THE DEVELOPMENT OF TEST PROCEDURES TO IDENTIFY THE ABILITY OF SYNTHETIC AGGREGATES TO RESIST TRAFFIC DEGRADATION

FINAL REPORT

by

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ABSTRACT

This investigation basically concerns the resistance of synthetic aggregates to degradation. It is a project that investigates various methods of testing aggregates with respect to particle strength. These test methods include some of the "accepted" standard methods of test, modifications of these procedures and some new approaches to degrading aggregates. The synthetic aggregates involved in this investigation represent both source sampled materials and job sampled materials.

SUMMARY

Some of the test methods included in this investigation appear to satisfactorily differentiate between aggregates and indicate that some of the synthetic aggregates do resist abrasion and/or degradation better than others. However, to date, all the synthetic aggregates used in the field performance tests have performed satisfactorily. This precludes the establishment of a test method and specification at this time.

IMPLEMENTATION

Materials that definitely show an inherent failure must be available for testing in order to develop a procedure and establish a specification value for quality control. These unsatisfactory aggregates may be a result of production errors and/or poor raw materials or they may be intentionally manufactured with the cooperation of a producer. In either case they must be a part of a field test project so that failure in the field is unquestionable. Until such unsatisfactory materials are available further testing is not indicated.

I. PURPOSE

This investigation was initiated for the purpose of developing a test method and corresponding specification that would control the degrading properties of synthetic aggregates. The procedure was to determine the aggregate's ability to resist degradation and develop specifications for acceptable limits.

II. CONCLUSIONS

Since the aggregates involved in the tests projects have performed satisfactorily under traffic to this date, a test method with accompanying specification can not be written. Field observations indicate that when used properly no synthetic aggregate of proper gradation has failed to perform adequately as a surface treatment aggregate. To establish specification requirements at this point would possibly result in the elimination of a satisfactory material. Field performance is the "key" to a quality control specification. Aggregates that have, without question, failed under traffic due to poor quality must be the basis of a justifiable specification.

III. RECOMMENDATIONS

The work of this investigation has revealed much concerning the qualities of synthetic aggregates. To continue the test program would be of little consequence to the establishment of a test method and specification for synthetic aggregate quality control. The only suggestion would be that found in the "Implementation" of this report: If it is considered justifiable, aggregates of poor quality, produced either accidentally or intentionally, could be investigated both in the laboratory and under traffic. This would require the testing of many poor quality aggregates to acquire adequate data for the basis of a specification. Field performance is an absolute essential in this effort, therefore costs would be considerable. The overall synthetic aggregate situation should be seriously evaluated before investigation is continued.

IV. MATERIALS

Table I - Synthetic aggregate produced by the Featherlite Corporation - Ranger, Texas:

R3-71-139 - Sampled from stockpile at plant, February, 1971.

R3-71-663 - Sampled from stockpile at job site of the Texas Transportation Institute's (T.T.I.) Research Study 2-6-71-83 in District 14 for use on S.H. 95 south of Elgin, Texas, October, 1971.

R3-72-152 - Same material as R3-71-663, sampled July, 1972.

R3-72-158 - Sampled from stockpile at job site of T.T.I. Research Study 2-6-71-83 in District 11 for use on U.S. 59 and S.H. 103 south of Diboll, Texas, and east of Lufkin, Texas, July, 1972.

R3-72-172 - Sampled from stockpile at job site of T.T.I. Research Study 2-6-71-83 in District 2 for use on S.H. 6 west of Dublin, Texas, August, 1972.

R3-72-193 - Sampled from stockpile at job site of T.T.I. Research Study 2-6-71-83 in District 5 for use on U.S. 62 and F.M. 1730 southwest of Lubbock, Texas, August, 1972.

R3-73-61 - Sampled from stockpile at plant, April, 1973.

The remaining aggregate samples listed in Table I were "routine samples," submitted by Districts for routine specification quality testing. A portion of each submitted sample was taken for use in this investigation.

Table II - Synthetic aggregate produced by Texas Industries, Inc. - Eastland, Texas:

R3-70-1363 - Sampled from stockpile in District 7 in Tom Green County, December, 1970.

R3-71-661 - Same location as Table I, R3-71-663.

R3-72-159 - Same location as Table I, R3-72-158.

R3-72-171 - Same location as Table I, R3-72-172.

R3-72-192 - Same location as Table I, R3-72-193.

R3-73-60 - Sampled from stockpile at plant, April, 1973.

The remaining aggregate samples listed in Table II were routine samples as described above under Table I.

Table III - Synthetic aggregate produced by Texas Industries, Inc. - Clodine, Texas:

R3-70-535 - Sampled from stockpile in District 11 in Polk County, June, 1970.

R3-71-659 - Same location as Table I, R3-71-663.

R3-72-153 - Same location as Table I, R3-72-152.

R3-72-160 - Same location as Table I, R3-72-158 but sampled August, 1972.

R3-72-169 - Same location as Table I, R3-72-172.

R3-72-194 - Same location as Table I, R3-72-193.

R3-73-90 - Sampled from stockpile at plant, May, 1973.

The remaining aggregate samples listed in Table III were routine samples as described above under Table I.

Table IV - Synthetic aggregate produced by Texas Industries, Inc. - Dallas, Texas:

R3-71-513 - Sampled from stockpile at plant, May, 1971.

R3-71-660 - Same location as Table I, R3-71-663.

R3-72-157 - Same location as Table I, R3-72-158.

R3-72-170 - Same location as Table I, R3-72-172.

R3-72-191 - Same location as Table I, R3-72-193.

R3-73-59 - Sampled from stockpile at plant, April, 1973.

The remaining aggregate samples listed in Table IV were routine samples as described previously under Table I.

Table V - Synthetic aggregate produced by Superock, Inc. - Streetman, Texas:

R3-73-97 - Sampled from stockpile at plant, May, 1973.

R3-72-268 - Sampled from stockpile at plant and submitted by District 17, November, 1972.

R3-72-280 - Sampled from stockpile at plant and submitted by District 14, November, 1972.

R3-72-288 - Sampled from stockpile at plant, December, 1972.

The remaining aggregate samples listed in Table V were routine samples as described previously under Table I.

Table VI - Synthetic aggregates and natural aggregates from various sources:

R3-71-649 - Synthetic aggregate sampled from stockpile at the Bay Prairie Aggregate Corporation's plant near

Wharton, Texas, October, 1971.

R3-72-150 - Synthetic aggregate (referred to as "burned clay") sampled from stockpile at the Trotti and Thompson plant near Beaumont, Texas, July, 1972.

R3-70-210 - A select sample of very porous, fine grained, chalky limestone aggregate somtimes referred to as "soft rock," from the Texas Crushed Stone Company near Georgetown, Texas, March, 1970.

R3-70-217 - Natural limestone aggregate from Servtex Materials Company near New Braunfels, Texas, March, 1970.

R3-70-245 - Natural limestone aggregate from the Gifford-Hill Company near Bridgeport, Texas, April, 1970.

R3-72-103 - A hard, dense, igneous, black nephaline basalt aggregate, commonly referred to as "trap rock," from the White's Mines, Inc. plant at Knippa, Texas, May, 1972.

R3-72-107 - A hard, siliceous river gravel from the Fordyce Gravel Co. in Victoria, Texas, May, 1972.

R3-72-142 - Limestone rock asphalt aggregate from White's Mines, Inc. near Uvalde, Texas, June, 1972.

Petrographic analyses of the synthetic aggregates are included in the "Appendix" of this report.

V. TEST METHODS AND EQUIPMENT

1. Sieve Analysis: All sieve analyses were performed according to Test Method Tex-200-F. (See Appendix)

2. Specific Gravity and Water Absorption: The first figures for specific gravity and water absorption were determined according to Test Method Tex-201-F (See Appendix). The water absorption was determined after 24 hours inundation.

The second pair of figures for specific gravity and water absorption were determined as described in Test Method Tex-433-A (See Appendix), the water absorption being determined after 24 hours inundation.

The last pair of figures for specific gravity and water absorption were determined by Test Method Tex-109-E (See Appendix).

The 3/8"-1/4" size aggregate was chosen as the "standard" aggregate size for this investigation.

3. Unit Weight: The standard and rodded unit weights for the 3/8"-1/4" sized aggregate and for the aggregate graded "as received" were determined according to Test Method Tex-404-A (See Appendix).

4. Pressure Slaking: The first pressure slaking values were determined according to Test Method Tex-431-A (See Appendix) standard equipoise shaker method, testing the specified aggregate size 3/4"-No. 10. The second row of figures resulted from testing the 3/8"-1/4" size aggregate in the same manner. The last pair of pressure slaking

values resulted from testing the two sizes according to the "Alternate Method" of Tex-431-A (See Appendix).

5. Freeze and Thaw Test: The freeze and thaw test results were determined according to Test Method Tex-432-A (See Appendix). Each aggregate was sieved over the sieves indicated, after exposure to the freeze and thaw test.

It was decided that for comparative purposes and as a method for evaluating degradation materials would be sieved, after test, over the 1/4", No. 10, and No. 40 sieves, recording the passing sieve values. This was established as a standard procedure and practiced throughout the investigation.

6. Los Angeles Abrasion Test: The first row of figures containes the Los Angeles abrasion value of each aggregate sample, as determined by Test Method Tex-410-A (See Appendix). Each Los Angeles abrasion value is followed by the standard sieving procedure results, as described previously. The second Los Angeles abrasion value determinations resulted from testing the 3/8"-1/4" sized aggregate according to Test Method Tex-410-A (See Appendix).

The last set of Los Angeles abrasion data result from testing 3,000 gram samples of aggregate after 500 revolutions of the Los Angeles drum.

7. Bituminous Section Mill Test: The Bituminous Section mill consists of a Bain Marie pot clamped horizontally in a variable speed, rotating

collar. Experimental testing with this device early in the investigation (described in the interim report previously published in June, 1972) indicated the optimum test method. The pot used for these tests was the Bain Marie pot with four 1/2 inch square steel ribs running lengthwise of the pot. The procedure was to rotate the weighed dry sample for one hour at 72 r.p.m., remove the sample and perform the standard sieve analysis recorded in the tables. The standard 3/8"-1/4" sized aggregate was used for all tests, as shown in the tables.

8. Bituminous Section Motorized Press Test: This procedure utilizes the Bituminous Section gyratory-shear motorized molding press. For the first series of tests the aggregate was placed in the mold and the mold gyrated for 50 gyrations while the pressure was maintained at 150 p.s.i. gauge pressure with the hand pump. The material was then removed and sieved.

The next series of tests consisted of 50 gyrations of the mold at a constant gauge pressure of 150 p.s.i., then leveling the mold and applying 2,500 p.s.i. gauge pressure on the sample. The load was immediately released and the sample sieved.

The last series of these tests simply reversed the order of the second series. The 2,500 p.s.i. gauge pressure load was applied to the material in the level mold, then the mold was tilted and gyrated for 50 gyrations at a constant pressure of 150 p.s.i. gauge pressure. The material was removed and sieved.

All tests utilized the standard 3/8"-1/4" sized aggregate.

9. Sandblast Test: The "standard procedure" for the sandblast test was the test method described in "A Sandblast Abrasion Test for Synthetic Aggregate Evaluation" by James T. Houston, Asst. Professor, University of Texas at Austin and W. B. Ledbetter, Assoc. Research Engineer, Texas Transportation Institute, Research Report 81-8. The first row of figures is the result of testing the size of aggregate required by the test method. The remaining test samples were all the standard 3/8"-1/4" size aggregates as indicated.

The second group of tests exposed the aggregates to 2,400 grams of sand during the sandblast and the last, 3,600 grams of sand.

10. British Aggregate Crushing Value Test: The British Aggregate Crushing Value Test procedure is found in "Methods for Sampling and Testing of Mineral Aggregates, Sands and Fillers," British Standard 812:1960 of the British Standards Institution. The procedure was slightly modified to fit existing laboratory equipment.

The dry aggregate was placed in a manual gyratory-shear molding press mold. A total load of 35,555 pounds was applied at a rate such that the total load was attained in 10 minutes. The aggregate was then sieved through the standard sieves for this investigation.

The standard 3/8"-1/4" sized aggregate was used for all tests.

11. British Aggregate Impact Value: The British Aggregate Impact test involves the dropping of a 30 pound "hammer" 15 inches upon a confined aggregate sample. Fifteen blows complete the test. The aggregate is dry. The complete procedure may be found in "Methods for Sampling and Testing Mineral Aggregates, Sands and Fillers," British Standard 812:1960 of the British Standards Institution. The Aggregate Impact Value is the percent by weight of material passing the No. 7 British Sieve (U.S. Standard No. 8).

The Aggregate Impact Value and the standard sieve analysis for two aggregate sizes are recorded in each table.

