutes)	100'	70'	53'	91'	106'	181'

FIG. 2

Gyratory Molding Data

72-183-R
No. 67 8 % RC-2

Time Gyrated - 2 Min. @ 20 P.S.I.
" " - 2 Min. @ 40 P.S.I.
" " - 10 Min. @ 60 P.S.I.

Loaded Ht.	@ 500 P.S.I.	5.978
" "	@ 5 Min.	5.967
" "	@ 10 Min.	5.964
" "	@ 15 Min.	
" "	@ 20 Min.	
" "	@ 25 Min.	
Released Load Height (Rebound)		6.041

Mixing Data

Wt. of Pan + Wetted Soil	22.919
Wt. of Added Asphalt	1.014
Wt. Pan + Wet. Soil + Asphalt	23.933
Wt.P. + W.S. + A. After Mixing	23.881
Wt. Moist. &/or Volatiles Loss	.052

Date 9-27-72 Operator Ed O'Dell

FIG. 3

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 2
DENSITY AND VOIDS DATA (GYRATORY MOLDING METHOD)
FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	1	2	3	4	5	6
% Stabilizer (Raw Soil)	0	0	0	0	0	0
% Bitumen in Stabilizer	-	-	-	-	-	-
% Bitumen in Mix *	-	-	-	-	-	-
Sp. Gr. of Bitumen	-	-	-	-	-	-
Sp. Gr. of Soil	2.657	2.657	2.657	2.657	2.657	2.657
Combined Sp. Gr. **	-	-	-	-	-	-
Molded Wet Wt. of Specimen	13.414	13.401	13.463	13.391	13.332	13.200
Molded Dry Wt. of Specimen	12.376	12.376	12.376	12.376	12.376	12.376
Loaded Vol. of Specimen	.092376	.091821	.091805	.092327	.091103	.092278
Loaded Dry Density	133.97	134.78	134.81	134.05	135.85	134.12
Loaded Wet Density	145.21	145.95	146.65	145.04	146.34	143.05
Rebound Vol. of Specimen	.095100	.093909	.093762	.094660	.093501	.093354
Rebound Dry Density	130.14	131.79	131.99	130.74	132.36	132.57
Rebound Wet Density	141.05	142.70	143.59	141.46	142.59	141.40
Zero Air Voids Density ***	165.78	165.78	165.78	165.78	165.78	165.78
% Voids Loaded (Dry) ****	19.2	18.7	18.7	19.1	18.1	19.1
% Voids Loaded (Wet) ****	12.4	12.0	11.5	12.5	11.7	13.7
% Voids Rebound (Dry) ****	21.5	20.5	20.4	21.1	20.2	20.0
% Voids Rebound (Wet) ****	14.9	13.9	13.4	14.7	14.0	14.7

FORMULAS

* Percent Bitumen in Mix $= \frac{\text{\% Bitumen x \% Stabilizer Added}}{\text{(\% Bitumen x \% Stabilizer Added) + 100}}$

** Combined Sp. Gr. $= \frac{100}{\frac{\text{\% Soil}}{\text{Ab.Sp.Gr. of Soil}} + \frac{\text{\% Bitumen in Mix}}{\text{Ab.Sp.Gr. of Bitumen}}}$

*** Zero Air Voids Density = 62.4 x Combined Sp. Gr.

**** Percent Voids $= (1 - \frac{\text{Density of Specimen}}{\text{Zero Air Voids Density}}) \text{ X } 100$

FIG. 4

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 3
CURING, TESTING AND DRYING DATA
FOR SOIL-ASPHALT MIXES
(M. - D. CURVE SPECIMENS)

Sample No. 72-183-R	1	2	3	4	5	6
Percent Stabilizer (Raw Soil)	0	0	0	0	0	0
Date Molded	7-24-72	7-25-72	7-25-72	7-25-72	7-26-72	7-26-72
Date in Oven						
Date out Oven						
Date Tested						
Ht. before Wetting & Heating						
Ht. after Wetting & Heating						
Difference in Height						
% Swell (Vertical)						
Cir. before Wetting & Heating						
Cir.after Wetting & Heating						
Cured Dry Wt. Specimen						
Oven Dry Wt. Specimen						
Wt. Moisture in Specimen						
% Moisture before Wetting						
Wt. after Wetting						
Oven Dry Wt. of Specimen						
Wt. Moisture in Specimen						
% Moisture after Wetting						
Dry Wt. Pan + Specimen	16.278	16.790	16.097	16.539	16.600	16.889
Tare Wt. Pan	3.932	4.503	3.819	4.171	4.242	4.529
Oven Dry Wt. Specimen	12.346	12.287	12.278	12.368	12.358	12.360
Molded Wet Wt. Specimen	13.414	13.401	13.463	13.391	13.332	13.200
Wt. H_2O & or Volatiles	1.068	1.114	1.185	1.023	.974	.840
% H_2O (& or Volatiles) on Total	8.7	9.1	9.7	8.3	7.9	6.8
Oven Dry Density Specimen	129.82	130.84	130.95	130.66	132.17	132.40
Loading - Rate (In./Min.)						
Total Load - Comp.						
Comp. Strength (psi)						
Testing Temp. ^oF						