VI. PROCEDURE

This investigation was officially proposed March 26, 1970. An interim report was issued June 1972 providing the details of the procedure followed and the results obtained from the inception of the investigation to that date. Following the recommendations of this first report, the procedure for the completion of the investigation was to simply reduce the number of tests and increase the number of samples being tested. Thus, working in conjunction with the Texas Transportation Institute's Research Study 2-6-71-83, samples of synthetic aggregates used in the roadway test sections at various locations around the State were obtained for testing, and additional samples from stockpiles at the plants along with plant samples from other synthetic and natural aggregate sources not included in the T.T.I. Study were taken for testing. The Districts of the Texas Highway Department cooperated by submitting extra large samples of synthetic aggregates for routine quality testing, providing adequate material for use in this project. The tests on all these aggregates were limited to those included in the tables and described previously under V. TEST METHODS AND EQUIPMENT.

VII. DISCUSSION

The data in the tables accompanying this report includes all the pertinent test results from the beginning of the investigation, for those procedures listed. As mentioned above, under "PROCEDURE," after the initial phase of this investigation the number of tests being performed were reduced to those thought to have shown promise. This reduction of test procedures permitted the testing of additional samples in the given time. For informational purposes the sieve analysis, specific gravity, 24-hour water absorption, and unit weight of each sample (other than routine samples) are included in the tables along with the other test data.

Each table of Tables I through V contains the test data from the testing of materials from one producer. The last columns in each of these tables provide the statistical analysis results.

Table VI contains the test results from testing only one sample from two synthetic aggregate sources and limited test results from testing six natural aggregates. The natural aggregates were included in this investigation for comparative purposes.

The statistical analysis data from Tables I through V are grouped together to form Table VII, "Statistical Analysis For Trends."

It should be noted that in Tables I through V all the materials identified with an "R3" number were submitted as Item 303, Grade 4 aggregates, sieve analyses to the contrary. The routine samples were of unknown gradations, except as indicated. Most of the tests involve sized aggregate and thus, to some extent, nullify the influence of gradation upon the majority of the test results.

An interesting observation is the variation of material from one source as reflected by the specific gravity determinations. This rather considerable variation is present in the aggregates from every source tested. A similar variation exists between the unit weight values of samples from any given source. These unit weight fluctuations take on added meaning when examined in the light of current specifications.

The aggregates with the higher pressure slaking values seem to perform more poorly than those with the lower values, the one exception being the Superock, Inc. material of Table V. This material consistently yields a comparatively high pressure slaking value but performs exceptionally well in all of the other tests.

Further work with the freeze and thaw test has indicated nothing to alter the criticisms made in the interim report of June 1972. In fact further testing has only justified these earlier observations. Examination of any portion of the freeze and thaw test data reveals the extremely poor reproducibility of this test method. As mentioned in the interim report, many variables are introduced into test results for which the test procedure is not responsible. However, these same variables are present to affect the test results from all test methods. Comparison of the freeze and thaw test reproducibility with that of any other method of test removes all doubt as to its poor performance. Although of questionable significance (to be discussed later), the statistical analysis supports this conclusion. The coefficient of variation for the freeze and thaw test, the statistical factor that defines repeatability numerically, is in a range by itself. No test method included in this investigation approaches this low level. The freeze and thaw test must remain suspect with regard to control testing, for its questionable performance is consistant.

The data from the various Los Angeles abrasion tests reveals a very high instance of repeatability. This is evidenced by the close agreement of individual ("A" and "B") test values. These pairs of samples are as close to being identical as is practical in a materials laboratory. This leads to the conclusion that, for the most part, the difference in the Los Angeles abrasion figures between different samples for any given test procedure is due to something other than the test procedure. On the negative side, the Los Angeles abrasion test does not very effectively separate synthetic aggregates from different sources.

The Bituminous Section Mill Test is another test of consistant repeatability between matching samples ("A" and "B" values). The disadvantageous feature of this procedure is that the test method is too "gentle." A greater loss as a result of abrasion and/or degradation is desirable.

Two Bituminous Section Motorized Press Test procedures were added to the procedure suggested for continued evaluation in the interim report of June 1972. The report recommended the continuation of the 50 gyrations at a constant 150 p.s.i. gauge pressure. The first modification of this procedure was to subject the aggregate sample to the 50 gyrations at constant 150 p.s.i. gauge pressure and then level the mold and apply a load of 2,500 p.s.i. The second modification was to reverse this procedure and apply the 2,500 p.s.i. gauge pressure load first, then follow through with the 50 gyrations at constant 150 p.s.i. gauge pressure. The purpose for these modifications was to increase degradation. Applying the load after the gyrations increased the degradation only slightly, but the data very definitely shows a considerable increase in degradation when the load is applied before the gyrations. This last procedure shows promise. It has good repeatability, it differentiates between the aggregates, and the degradation is severe enough to provide good, workable figures. An advantage is that this procedure uses equipment readily available. A serious disadvantage is that the procedure abuses the motorized press. The press was not designed for the abrasive stress exerted during testing. Should this procedure ever be considered for extensive use, a heavy duty press should be developed.

The sandblast test is unique in that it is pure abrasion. It suffers from the same undesirable characteristic as does the Bituminous Section Mill Test. It is too gentle. The procedure does not abrade the materials sufficient to produce the desirable loss, and it does not adequately separate the materials.

The British Aggregate Crushing Value test procedure shows some merit. It appears to have satisfactory repeatability, it differentiates between materials, and it yields adequate loss figures. Some slight abrasive action may take place during testing, but the degradation of aggregates is primarily due to aggregate fracture resulting from the direct compressive load. This test may prove helpful in evaluating aggregates.

Aggregates respond to the British Aggregate Impact Value test in a manner similar to their response to the British Aggregate Crushing Value test. It, too, is basically an aggregate fracture test. It is a simple, quick test using a minimum of unsophisticated equipment. As mentioned in the interim report, the undesirable aspect of this procedure is the sample size. It is small. This may be overcome somewhat by the fact that a number of tests can be run in a brief period of time.

Table VII contains the grouping of the "Statistical Analysis For Trends" from each table of Tables I through V. The statistical analysis includes the arithmetic mean ($\bar{X}$), the standard deviation (σ), the coefficient of variation ($C_V\%$), and the range (R). The value of this analysis is doubtful. To properly evaluate a test procedure from a statistical standpoint many tests should be run using identical samples such that any variation in the test results will be due to the test (equipment, procedure, or human factor) and not due to the material. This of course is not the case in this investigation. The considerable variations in the aggregate samples possible through any number of sources could result in either positive or negative reflections in the statistical analysis. Though some insight may be gained through study of the statistical analysis, caution should be exercised, for the numerically expressed "trend" may be misleading.

As this investigation comes to completion a stalemate has been reached. At the beginning of this report it was mentioned that this investigation included cooperation with the Texas Transportation Institute in their Research Study 2-6-71-83. The field test sections utilizing the indicated aggregates of this investigation have been periodically examined and evaluated with respect to actual performance under traffic. Though many variables were introduced into the construction of these sections that prevent considering and evaluating the aggregate alone, no section of any test area has revealed poor aggregate performance as rated by D-9 representatives. Some sections do appear better than others, but close examination finds the aggregate particles intact with no signs of excessive abrasion and/or degradation. All aggregates have performed well to date. Thus, the stalemate in this investigation.

Before a test method and specification can be chosen with confidence, materials that have definitely failed in the field must be subjected to testing to establish a pass-fail value. Anything short of this is conjecture, subject not only to severe, justifiable criticism but to complete rejection by knowledgeable personnel. Since proven unsatisfactory materials have not been available for laboratory testing, a test procedure has not been singled out nor a specification suggested as a new approach to evaluating surface treatment aggregates.

APPENDIX

PETROGRAPHY AND POLISH VALUE DETERMINATIONS FOR

FEATHERLITE-RANGER SYNTHETIC AGGREGATE SAMPLES

3-06-70-017

I. INTRODUCTION

The Featherlite Corporation, Ranger Plant is located at the north edge of the city of Ranger in Eastland County, Texas. The plant, which utilizes a gray shale from the Brad Formation (Pennsylvanian Age), has been operating at its present site since 1952. Raw material from pits south of town, in addition to nearby shale quarries, is obtained for kiln feed. Primary production is from three 10' x 150' rotary kilns.

II. PETROGRAPHIC ANALYSIS

Five samples submitted over an eight-month period have been examined individually but will be treated jointly in this report. Representative particles numbering 250-300 from each sample have been examined microscopically. Each sample has been compared to one another and to Featherlite-Ranger samples previously examined and reported in the report 3-06-70-017(1) dated June 1972.

Externally, the Ranger samples vary in color from gray to black; whereas, internally the color ranges from pale gray, to medium gray to jet black. Less than 1-2% include the mentioned extremes and less than 1% are orange in color.

The degree of bloating ranges from highly vesicular to absent, the latter case being rare. Figures 1 and 2 illustrate typical particle types in terms of bloating and rind development. Most particles have a rind which is generally very thin. The rind on the particle shown in Figure 2 is exceptionally thick. A small percentage of particles have internal cracks mostly parallel to the bedding planes and a few have been noted with mineral inclusions (Fig. 4). Although rare, some particles are composed of fines fused into conglomerates (Fig. 3).

Thin-section analysis shows that the Ranger material has a fairly uniform amorphous matrix with essentially no birefringent mineral and only a few opaque types. Particle hardness (Moh's Scale) is generally 6-7 with interior portions somewhat brittle.

III. POLISH VALUE DETERMINATIONS

The Ranger samples were each subjected to an accelerated polishing action by means of the British Polishing Machine in accordance to Test Method Tex 438-A. The frictional measurements were made with a British Portable Tester in accordance to ASTM Designation: E 303. The results of this test are summarized as follows:

Sample #	Polish Value
R3-72-152	44
R3-72-158	42
R3-72-172	39
R3-72-193	44
R3-73-61	38

Figures 5 and 6 show typical Ranger material after 9 hours of the accelerated polish test. The particles are typically angular to subangular and, when the rind has been abraded, a vesicular interior is common. Gradation, average thickness of the rind and number of crushed faces apparently affect the polish values to some degree. However, over the past three years the Ranger material has had polish values averaging in the low 40's and has varied very little.

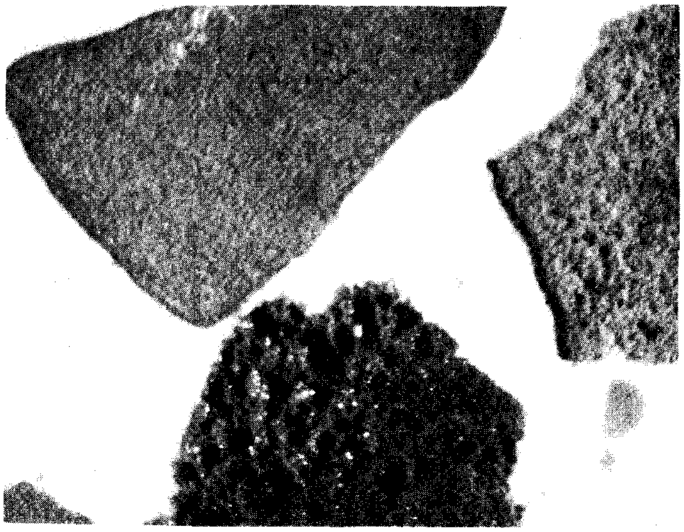


Figure 1. Sample of Featherlite-Ranger showing typical particle types. (Mag. 7-1/2X)

Figure 2. Particles showing interior colors from gray to black and the development of a thick rind. (Mag. 7-1/2X)

Figure 3. A conglomerate particle. (Mag. 7-1/2X)

Figure 4. Particle containing a carbonate mineral inclusion. (Mag. 7-1/2X)

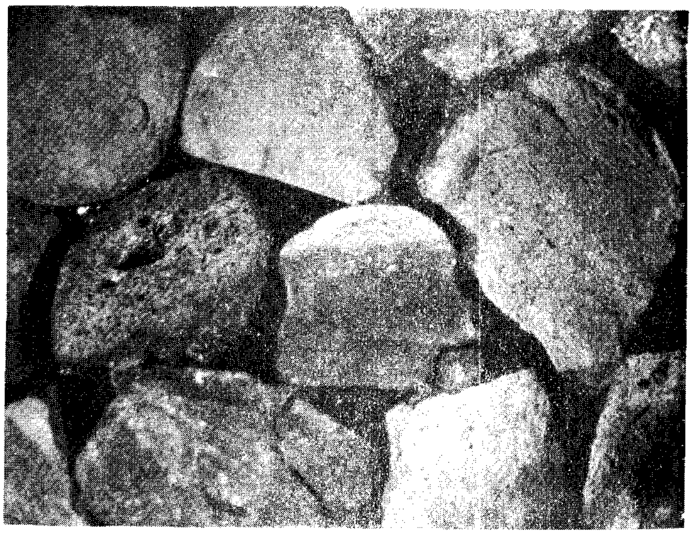


Figure 5. Polish value specimen after 9 hours on the accelerated polishing machine.

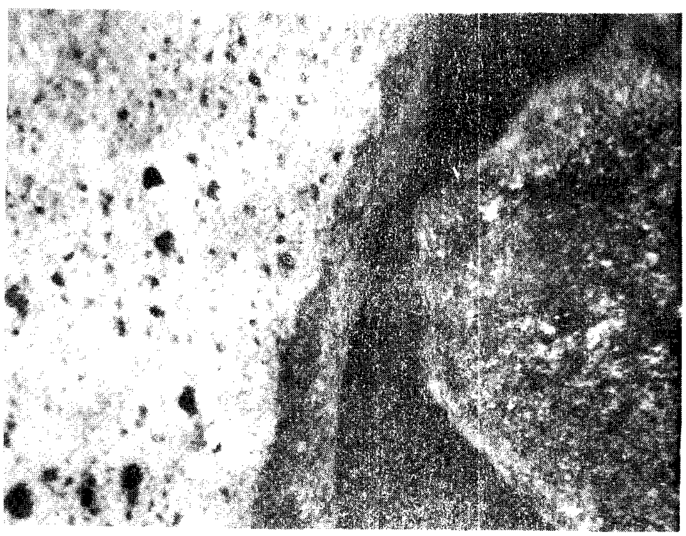


Figure 6. Close-up of above sample showing vesicular structure.

PETROGRAPHY AND POLISH VALUE DETERMINATIONS FOR

TXI-EASTLAND SYNTHETIC AGGREGATE SAMPLES

3-06-70-017

I. INTRODUCTION

Texas Industries, Inc., Eastland Plant, is located 1/2 mile northwest of Eastland on the Texas and Pacific Railroad. A gray shale from the upper Caddo Creek Formation (Pennsylvanian Age) is quarried from an open pit about 5 miles south of the plant and serves as raw material for the lightweight aggregate plant. Four rotary kilns, three 6' x 60' and one 7' x 100' are currently utilized.

II. PETROGRAPHIC ANALYSIS

The four samples of TXI-Eastland aggregate submitted over an eight-month period have been examined individually but are treated jointly in this report. Some 300 particles from each sample have been examined microscopically and compared to one another and to previously examined samples reported in the report 3-06-70-017(1) dated June 1972.

The samples of Eastland material are gray in color externally with 5-10% black and yellow-orange particles. Internally, the colors are mostly gray with some black and yellow-orange. In many particles the internal vesicules tend to show lineation parallel to bedding planes. Figures 1 and 2 illustrate typical particles with bloating indexes from highly bloated to slight.

A well-developed rind is very thin to absent; however, the external surfaces are normally glazed. The internal matrix is typically well transformed amorphous silicates with very little to no birefringent minerals. A few opaque matallic oxide minerals have been noted as well as an insignificant quantity of unfused quartz. Internal cracks are not significant.

III. POLISH VALUE DETERMINATIONS

Each of the Eastland samples have been subjected to the accelerated polish test in accordance to Test Method Tex 438-A. The frictional measurements have been made with a British Portable Tester in accordance to ASTM Designation: E 303. The results of this test are summarized as follows:

Sample #	Polish Value
R3-72-159	41
R3-72-171	40
R3-72-192	41
R3-73-60	43

Figure 3 illustrates typical abraded particles after 9 hours of the polish test. The above listed values agree with other Eastland samples tested during the past 3 years.

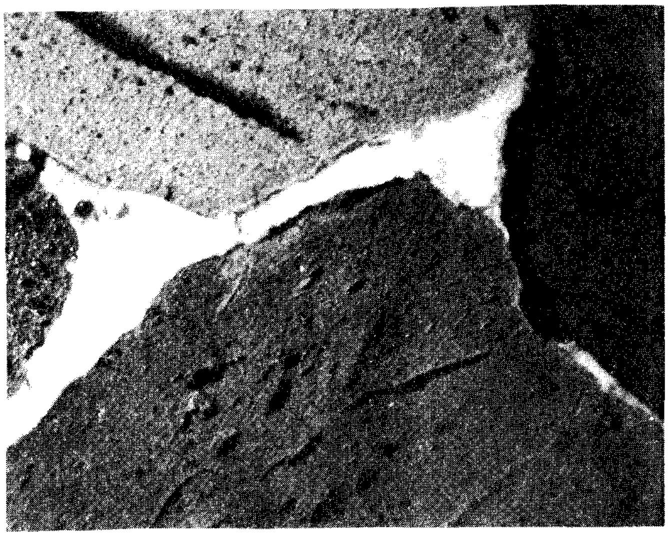


Figure 1. Particles of TXI-Eastland material showing internal bloating features. (Mag. 7-1/2X)

Figure 2. Particles of TXI-Eastland. (Mag. 7-1/2X)

Figure 3. View of polish value sample showing abraded particles of TXI-Eastland material. (Mag. 3X)

PETROGRAPHY AND POLISH VALUE DETERMINATIONS FOR

TXI-DALLAS SYNTHETIC AGGREGATE SAMPLES

3-06-70-017

I. INTRODUCTION

Texas Industries, Inc., has its Dallas plant located at Eagle Ford on Chalk Hill Road just north of the Dallas-Fort Worth Turnpike and 1 mile east of Loop 12. Olive-gray shale from the Eagle Ford Formation (Upper Cretaceous Age) is quarried from an open pit located 1/2 mile southwest of the plant and serves as raw material for the kiln feed.

II. PETROGRAPHIC ANALYSIS

Four samples from TXI-Dallas have been submitted for this study over an eight-month period but are treated jointly in this report. About 300 particles from each sample have been examined both externally and internally and compared to other samples and to previously examined material from Dallas reported in the report 3-06-70-017(1) dated June 1972.

Externally, the Dallas material is characteristically dark gray with 25-30% tan to yellow-orange colored particles. Internally, the ratio of yellow-orange to dark gray particles is slightly less than above percentage. The most diagnostic internal features, however, are the pronounced polygonal and random crack patterns in addition to well-developed expansion cracks parallel to the original bedding planes. No external rind is found in the Dallas material; however, the particle surfaces are very faintly glazed. The internal bloating ranges from highly to slight and non-transformed mineral inclusions are insignificant except for occasional grains of quartz. Metallic oxides are common and entrapped hydrogen sulfide gas frequently gives odor to freshly crushed particles. Examination of raw shale from the pit reveals the presence of appreciable quantities of iron pyrite (FeS_2) and hematite (Fe_2O_3). Also, large iron carbonate and calcium carbonate concretions commonly occur in the Eagle Ford shale at the quarry site.

III. POLISH VALUE DETERMINATIONS

Each of the TXI-Dallas samples have been subjected to the accelerated polish test in accordance to Test Method Tex 438-A. The frictional measurements were taken with a British Portable Tester in accordance to ASTM Designation: E 303. The results of this test are summarized as follows:

Sample #	Polish Value
R3-72-157	51
R3-72-170	46
R3-72-191	50
R3-73-59	50

Due to the degree of bloating and brittleness of the internal structure of the Dallas material, many particles in the polish value specimens would show extensive abraded loss. Some particles would increase in frictional character during the polish test. Figure 3 shows typical particles after the 9 hour test period.

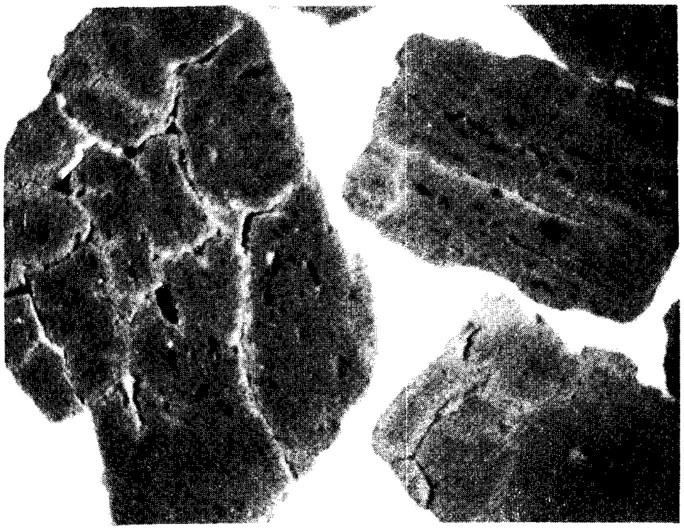


Figure 1. Typical crack patterns found in 85-90% of the TXI-Dallas material. (Mag. 4X)

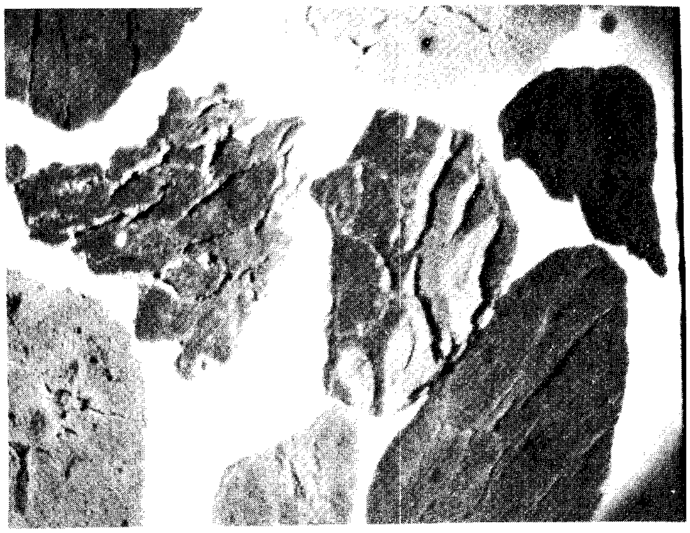


Figure 2. Additional particles of the Dallas material showing internal structure and cracks. (Mag. 3X)

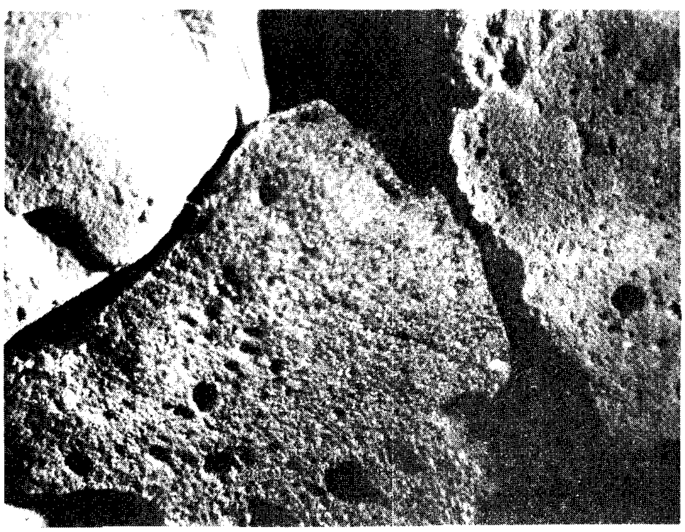


Figure 3. Polish value sample showing highly abraded particles with vesicular structure. (Mag. 7X)

PETROGRAPHY AND POLISH VALUE DETERMINATIONS FOR

TXI-CLODINE SYNTHETIC AGGREGATE SAMPLES

3-06-70-017

I. INTRODUCTION

Texas Industries, Inc., Clodine plant, is located about 2-1/2 miles southwest of Clodine in northeastern Fort Bend County, a few miles west of Houston. Clay from the Beaumont Formation (Quaternary Age) is quarried nearby and utilized as raw material for the rotary kiln process. The clay is generally brown in color and contains varying amounts of carbonaceous materials, iron oxide and iron carbonate pellets and concretionary bodies as well as appreciable quantities of quartz sand.

II. PETROGRAPHIC ANALYSIS

Five samples from the Clodine source have been submitted for this study over an eight-month period but are treated jointly in this report. The samples have been examined both externally and internally and compared to each other and to other previously examined material from Clodine reported in the report 3-06-70-017(1) dated June 1972.

Externally, Clodine production ranges from a pale olive gray to black with a small percentage of yellow-orange particles. Internally, the colors are generally light to dark gray. Bloating ranges from absent to moderate (Figures 1-6) and although no rind is clearly developed, many particles have an external discolored layer and most are glazed.

About half of the particles have well-developed internal random cracks and in some the cracks follow bedding plans (Fig. 3). One diagnostic feature is the presence of minute concretionary bodies which generally differ in bloating character from the surrounding matrix (Figures 1 and 4). Better than half of the particles contained unfused-quartz sand (Figures 1, 2 and 6).

III. POLISH VALUE DETERMINATIONS

Each of the five TXI-Clodine samples have been subjected to the accelerated polish test in accordance to Test Method 438-A. The frictional measurements were taken with a British Portable Tester in accordance to ASTM Designation: E 303. The results of this test are summarized as follows:

Sample #	Polish Value
R3-72-153	52
R3-72-160	49
R3-72-169	49
R3-72-194	51
R3-73-90	53

Figures 5 and 6 illustrate the textured surface of the Clodine material after 9 hours of the polish test. Figure 6 shows sand grains embedded in a slightly bloated matrix which add to the frictional character of the microtexture.