FIG. 5

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 4
AERATION DATA FOR SOIL-ASPHALT MIXES

Sample No. 72-183-R	1	2	3	4	5	6
Date Aerated	7-24-72	7-25-72	7-25-72	7-25-72	7-25-72	7-26-72
Percent Stabilizer (Raw Soil)	0	0	0	0	0	0
Aeration Method	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)	(Lamp)
% M. or V. Aerated	3.0	2.0	1.0	4.0	4.0	6.0
Wt. M. or V. Aerated	.371	.248	.124	.495	.495	.743
M. or V. Loss After Mixing						
Wt. Pan + S.A. after mixing	18.969	19.341	19.115	19.161	19.385	19.382
Wt. M. or V. Aerated	.371	.248	.124	.495	.495	.743
Wt. Pan + S.A.after Aerating	18.598	19.093	18.991	18.666	18.890	18.639
Time Aerated	67'	70'	53'	43'	106'	122'
Wt. Pan + Soil-Asphalt	18.728	19.040	18.882	18.939	18.818	18.878
Time Aerated	33'			48'	Room	42'
Wt.Pan + Soil-Asphalt	18.580			18.660	18.807	18.728
Time Aerated						17'
Wt. Pan + Soil-Asphalt						18.660
Time Aerated						Room
Wt. Pan + Soil-Asphalt						18.618
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Time Aerated						
Wt. Pan + Soil-Asphalt						
Total Time Aerated(Minutes)	100'	70'	53'	91'	106'	181'
Wt. M. & or V. Aerated	.389	.301	.233	.501	.578	.764
Corrected %M.& or V.Aerated	3.1	2.4	1.9	4.0	4.7	6.2
Total Wt. H_2O in Mix	1.609	1.609	1.609	1.609	1.609	1.609
Wt. Molding Moist.	1.220	1.308	1.376	1.108	1.031	.845
% Molding Moist.	9.9	10.6	11.1	9.0	8.3	6.8

FIG. 6

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 5
QUICK TEST DATA FOR SOIL ASPHALT MIXES

Sample No. 72-183-R	67	68	69	70	71	72
Percent Stabilizer (RC-2)	8	8	8	8	8	8
Date Molded	10-10-72 →			10-11-72 →		
Date Tested	10-12-72 →					
Moisture Pan No.	1	2	3	4	5	6
Oven Dry Weight Test Spec. & Pan	17.761	18.017	17.413	17.847	17.751	17.468
Tare Weight Pan	4.258	4.503	3.919	4.340	4.242	3.956
Oven Dry Weight Test Spec.	13.503	13.514	13.494	13.507	13.509	13.512
Wet Wt. Test Spec.	13.839	13.972	14.099	13.572	13.701	13.770
Calculated Dry Wt. Test Spec.	13.505	13.505	13.505	13.505	13.505	13.505
Wt. M. &/or V. in Test Spec.	.334	.467	.594	.067	.196	.265
% M. &/or V. in Test Spec	2.47	3.46	4.40	0.50	1.45	1.96
% M. &/or V. Aerated	4.00	3.00	2.00	6.05	5.05	4.50
% M. &/or V. in Mix	6.47	6.46	6.40	6.55	6.50	6.46
Wet Wt. Test Spec. (LBS.)	13.839	13.972	14.099	13.572	13.701	13.770
Wet Density Test Spec.	142.49	140.67	139.50	138.41	143.50	143.20
Calculated Dry Density Test Spec.	139.05	135.97	133.62	137.73	141.45	140.44
Wt. Spec. before Test (LBS.)	13.839	13.972	14.099	13.572	13.701	13.770
Ht. Spec. before Test	5.953	6.088	6.195	6.010	5.852	5.894
Cir. Spec. before Test	18.85	18.85	18.80	18.80	18.80	18.80
Vol. Spec. before Test	.097123	.099326	.101071	.098053	.095475	.096161
Loading Rate (IN/MIN.)	0.15	0.15	0.15	0.15	0.15	0.15
Total Load - Comp. (LBS.)	4,122	2,645	1,563	4,047	5,410	4,463
Comp. Strength (PSI)	145.8	93.5	55.6	143.9	192.4	158.7
Testing Temp. °F.	75°	75°	75°	75°	76°	76°

FIG. 7

COMPRESSIVE STRENGTH TEST WORK SHEET NO. 6
CAPILLARY WETTING, CURING, TESTING AND DRYING DATA
FOR SOIL OR SOIL-ASPHALT MIXES
(COMPRESSION TEST SPECIMENS)