Figure 1. Particle of TXI-Clodine material showing typical crack pattern, low degree of bloating and concretionary inclusion. (Mag. 7X)

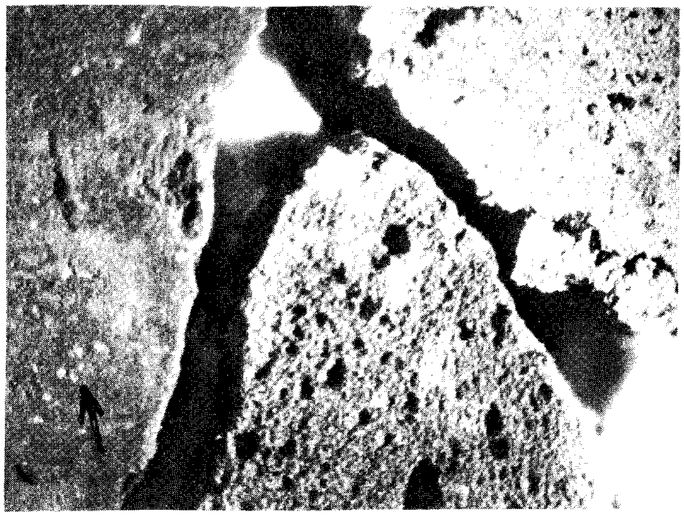


Figure 2. Particles showing various bloating character and quartz sand inclusions. (Mag. 7X)

Figure 3. Particle showing low degree of bloating and crack along bedding planes. Sand grains are indicated with arrow. (Mag. 7X)

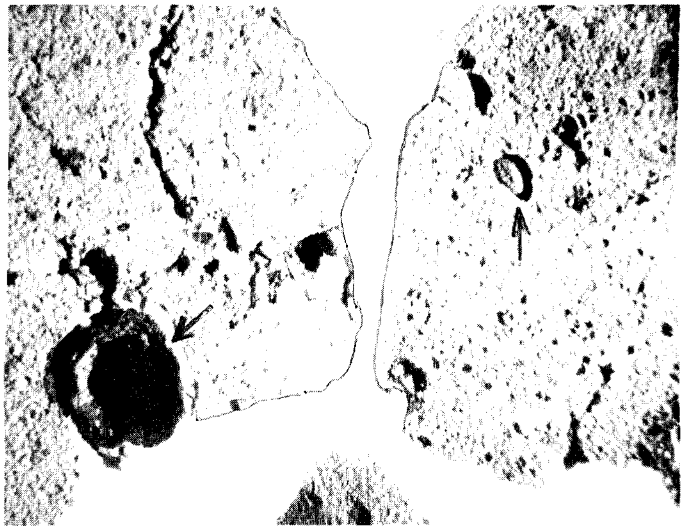


Figure 4. Typical concretionary bodies noted in TXI-Clodine material. (mag. 7X)

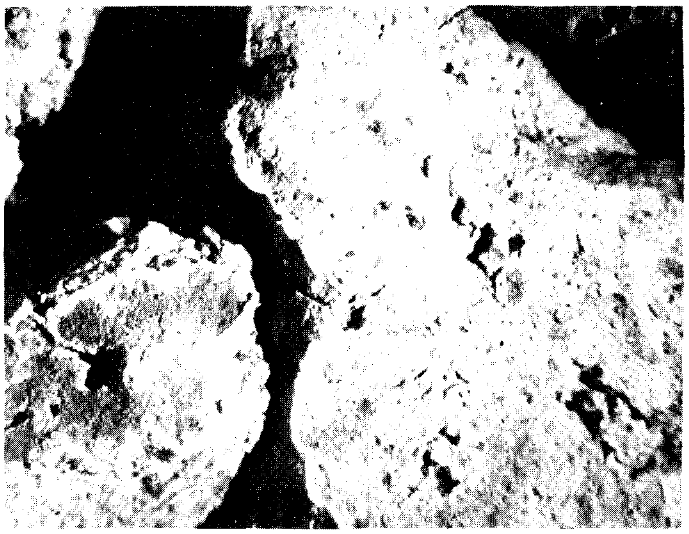


Figure 5. Clodine material showing type of abrasion after accelerated polish test. (Mag. 7X)

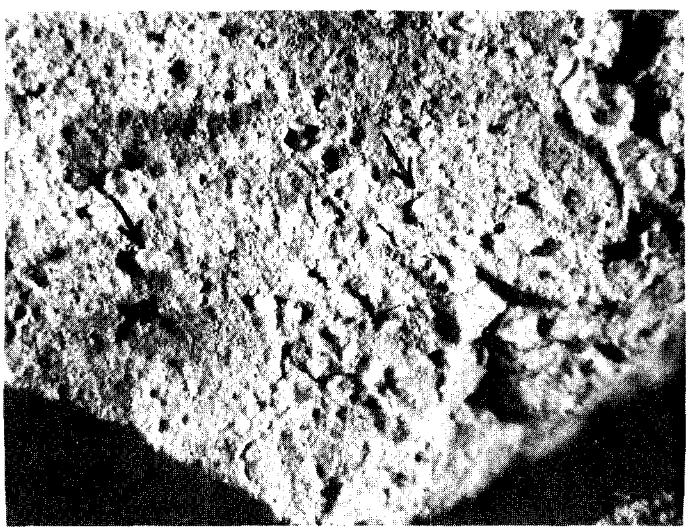


Figure 6. Close-up of a particle after the polish test showing microtexture resulting from sand inclusions. (Mag. 15X)

PETROGRAPHY AND POLISH VALUE DETERMINATION FOR TROTTI AND THOMPSON-BEAUMONT SYNTHETIC AGGREGATE SAMPLE 3-06-70-017

I. INTRODUCTION

The plant of Trotti and Thompson, Inc., is located on Washington Boulevard just north of IH-10 in west Beaumont, Jefferson County. Clay from the Beaumont Formation (Quaternary Age) is quarried from a nearby open pit and utilized in the rotary kiln process. The finished material is a non-bloated burned clay. The plant went into production in the mid 1960's. Two kilns are currently in operation.

II. PETROGRAPHIC ANALYSIS

The single sample submitted for this study consisted of an orange to brownish-red colored burned clay. The external color is fairly uniform; however, some of the particles have interior colors ranging from yellow to gray. Diagnostic features include internal shrinkage cracks which follow highly contorted bedding planes (Figures 1-3). Unfused quartz sand grains are common in 50-60% of the particles. Other mineral inclusions are common and sometimes form minute bloated spots. A well developed rind is absent, although a thin darker orange colored zone occurs at the surface of most particles.

Characteristically, the material has a dull earthy external coating and much of the production looks like well-rounded "mud balls." However, when crushed or broken the particles are very irregular. Observations show the material to be very absorptive.

III. POLISH VALUE DETERMINATION

The Trotti and Thompson sample has been subjected to the accelerated polishing test in accordance to Test Method Tex 438-A. The frictional measurements have been made with a British Portable Tester in accordance to ASTM Designation: E 303. The results of this test are as follows:

Sample #	Polish Value
R3-72-150	43

The typical irregular surface character and sand inclusions can be seen in Figures 4-6. These features are the apparent factors affecting the non-polishing nature of this material.

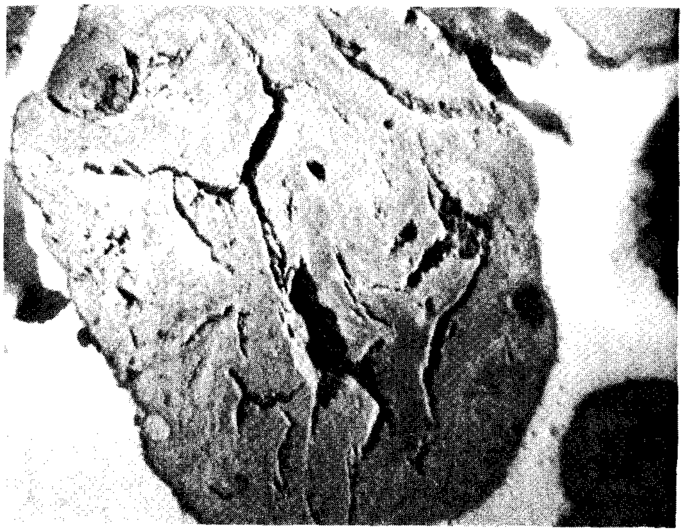


Figure 1. Particle of the Trotti and Thompson-Beaumont material showing typical internal crack pattern. (Mag. 7X)

Figure 2. Particles showing the absence of a rind and non-bloated nature of the burned clay. (Mag. 7X)

Figure 3. Particle showing cracks along the contorted bedding planes. The external color is orange and the interior is gray. (Mag. 7X)

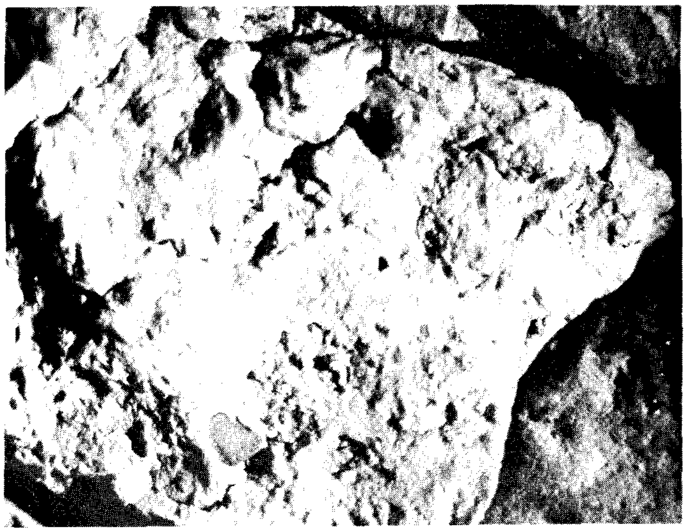


Figure 4. Surface features of a particle in a polish value sample after 9 hours of testing. (Mag. 7X)

Figure 5. Particle showing microtexture resulting from sand inclusions in addition to crack systems. (Mag. 7X)

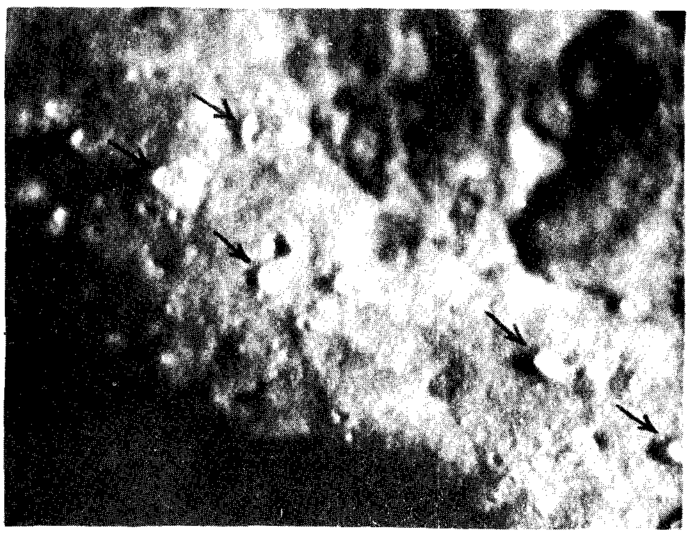


Figure 6. Close-up of above particle showing microtexture brought about by quartz sand inclusions. (Mag. 50X)

PETROGRAPHY AND POLISH VALUE DETERMINATION FOR

SUPEROCK-STREETMAN SYNTHETIC AGGREGATE SAMPLE

3-06-70-017

I. INTRODUCTION

The Superock, Inc., Streetman Plant is located 2 miles north of Streetman and about 2 miles east of I-45 along the Burlington and Rock Island Railroad in southeastern Navarro County. The plant was built in early 1972 and production had commenced by the end of the year. Currently a single 12 x 250' rotary kiln is in use. Shale in the Wills Point Formation (Eocene Age) is quarried nearby and utilized for kiln feed.

II. PETROGRAPHIC ANALYSIS

The single sample submitted for this study is tannish brown in color with some light gray and orange-brown particles. Earlier production from Superock was predominantly orange-brown in color. Internally, the material is uniformly gray-black in color. The degree of bloating is generally moderate to high with many particles containing isolated "exploded" gas voids (Figures 1-3). An impervious rind is developed on 80-90% of the particles. The texture externally varies from smooth to rough depending on the sculpturing on the surface (Figures 4-6). About 40-50% of the particles have polygonal crack patterns (Figure 3) which are slight to moderately developed. Often these cracks have been "healed" during the later stages of firing; however, a discolored oxidation zone is traceable where the crack had been.