Sample No. 72-183-R	7	8	9	10		
Percent Stabilizer(Raw Soil)	0	0	0	0		
Cell No.	30	83	61	76		
Lbs. of Added Surcharge	10	10	10	10		
Date in Oven	7-28-72	7-28-72	7-28-72	7-28-72		
Date out Oven (6 Hrs.)	7-28-72	7-28-72	7-28-72	7-28-72		
Date in Capillarity	7-31-72	7-31-72	7-31-72	7-31-72		
Date out Capillarity 10 (Days)	8-10-72	8-10-72	8-10-72	8-10-72		
Ht. in Capillarity - Stones	6.430	6.082	5.882	6.013		
Ht. out Capillarity - Stones	6.432	6.082	5.886	6.013		
% Swell (Vertical)	Nil	Nil	Nil	Nil		
Cir. in Capillarity	18.8	18.8	18.8	18.8		
Cir. out Capillarity	18.8	18.8	18.8	18.8		
Cured Dry Wt. Spec. + Stones	22.112	22.161	22.207	22.172		
Dry Weight Stones	8.911	8.913	8.922	8.925		
Cured Dry Wt. Specimen	13.201	13.248	13.285	13.247		
Wt. H_2O(& or Volatiles)in Spec.	.379	.418	.464	.429		
% H_2O(& or Volatiles)in Spec.	2.96	3.26	3.62	3.35		
Wt. after Capillarity	23.776	23.631	23.461	23.568		
Wet Wt. Stones	9.657	9.683	9.655	9.661		
Wet Wt. Specimen	14.119	13.948	13.806	13.907		
Oven Dry Wt. Specimen	12.822	12.830	12.821	12.818		
Wt. H_2O(& or Volatiles)inSpec.	1.297	1.118	.985	1.089		
% H_2O (& or Volatiles)after Cap.	10.12	8.71	7.68	8.50		
Dry Wt. Pan + Specimen	16.641	16.765	16.731	16.989		
Tare Wt. Pan	3.819	3.935	3.910	4.171		
Oven Dry Wt. Specimen	12.822	12.830	12.821	12.818		
Oven Dry Density Specimen	122.24	129.26	133.49	130.33		
Loading-Rate (In./Minute)	0.15"	0.15"	0.15"	0.15"		
Total Load-Comp.	129.65	309.65	656.70	361.39		
Comp. Strength (P.S.I.)	4.61	11.01	23.35	12.85		
Testing Temp. ^oF	75^o	75^o	75^o	75^o		

FIG. 8

PRESSURE PYCNOMETER WORK SHEET

ABSOLUTE VOLUME, SPECIFIC GRAVITY, AND MOISTURE

CONTENT TEST DATA

DATE: Jan. 29, 1973

SAMPLE NO. 72-183-R	1	2				
PRES.-PYC. VOLUME (LBS.)	1.938	1.936				
VOLUME PLASTIC BAG (LBS.)	.051	.051				
VOLUME SAMPLE (LBS.)	1.887	1.885				
WET WT. SAMPLE (LBS.)	4.990	4.989				
* DRY WT. SAMPLE (LBS.)	4.984	4.984				
WT. WATER IN SAMPLE (LBS.)	.006	.005				
** % WATER IN SAMPLE	0.1	0.1				
CORR. PRES.-PYC. VOL.(LBS.)	1.881	1.880				
*** SPECIFIC GRAVITY	2.650	2.651				

* DRY WEIGHT FORMULA

$$\text{DRY WT.} = \text{WET WT.} - \frac{\text{SP. GR. X VOL. - WET WT.}}{\text{SP. GR. - 1}}$$

** MOISTURE CONTENT FORMULA

$$\text{\% MOIST.} = \left\{ \frac{\text{SP. GR. X VOL. - WET WT.}}{\text{SP. GR. - 1}} \Big/ \text{DRY WT.} \right\} 100$$

*** SPECIFIC GRAVITY FORMULA

$$\text{SP. GR.} = \frac{\text{DRY WT.}}{\text{VOL. - (WET WT. - DRY WT.)}}$$

FIG. 9

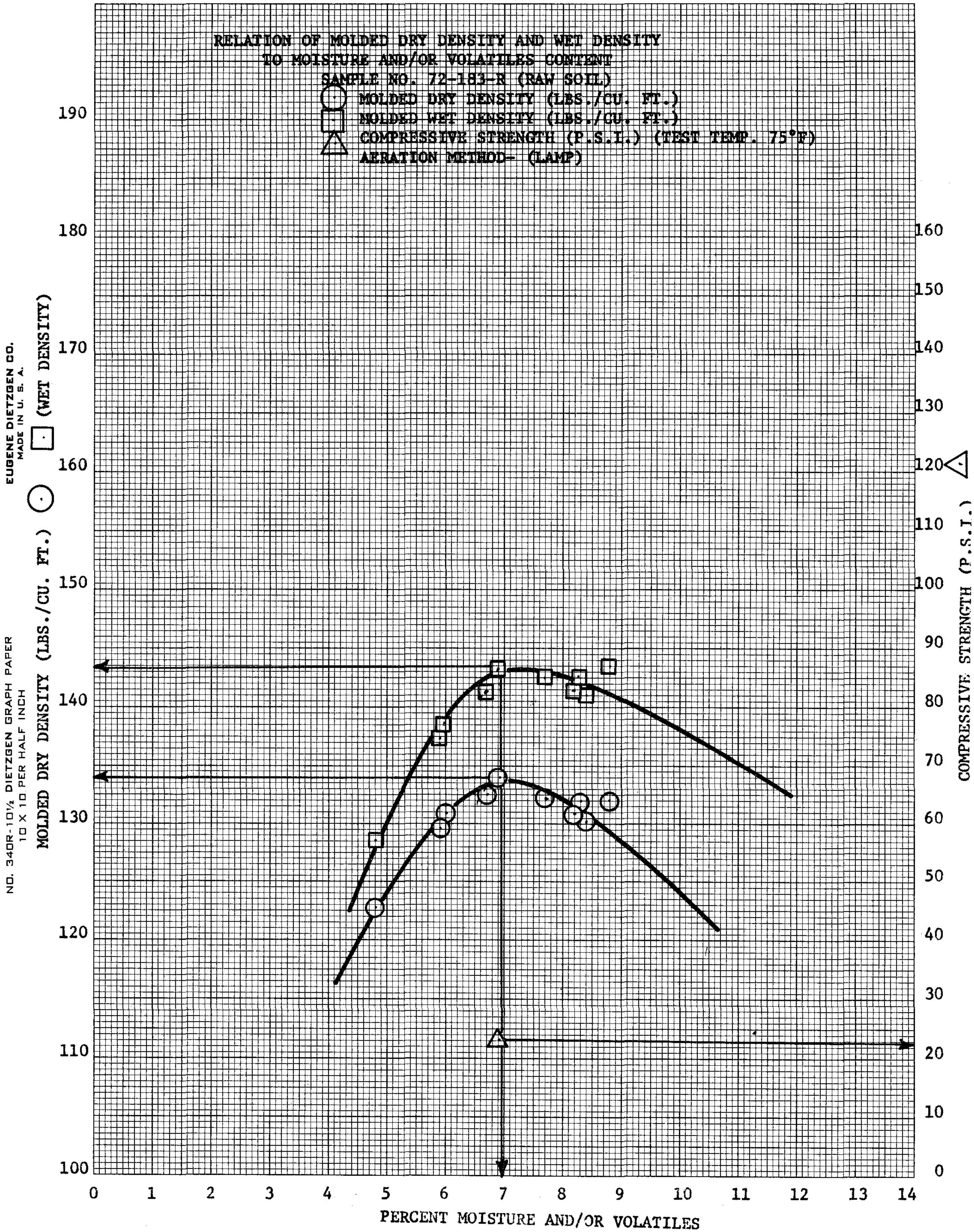

RELATION OF MOLDED DRY DENSITY AND WET DENSITY
TO MOISTURE AND/OR VOLATILES CONTENT
SAMPLE NO. 72-183-R (RAW SOIL)
MOLDED DRY DENSITY (LBS./CU. FT.)
MOLDED WET DENSITY (LBS./CU. FT.)
COMPRESSIVE STRENGTH (P.S.I.) (TEST TEMP. 75°F)
AERATION METHOD- (LAMP)
MOLDED DRY DENSITY (LBS./CU. FT.) (WET DENSITY)
COMPRESSIVE STRENGTH (P.S.I.)
PERCENT MOISTURE AND/OR VOLATILES
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.
100
110
120
130
140
150
160
170
180
190
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14