III. POLISH VALUE DETERMINATION

The Superock sample has been subjected to the accelerated polishing test in accordance to Test Method Tex 438-A. The frictional measurements have been made with a British Portable Tester in accordance to ASTM Designation: E 303. The result of this test is as follows:

Sample #	Polish Value
R3-73-97	46

The microtexture resulting from particle character can be seen in Figures 4-6. Even when unabraded most of the Superock particles exhibit sculptured and highly frictional surfaces. The glazed rind is relatively tough and when abraded often forms an edge with a higher relief than the vesicular interior (Figures 4 and 5).

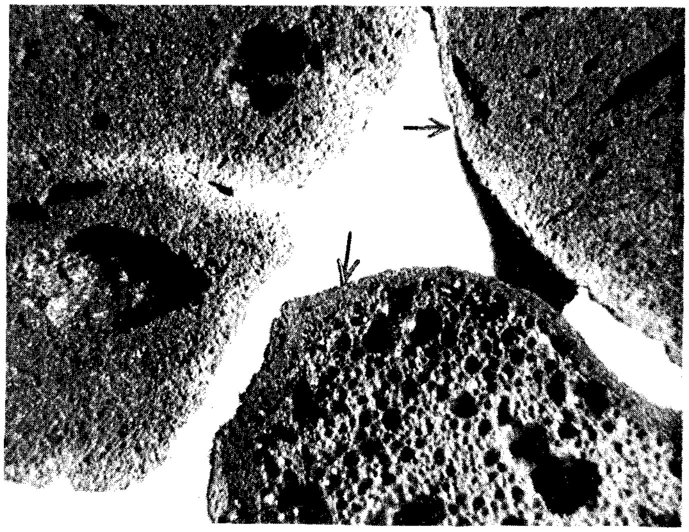


Figure 1. Particles of Superock aggregate showing bloating features and rind development. (Mag. 7X)

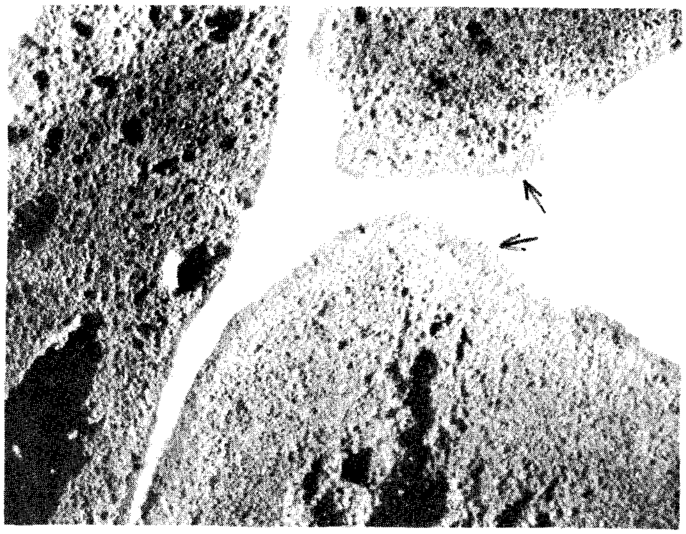


Figure 2. Superock material with a rind. Note irregular shaped voids. (Mag. 7X)

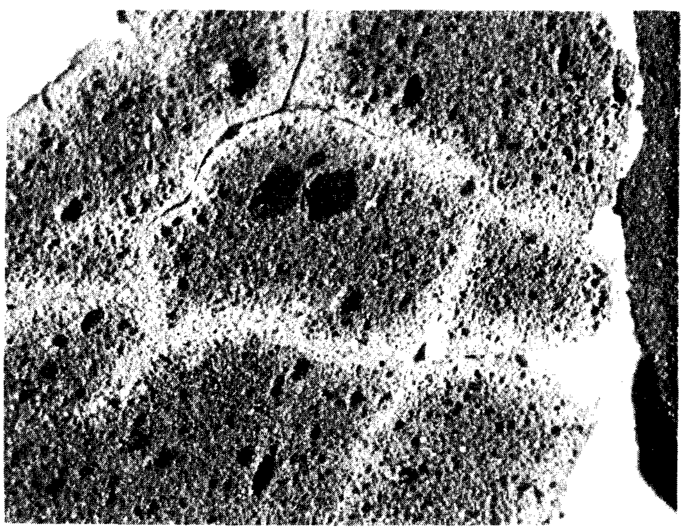


Figure 3. Typical crack pattern noted in some of the Superock material. The cracks and their traces have an adjacent discolored zone. (Mag. 7X)

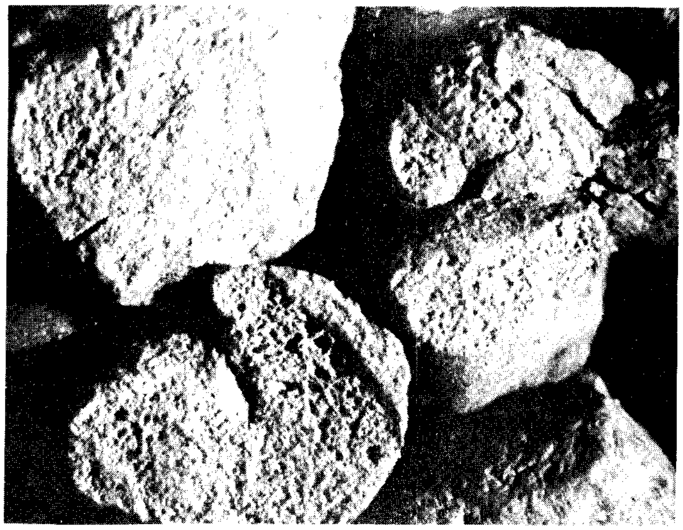


Figure 4. Superock material after the accelerated polishing test.
(Mag. 7X)

Figure 5. Same as above. Note more resistant rind in relief after the polish test.
(Mag. 7X)

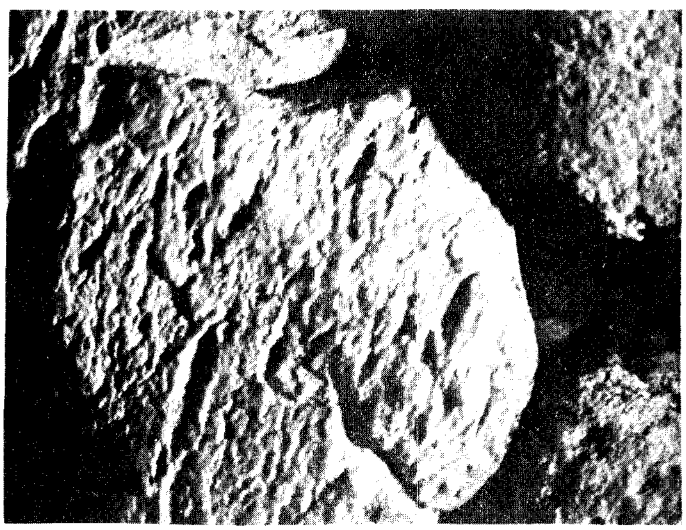


Figure 6. Sculptured exterior surface resulting from expansion of the entire particle.
(Mag. 7X)

Texas Highway Department

Materials and Tests Division

PRESSURE PYCNOMETER METHODS FOR DETERMINATION OF SPECIFIC GRAVITY, MOISTURE CONTENT AND FOR SLAKING OR WETTING MATERIALS

Scope

(This procedure consists of four parts.)

In Part I the pressure pycnometer is used to find the percent moisture and the specific gravities of soils by weighing and measuring the volume of soil solids and moisture by elimination of air voids through the use of pressure and absorption. If a sufficient number of specific gravities have been predetermined to justify assignment of a value, the use of a high pressure pycnometer will expedite moisture density control tests because oven drying of samples will not be required. When neither specific gravity nor moisture content are known, both can be found from the same sample, but oven drying will be required.

As described in Part II, this device or a pressure vessel may also be used to saturate and slake a sample of soil and water by forcing water under high pressure into the voids, thereby reducing the time required for air drying and saturation of samples subjected to the wet method of preparation of soil binder.

In Part III, the pressure vessel is also used to saturate a specimen of soil-bituminous material by forcing water into the voids under high pressure in a very short period of time. Protection is given the specimen during this pressurization procedure to prevent its loss of structure.

Part IV has been added to give the method of pressure wetting bituminous hot mix stabilized base (black base) in which the pressure restrainers from Part III are not used. The specimen is pressure wetted using hot water that is forced into the voids, which wets the material in a very short time. The pressure apparatus is protected from scratches and dents through the use of plastic bags or buckets.

PART I

DETERMINATION OF ABSOLUTE SPECIFIC GRAVITY AND MOISTURE CONTENT

Apparatus

1. Suitable high pressure pycnometer and pump, see Figure 1.

2. Same as listed in Test Method Tex-103-E.

3. A supply of plastic bags.

4. Butcher knife, syringe, etc.

5. A source of compressed air, or other suitable gas capable of furnishing 100 pounds pressure during tests.

Procedure

1. Select an adequate representative sample, ranging from 5 to 15 pounds*.

2. Slice any clay lumps, which might exist in the sample, to a maximum thickness of 1/4-inch. In this operation, precautions should be taken to avoid the loss of any more moisture than is absolutely necessary.

3. Place sample in plastic bag, weigh, and subtract weight of plastic bag, and record as W. If the sample is weighed out to an exact ten pounds or any convenient percent thereof, then the calculations under step 16 can be replaced by available tables.

ZERO DETERMINATION FOR WATER ONLY***

4. Fill lower portion with ample amount of zeroing water to cover sample (which will be introduced in step 12) usually about 6 to 8 inches.

5. Place piston, with vent plug removed, in pressure pycnometer. Press gently until water is barely visible in vent plug opening.

6. When water level in opening is properly adjusted, screw in plug tightly.

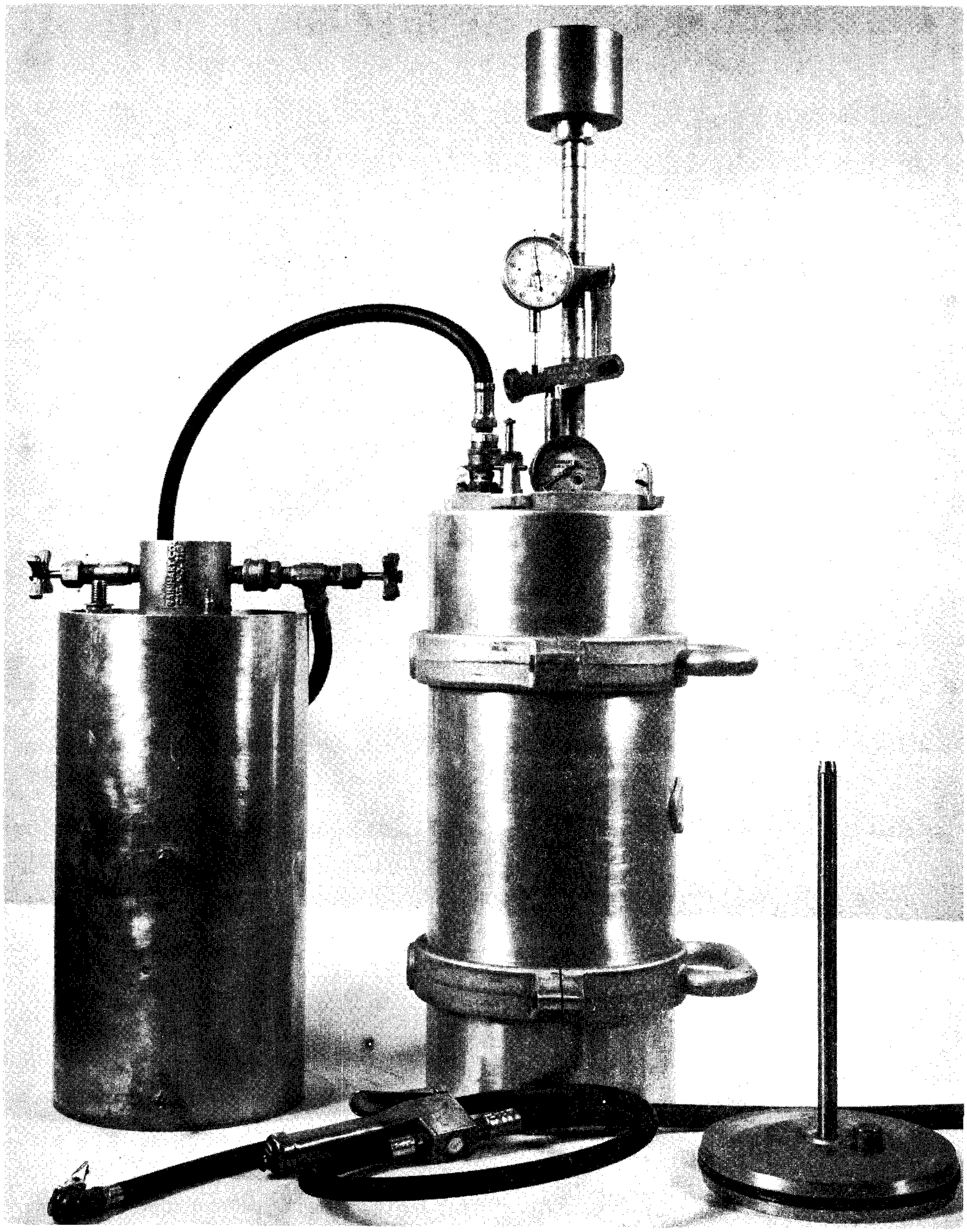
7. Fill remainder of pressure pycnometer with water to the shoulder and insert head of pycnometer with release valve open so that water overflows. Then fasten head securely.