FIG. 10

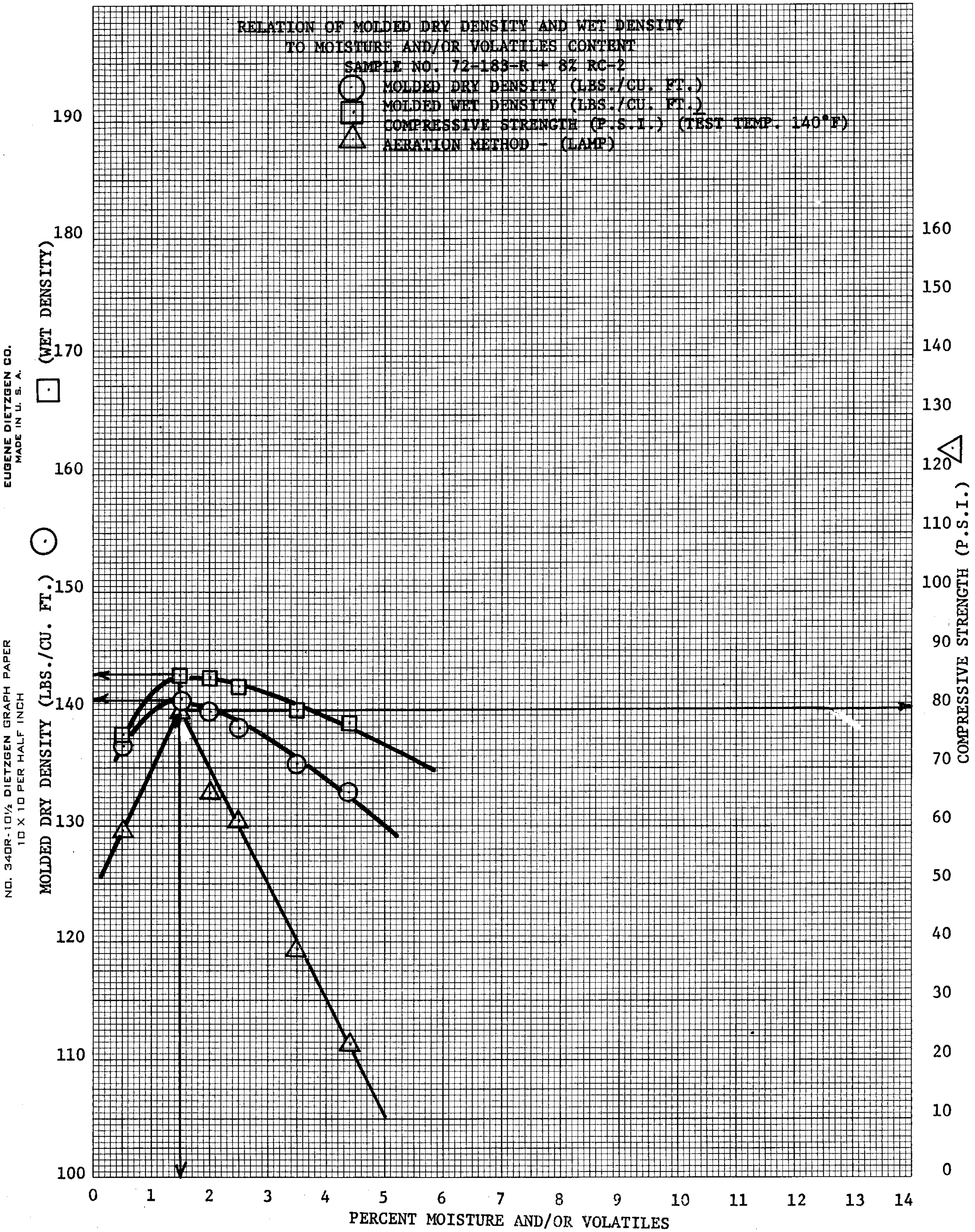

RELATION OF MOLDED DRY DENSITY AND WET DENSITY
TO MOISTURE AND/OR VOLATILES CONTENT
SAMPLE NO. 72-183-R + 8% RC-2
MOLDED DRY DENSITY (LBS./CU. FT.)
MOLDED WET DENSITY (LBS./CU. FT.)
COMPRESSIVE STRENGTH (P.S.I.) (TEST TEMP. 140°F)
AERATION METHOD - (LAMP)
MOLDED DRY DENSITY (LBS./CU. FT.)
(WET DENSITY)
COMPRESSIVE STRENGTH (P.S.I.)
PERCENT MOISTURE AND/OR VOLATILES
EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
100
110
120
130
140
150
160
170
180
190
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14