8. Apply pressure to water reservoir with high pressure water pump** with water reservoir valve open. When pressure gauge indicates line pressure, close water reservoir valve. Move air pressure line to bottom stem on Prespump. Pump to 1200 psi.

*Such as might be obtained from digging a hole for density tests.

**See manufacturer's instructions for operation.

***Although almost any convenient temperature may be used for running tests in Part I, precautions should be taken to prevent any significant change in temperature during any single test.



Pump   Air Supply   Pycnometer   Piston

Figure 1

9. Set dial indicator on piston rod at zero by selection of calibrated spacers for coarse adjustment and micrometer screw for fine adjustment and lock adjustment.** Carefully recheck pressure and readjust, if necessary, then remove dial indicator.

NOTE: In determining the zero setting in using the pressure pycnometer, the dial indicator lever arm must always be zeroed below the horizontal or in the "down" position. Zeroing with the arm above the horizontal gives erroneous results.

10. Release pressure and remove head. Drain water and wipe all parts until dry.

11. Extrude piston** and remove vent plug and set aside without losing any zeroing water from bottom of piston or pycnometer.

VOLUMETRIC DETERMINATION OF SAMPLE***

12. Place sample, mentioned in step 3, in water in pressure pycnometer so that water overflows into the bag without washing out soil.

13. Replace piston in pressure pycnometer as indicated in steps 5 and 6. If water overflows, raise piston and by use of a pre-wetted syringe, suck up water and return through vent opening.

14. Fill remainder of pressure pycnometer with water and pump to 1200 psi. as set forth in steps 7 and 8. Maintain this pressure for a minimum of 15 minutes. Care must be taken to reproduce exact pressure gauge reading that was used in setting zero dial indicator in step 9.

15. By selection of calibrated spacers, etc.** (see step 9), set dial indicator on piston rod and record volume of solids and moisture displaced in pycnometer as V_1 from which the volume of the plastic bag must be subtracted to obtain V. The volume of the bag can be determined using the bag as the sample in steps 1 to 15 in Part I. The use of plastic bags of uniform volume or weight is highly desirable in order to avoid repetitious volume determinations.

16. Calculations (The use of high pressure pycnometer tables will replace most calculations as expressed in the formulas given below.)

$$DW = W - \frac{GV - W}{G - 1}$$

and

$$M = \left(\frac{GV - W}{G - 1} / DW\right) 100$$

Where:

W = Total weight of sample

DW = Oven-dry weight of sample. If sample is from density determination, divide DW in lbs. by volume of hole in cu. ft. for density in lbs./cu.ft.

V = Volume displaced by sample (solids and water).

G = Specific Gravity of solids

M = Moisture content expressed as a percentage of dry weight.

If specific gravity has not been previously determined, remove sample from pressure pycnometer and oven dry at 230° F. and determine DW.

Then $G = \frac{DW}{V - (W - DW)}$ or if a separate representative moisture content sample is used to find M

and DW, $G = \frac{W}{V - (W - DW)\ (1 + \frac{M}{100})}$ and $DW = \frac{W}{1 + \frac{M}{100}}$

Conventional C and D scales of slide rules may be used for calculation where weight of moisture =

$$\frac{GV - W}{G - 1} = \left(\frac{W}{G - 1}\right)\left(\frac{GV}{W} - 1\right)$$

(1) Set C scale index to G on D scale.

(2) Move cursor to V on C scale. $\frac{GV}{W}$

(3) Set W on C scale under cursor.

(4) Record value (1 to 2) on D scale and subtract one.

(5) Set cursor at W on D scale. $\frac{W}{G-1}$

(6) Move C scale until G-1 is at cursor.

(7) Move cursor over C scale to value found in step 4.

(8) Read answer under cursor on D scale. Subtract this weight of water from W to obtain DW or dry weight.

$$\left(\frac{W}{G-1}\right)\left(\frac{GV}{W} - 1\right)$$ For (7) & (8) above

17. Record data on Pressure Pycnometer Work Sheet, Figure 6.

Note: The use of the pressure pycnometer for determining specific gravities is based on the fact that air, and any other gases in the material being tested, is absorbed in the water at pressures well below the 1200 psi being applied. Also at 1200 psi, water is forced into the voids of the material to completely saturate it. This occurs much faster in some materials than others and is particularly noticeable in specific gravity determinations when the dial indicator needle continues to move while under 1200 psi pressure, even after 15 minutes. Therefore, in order to expedite the determination of the combined specific gravity (or asphalt determination) of a fresh field or plant mix of bituminous mixture (or a core taken from the pavement), it may be important that the material be well broken up and placed loose in a plastic bag in the pycnometer. The final reading on the dial indicator should not be taken until movement of the dial hand stops, even though fifteen minutes has been exceeded.

When determining the percent asphalt through the use of the pressure pycnometer, it is suggested that the sample, pycnometer and water be at, or near, 90°F. More accuracy can be obtained by mixing test size batches of aggregate and known asphalt content and determining the combined specific gravity (and asphalt content) at, say, 75°F, 90°F and 110°F. From these data the temperature giving the most accuracy can be extrapolated.

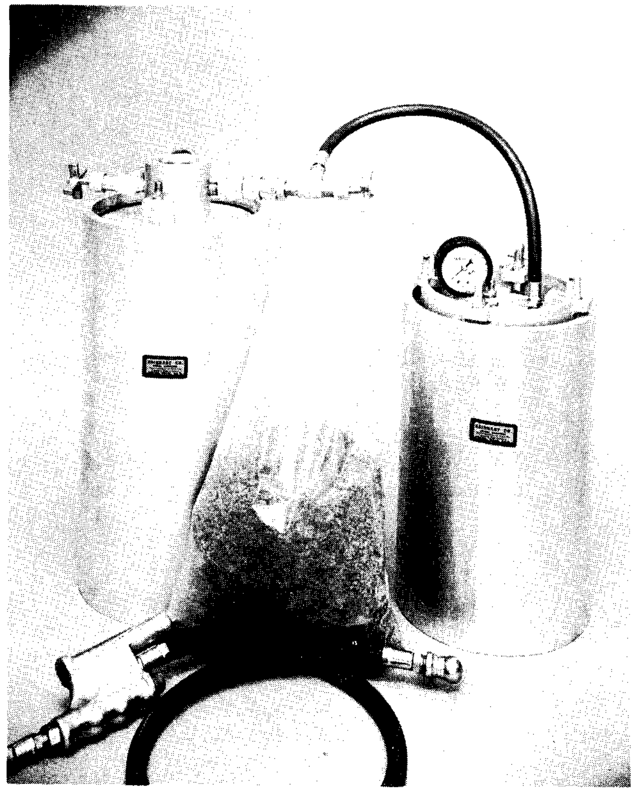


Figure 2

PART II

SATURATION FOR SLAKING OF SOILS

Apparatus

1. Pump and pressure vessel as shown in Figure 2. It is possible to use the pressure pycnometer instead of the pressure vessel, except volumetric measuring equipment (piston, dial indicator, etc.) are eliminated.

Procedure

1. Select suitable size sample for soil constants and gradation (see Test Method Tex-100-E).

2. Prepare sample by chopping or breaking clay lumps into minus 1/4-inch thick slices and place in plastic bag.

3. Place bag in pressure vessel and fill both with water to the shoulder so as to avoid washing soil out of plastic bag.

4. Place head in pressure vessel and press down until water flows out of release valve.

5. Fasten head securely and apply the line pressure (approximately 80 pounds) with the high pressure water pump, then close the valve.

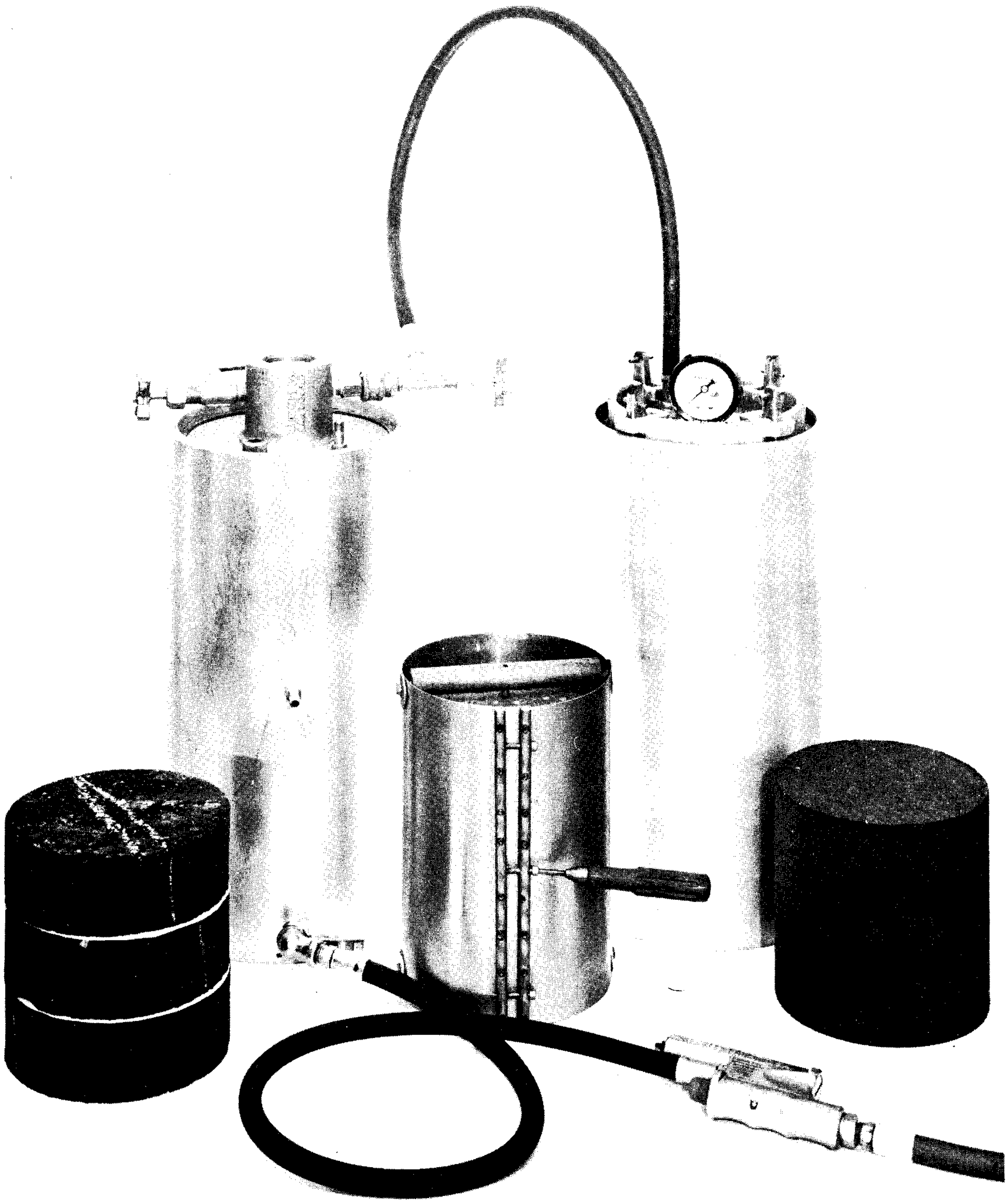
6. Apply pressure until 1200 psi. is read on the gauge and maintain this pressure for at least 15 minutes.

7. Release pressure, remove head and remove sample for washing and preparing as set forth in Test Method Tex-101-E.

PART III

WETTING OF BITUMINOUS MIXTURES FOR COHESIOMETER TESTS

NOTE: Details for wetting triaxial specimens are given in Test Method Tex-119-E.



Prespump

Presves

Specimen in Restrainer

Cohesiometer Specimens

Soil Asphalt Specimen

Figure 3

PRESSURE RESTRAINER ASSEMBLY USED IN WETTING OF BITUMINOUS TREATED SPECIMENS BY PRESSURE VESSEL

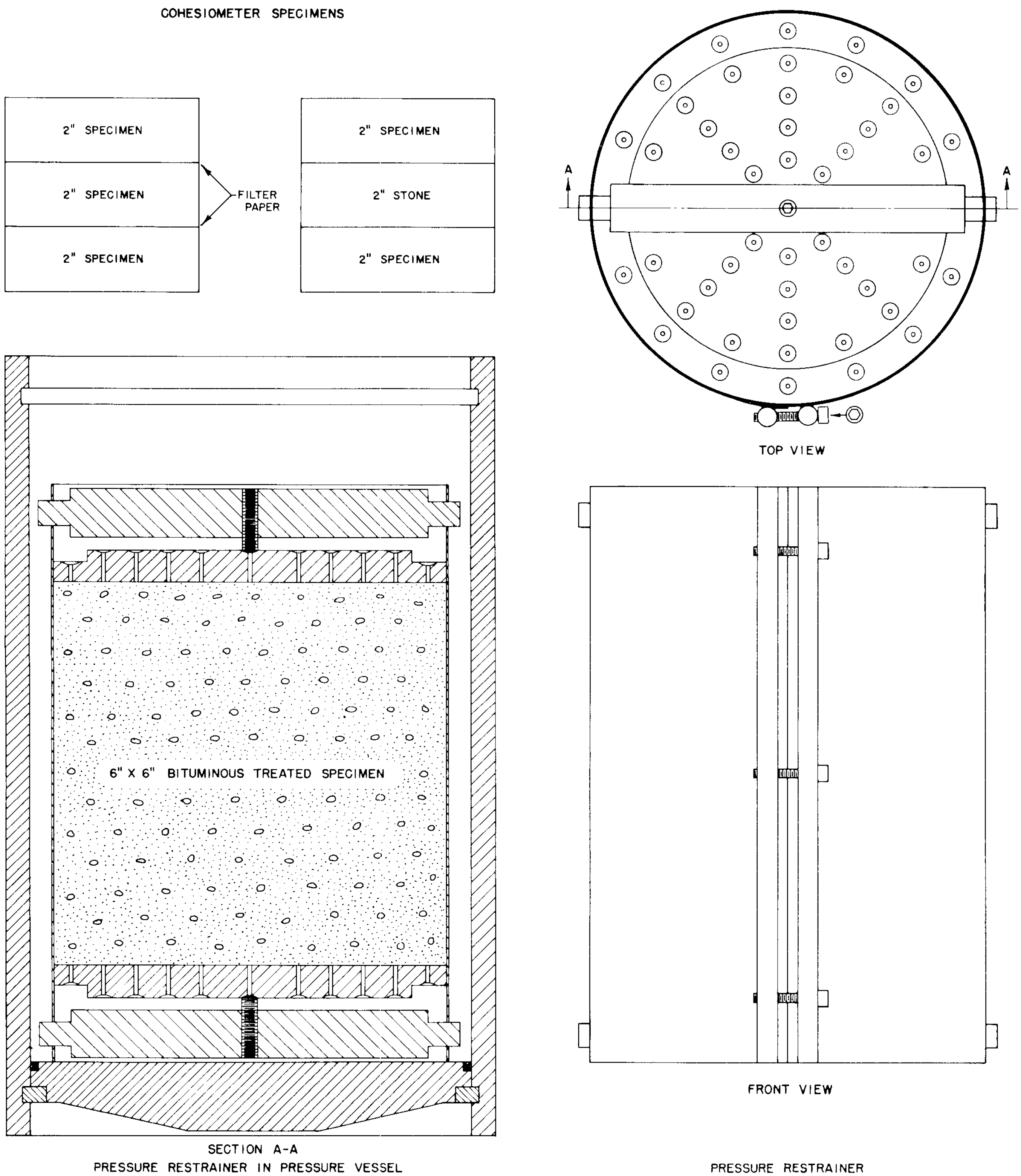


Figure 4

Apparatus

1. Same as Part II.

2. Pressure restrainers. See Figures 3 and 4.

3. A source of hot water.

4. A suitable size 140° F. oven.

Procedure

1. After specimens for cohesiometer tests (see Test Method Tex-122-E) have been dry-cured, weigh and measure height and circumference.

2. Place specimen in pressure restrainer as shown in Figure 4 and tighten screws securely.

3. Fill pressure vessel with hot water and apply pressure as indicated in steps 5 and 6 of Part II, except use 150° F. plus or minus 10° F. water.

4. Release pressure slowly and remove head.

5. Leave pressure restrainer assembly in hot water until bubbling of escaping gas ceases. Remove pressure restrainer assembly from water. If other specimens are to be pressurized, remove pressure restrainer assembly from pressure vessel and place in hot water tank at same temperature. This change allows the bubbling of escaping gases to continue but does not tie up the pressurizing equipment.

6. Remove specimen from pressure restrainer, weigh and measure height and circumference.*

7. Place a plastic disk slightly larger than the top and bottom stones; then the stones, and finally the triaxial cell around the specimen and return to the 140° F. oven. Specimen is now ready for cohesiometer tests (see Test Method Tex-122-E).

NOTE: Paragraphs 17 through 21, Test Method Tex-119-E, are applicable to pressurization of cohesiometer specimens, except that porous stones may be used as spacers to fill the restrainer.

PART IV

PRESSURE WETTING OF BLACK BASE SPECIMENS

*This measurement of circumference is necessary in the case of cohesiometer specimens wetted by submerged-capillary conditions at 1 psi. lateral pressure confinement.

NOTE: Pressure wetting of black base specimens differs from the testing details given in Part III, herein, or Test Method Tex-119-E in that specimens are not pressurized in metal restrainers.

Apparatus

1. Same as Part III, except that pressure restrainers are not used.

2. A supply of plastic bags 10-1/2 inches by 18 inches, or a plastic or metal bucket with bail, which slide into the pressure vessel or pycnometer.

Procedure

At this point the specimens should have been molded previously and should be in the 140° F. oven awaiting further handling. Proceed as follows:

1. Fill the pressure pump and pressure vessel with hot water (150° F. ± 10° F.).

2. Remove the first specimen from the oven and obtain the weight to the nearest estimated 0.001 pound.

3. Carefully place the specimen in a plastic bag that has been perforated, or the bucket, and lower into the hot water in the pressure vessel (or pycnometer, if used) making sure the mouth of the bag is opened and allowing water to fill the bag also. (Figure 5)

4. Place head in pressure vessel and press down until water flows out of release valve.

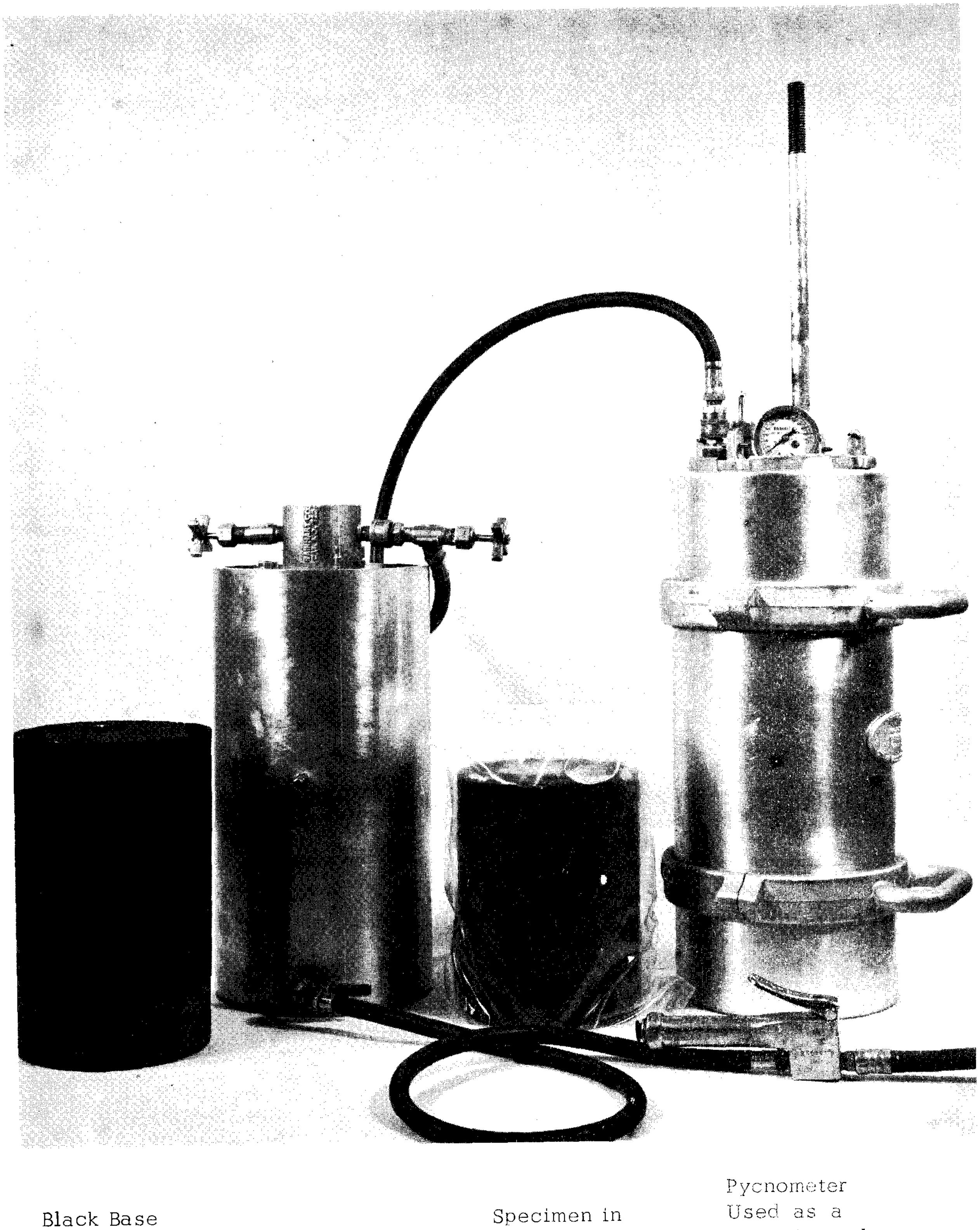
5. Fasten head securely, and using the manufacturer's instructions, apply 1200 psi. on the specimen, as indicated by the gauge, for fifteen minutes.

6. Release the pressure, carefully remove the specimen to the scales, blot, and obtain its wet saturated weight. Record data on Pressure Pycnometer Work Sheet, Figure 6.

7. Specimens near 140° F. may be removed to the testing area and tested as described under Procedure for Testing Black Base Specimens in Unconfined Compression, Test Method Tex-126-E, Part III.

8. Specimens whose temperature is low, or if it is desired to test them later, should be fitted with two porous stones (triaxial test stones) and a triaxial cell. The stones and cell should have been pre-heated to 140° F., and a plastic disk placed between the specimen and stones for moisture preservation and keeping stones freer from asphalt.

9. Store the specimen in the 140° F. oven for later testing.



Black Base Specimen

Pump

Specimen in Plastic Bag

Pycnometer Used as a Pressure Vessel

Figure 5

PRESSURE PYCNOMETER WORK SHEET

ABSOLUTE VOLUME, SPECIFIC GRAVITY, AND MOISTURE

CONTENT TEST DATA

DATE: ____________

SAMPLE NO.						
PRES.-PYC. VOLUME (LBS.)						
VOLUME PLASTIC BAG (LBS.)						
VOLUME SAMPLE (LBS.)						
WET WT. SAMPLE (LBS.)						
* DRY WT. SAMPLE (LBS.)						
WT. WATER IN SAMPLE (LBS.)						
** % WATER IN SAMPLE						
CORR. PRES.-PYC. VOL.(LBS.)						
*** SPECIFIC GRAVITY						

* DRY WEIGHT FORMULA

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

** MOISTURE CONTENT FORMULA

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

*** SPECIFIC GRAVITY FORMULA

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

Figure 6

Texas Highway Department

Materials and Tests Division

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES

Scope

This test method, which is a modification of A. S. T. M. Designation: C 136, covers a procedure for the determination of the particle size distribution of fine and coarse aggregate samples, using sieves with square openings. The method is also applicable for use to obtain the sieve analysis of aggregate recovered from bituminous mixtures obtained from plant or roadway.

Apparatus

1. Sample-splitter (Figure 1), quartering cloth (Figure 2), shoveling method on clean surface (Figure 3 and 4), or quartering machine (Not shown).

2. Set of Standard U. S. Sieves - woven wire with square openings (A.S.T.M. E-11)

3. Mechanical sieve shaker (Figure 5)

4. Scale or balance with at least 4500 grams capacity and sensitive to 0.1 gram.

5. Drying oven capable of attaining a temperature of 200°F. or more.

6. Various pans as needed

7. Scoop, brass wire brush and hair brush

Test Record Forms

Identify sample with a laboratory number and record test data on the appropriate work card as follows: Forms D-9-F14, D-9-F23, D-9-F2.