FIG. 11

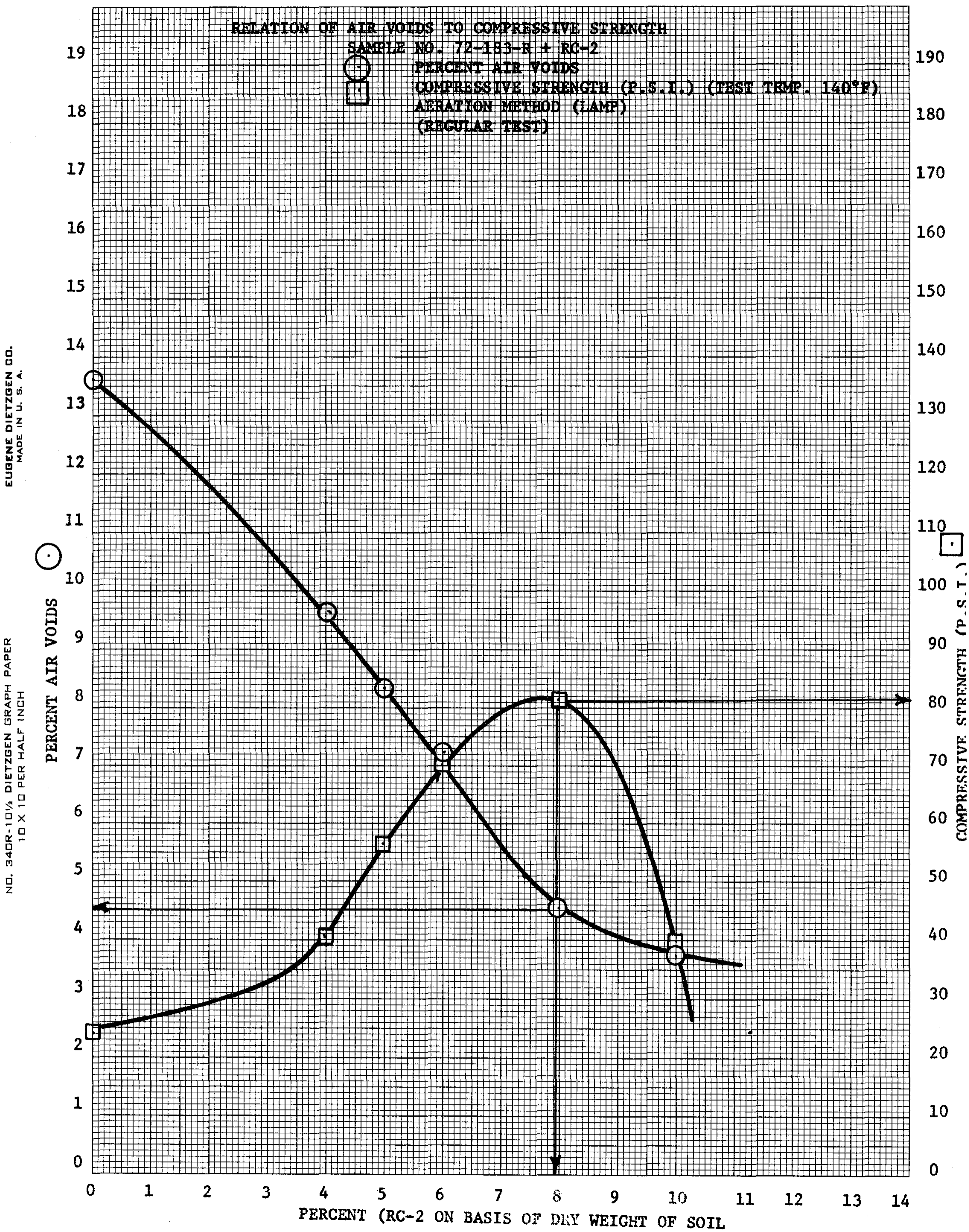

RELATION OF AIR VOIDS TO COMPRESSIVE STRENGTH
SAMPLE NO. 72-183-R + RC-2
PERCENT AIR VOIDS
COMPRESSIVE STRENGTH (P.S.I.) (TEST TEMP. 140°F)
AERATION METHOD (LAMP)
(REGULAR TEST)
PERCENT AIR VOIDS
COMPRESSIVE STRENGTH (P.S.I.)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190
PERCENT (RC-2 ON BASIS OF DRY WEIGHT OF SOIL
EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

FIG. 12

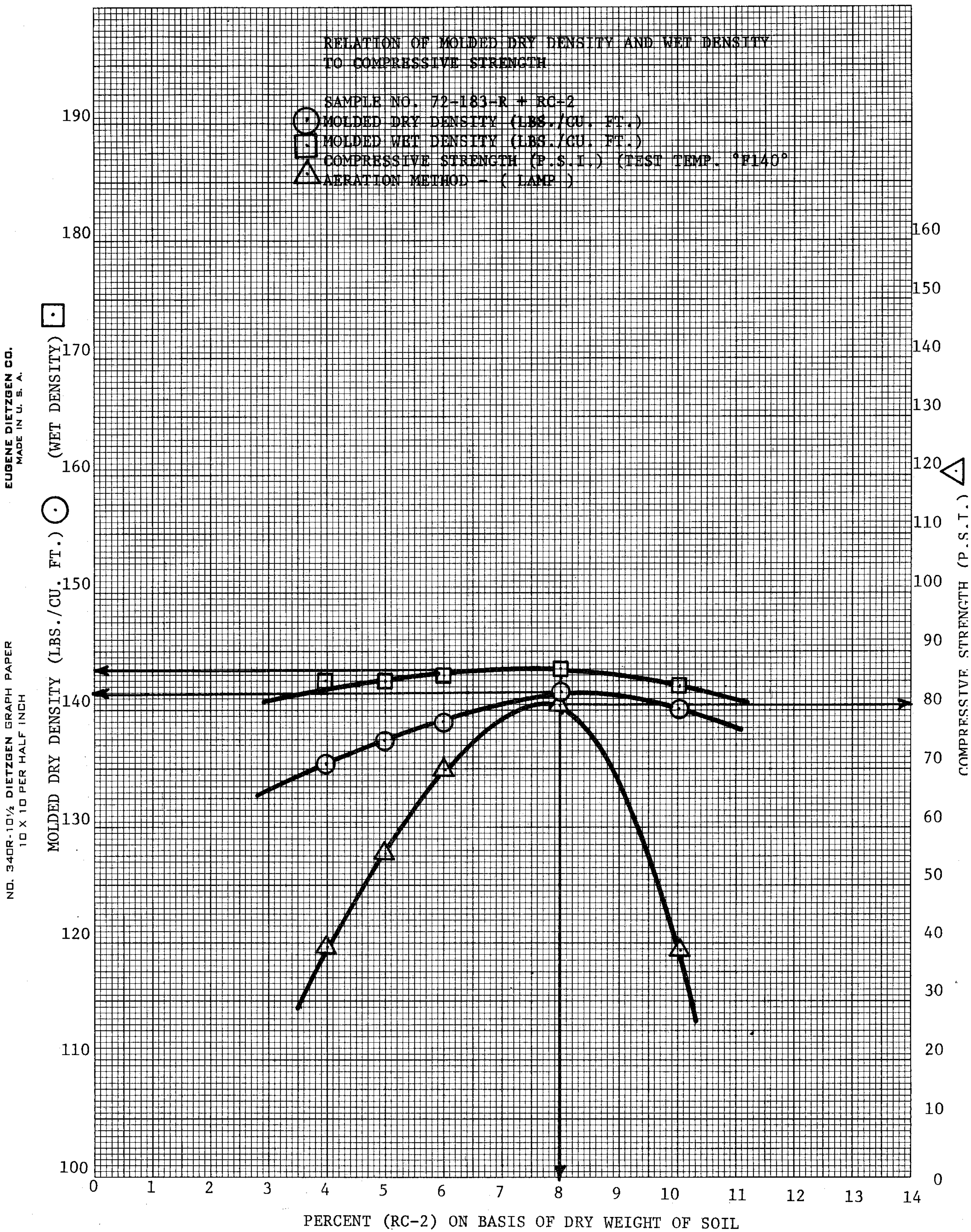

RELATION OF MOLDED DRY DENSITY AND WET DENSITY TO COMPRESSIVE STRENGTH
SAMPLE NO. 72-183-R + RC-2
MOLDED DRY DENSITY (LBS./CU. FT.)
MOLDED WET DENSITY (LBS./CU. FT.)
COMPRESSIVE STRENGTH (P.S.I.) (TEST TEMP. °F140°
AERATION METHOD - (LAMP)
MOLDED DRY DENSITY (LBS./CU. FT.)
(WET DENSITY)
COMPRESSIVE STRENGTH (P.S.I.)
PERCENT (RC-2) ON BASIS OF DRY WEIGHT OF SOIL
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.

FIG. 13

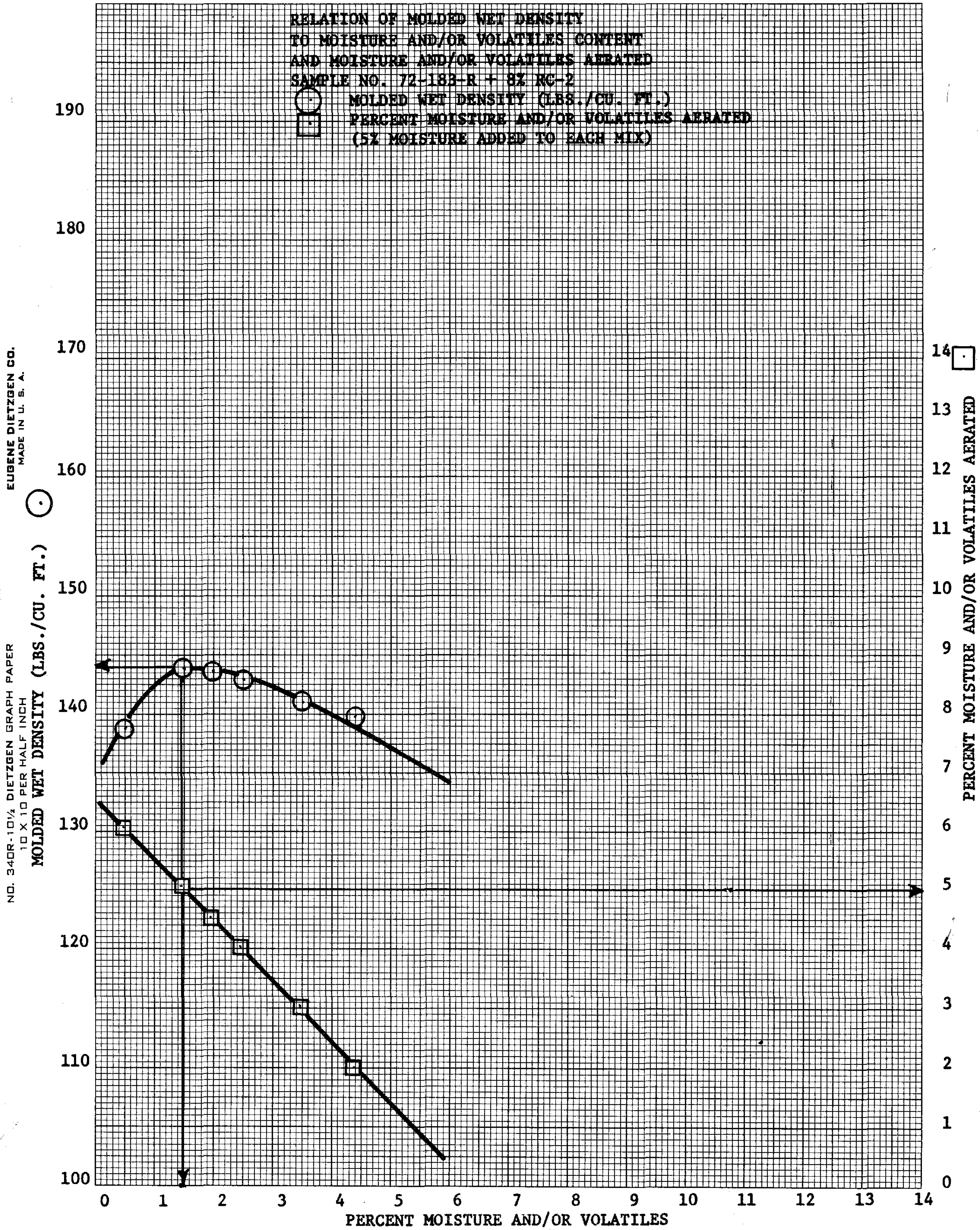

RELATION OF MOLDED WET DENSITY
TO MOISTURE AND/OR VOLATILES CONTENT
AND MOISTURE AND/OR VOLATILES AERATED
SAMPLE NO. 72-183-R + 8% RC-2
MOLDED WET DENSITY (LBS./CU. FT.)
PERCENT MOISTURE AND/OR VOLATILES AERATED
(5% MOISTURE ADDED TO EACH MIX)
NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.
MOLDED WET DENSITY (LBS./CU. FT.)
190
180
170
160
150
140
130
120
110
100
PERCENT MOISTURE AND/OR VOLATILES AERATED
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
PERCENT MOISTURE AND/OR VOLATILES

FIG. 14

TABLE 1

ASPHALT STABILIZERS FOR SOIL-ASPHALT STABILIZATION
FORMULA* FOR CALCULATING PERCENT LIQUID ASPHALT FOR START OF LAB TESTS

TYPE - GRADE	TYPE VOLATILES	AVERAGE PERCENT RESIDUAL ASPHALT	ASPHALT FACTOR (RANGE)	ASPHALT FACTOR MID POINT
RC-2 (RAPID CURING - 2)	LIGHT VOLATILES (GASOLINE, NAPHTHA, KEROSENE)	81.6	.41 - .56	.49
MC-30 (MEDIUM CURING - 1 or 30)	MORE MEDIUM LIGHT VOLATILES (KEROSENE)	63.9	.35 - .48	.42
MC-800 (MEDIUM CURING - 3 or 800)	LESS MEDIUM LIGHT VOLATILES (KEROSENE)	86.9	.51 - .65	.58
RO-3 (ROAD OIL - 3)	LESS HEAVY VOLATILES (LUBE OIL, DIESEL OIL, WAX)	75.0	.42 - .55	.48
C.F.O. (CRACKED FUEL OIL)	MORE HEAVY VOLATILES (LUBE OIL, DIESEL OIL, WAX)	69.1	.36 - .50	.43
EA-11M (EMULSIFIED ASPHALT - 11 SLOW SET)	ANIONIC EMULSION	64.8	.30 - .46	.38
HVMS (HIGH VISCOSITY MEDIUM SET)	ANIONIC EMULSION	68.5	.30 - .40	.35

*Percent Liquid Asphalt for start of Lab Tests = $\frac{\text{Factor} \times \text{\% Gyratory Voids Raw Soil}}{\text{\% Residual Asphalt} \div 100}$