Preparation of Sample

1. Select a representative portion of processed aggregates for test.

2. Place aggregate in oven and dry to constant weight at a temperature of 100° to 300° F. (aggregates may be dried in a pan over open flame with frequent stirring.) Drying to a "constant weight" may be accomplished by drying for a specific period of time that has proven by experiment to be adequate or drying to the point that by observation, based on experience, the aggregate is sufficiently dry for testing.

When drying rock asphalt samples prior to testing, care must be taken to adjust oven temperatures so that native bitumen is not fluxed from aggregate. (For control testing, rock asphalt aggregate need not be dried)

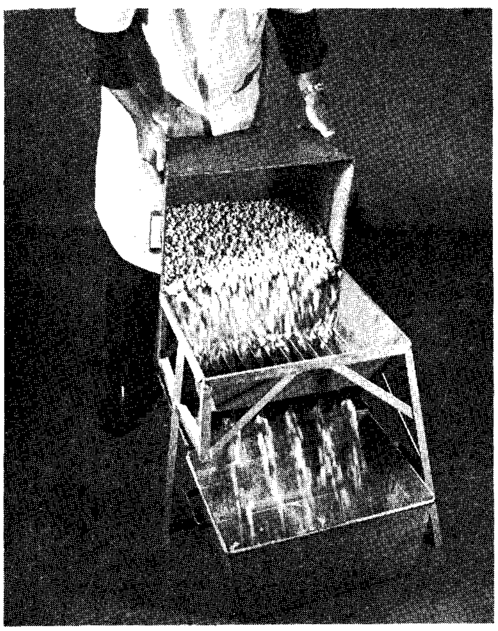


Figure 1

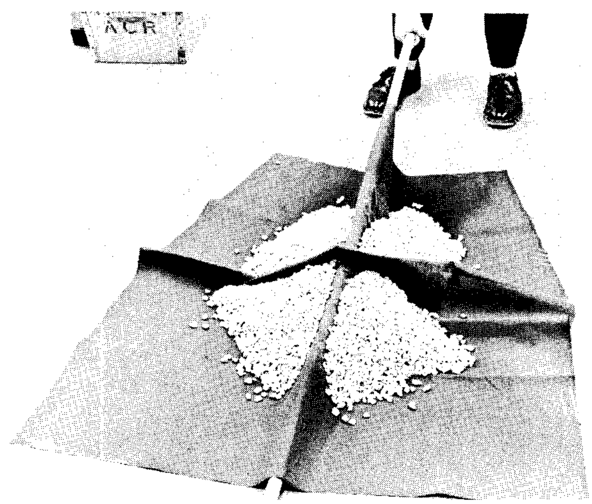


Figure 2

Remove samples from oven and allow to cool to room temperature. (For control testing, samples need not be cooled to room temperature prior to testing.)

3. To quarter the material use either the sample splitter, the quartering cloth, guartering machine, or the method of manipulating the aggregate with a large flat scoop or shovel blending it back and forth on a smooth clean surface until blended and then quartering machanically with some straight-edge, thus reducing the dry aggregate sample to laboratory testing size. (Figures 3 & 4). It is permissible for fine materials (major portion passing No. 10 sieve) to thoroughly blend the material and take small portions form several places covering the entire area of the pan to make up the test sample. (For control testing it is permissible to make up the test sample for all size aggregates by blending small portions taken from several places in the pan.) See Tex-221-F. Table 1 for size of sample.

PART I

DRY SIEVE ANALYSIS

Procedure

1. Accurately weigh the total sample to the nearest estimated 0.1 gm. When testing surface treatment aggregates, this weight may be omitted, the total sample weight being the summation of the individual weights of the analysis.

2. Place the set of sieves, with the largest opening on top, into a pan and pour the aggregate onto the top sieve. Perform a sieve analysis on the aggregate sample by separating the material into a series of particle sizes using such sieves as are necessary to determine compliance with specifications for the material. The hand sieving operation is done by means of a lateral and vertical motion of the sieves, accompanied by a jarring action so as to keep the material moving continuously over the surface of the sieves. Continue hand sieving until by visual observation no material continues to pass through the sieves in use. When mechanical sieving is used, shaking time should be established that will assure proper sieving of the material without degradation. Check the thoroughness of the sieving by the above described method.

3. Remove any particles clinging to sieves with a brush taking care to lose none of the material. Determine the weights to the nearest estimated 0.1 gram of aggregate retained on each sieve in succession, record these weights along with the respective passing and retained sieve sizes. Also, record the weight of material passing the smallest size sieve used. If the sieve analysis of a material is desired on a "total retained" basis, one of two methods may be chosen. A "passing and retained" sieve analysis may be made and then converted mathematically to a "total retained" analysis by adding accumulatively the weights of all material retained on sieves larger than the particular sieve size under consideration to the material retained on that sieve. The second method is to make the original sieve analysis a "total retained" analysis by weighing material cumulatively, placing the material retained on one sieve directly on top of the previously weighed material on the balance from the larger size sieve. At the completion of this analysis all material, with the exception of that portion passing the smallest opening sieve will be on the balance pan.

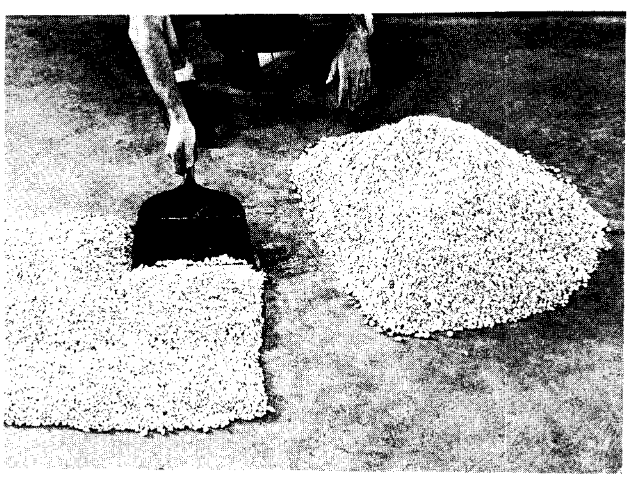


Figure 3

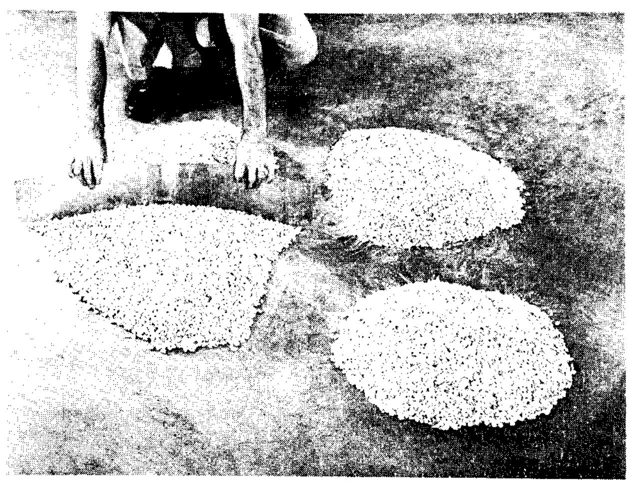


Figure 4

PART II

WASHED SIEVE ANALYSIS
(When Specified)

Follow the same steps as indicated under Tex-200-F "Preparation of Sample."

Procedure

1. Weigh the total dry sample to the nearest estimated 0.1 gm. and record the weight.

2. Place a set of sieves consisting of the sizes required in a pan with the largest opening on top. Pour the complete sample of material onto the top sieve. Shake gently so that the majority of the material passes through this sieve onto the next smaller sieve. Mechanical shaking for a brief period is permissible.

3. Remove the top sieve and place in a clean pan. Run or spray clean tap water over the material in the sieve until the pan is approximately one third full. Then shake the sieve vigorously back and forth, and up and down in the water, washing the finer material into the wash water.

4. After considerable shaking, hold the sieve above the pan and pour or spray clean water over the material, observing the water as it drips from the sieve into the pan. If it appears dirty, continue the shaking in the water until the sample is washed clean.

5. Pour the wash water into the stack of sieves washing all the fine material from the pan onto the next sieve.

6. Remove the clean material from the sieve and place in a tared pan to dry. (For fine materials this will require water to wash the material from the sieve into the drying pan. The pan should be allowed to sit undisturbed until the material has settled. The water can then be carefully decanted, and the material placed in an oven, min. 200 F, to dry). Statement in parentheses may be omitted when testing surface treatment aggregates. Any fine material washed through the smallest sieve will be counted as material passing the smallest sieve.

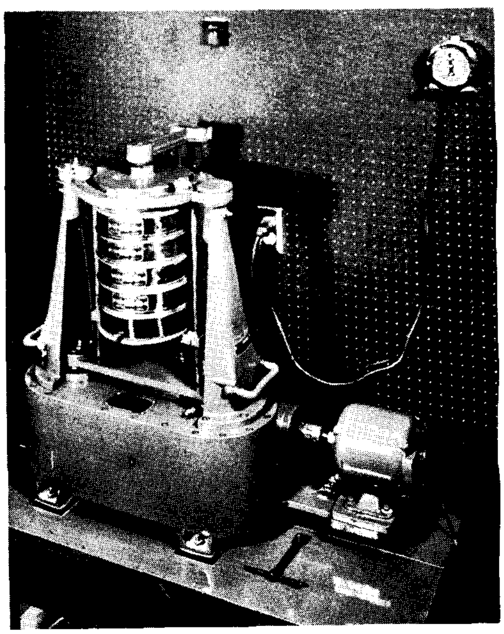


Figure 5

7. After dry, weigh the material to the nearest estimated 0.1 gm. and record the weight.

8. This procedure is repeated for each sieve size.

9. The per cent by weight of each sieve size is based on the original dry sample weight determined in step 1.

Reporting Test Results

Report the percentages to the nearest 0.1 percent for each size of aggregate passing and retained between consecutive sieves, retained on each sieve, or passing each sieve as set forth by specification requirements.

Notes

1. The term "sieve" as used in this procedure shall apply to an apparatus in which the aperatures are square.

2. In performing the sieve analysis, be careful to lose none of the sample during the sieving operations. However, if there is an insignificant discrepancy between the original dry weight of sample and the sum of the weights of the various parts, assume the small amount as particles passing the smallest size sieve and use the original weight. If the discrepancy is large, check the weights of the various sizes or re-run analysis with new sample to correct error.

Calculations

Calculate the percentages by weight retained between consecutive sieves depending upon the specifications for the use of the material tested as follows:

$$W = \frac{X_1}{W_T} \times 100$$

Where:

W = Percentage by weight of aggregate retained between consecutive sieves.

X_1 = Weight of oven-dry aggregate passing one size sieve and retained on a smaller size sieve.

W_T = Total weight of original sample which equals the sum ($X_1 + X_2$, etc.) of all the weights of aggregate retained on sieve sizes and includes the portion which passes the smallest size sieve used.

Texas Highway Department

Materials and Tests Division

BULK SPECIFIC GRAVITY AND WATER ABSORPTION OF AGGREGATE

Scope

This test method describes a procedure for determining the bulk specific gravity and water absorption of aggregate. The test is performed by obtaining the oven-dry weight of a quantity of aggregate and measuring the volume of the material in a saturated surface-dry condition by displacement of water. This bulk specific gravity is the value used in calculating the theoretical gravity of a bituminous mixture. The water absorption may be used to determine the amount of free moisture in aggregate which is an indication of the porosity of the material. Figure 1 demonstrates the theory of the bulk specific gravity determination.

Definitions

Bulk Volume: The bulk volume of an aggregate includes both the volume of the impermeable portion of the aggregate particles and the volume of the permeable voids in the particles. The bulk volume of the aggregate is equal to the volume of water displaced by the aggregate in a saturated, surface-dry condition.

Bulk Specific Gravity: This term is defined as the ratio of the oven-dry weight of the aggregate to the bulk volume of the aggregate particles.

Apparatus

1. Scale or balance: A balance with at least 4500 gram capacity, sensitive to 0.1 gram.

2. Half-gallon glass fruit jar and pycnometer cap

3. Drying oven capable of attaining a temperature of 200°F. or more, hot plate or gas burner.

4. Wide-mouth funnel

5. Sieve, set of U. S. Standard sieves with square openings

6. Round pans, 7-3/4 quart capacity

7. Small masonry pointing trowel

8. Small ear syringe

9. Sample-splitter, quartering machine, or quartering cloth (unless shoveling method on clean surface is used)

Materials

1. Lint-free cotton cloth

2. Fine carborundum cloth

3. Turpentine

4. Clean tap water

Test Record Form

Record test data on work card, Form No. D-9-F15 and report test values on Form No. 231.

Calibration of Pycnometer

It is necessary to prepare and calibrate the pycnometer to assure that it is of definite and constant volume. Select a half-gallon fruit jar with good threads on neck and with rim free from cracks or broken places. Clean the jar and fill with clean tap water. With the gasket seated smoothly in place, screw the metal pycnometer cap snugly on the jar. Use ear syringe, Figure 3, and fill with water, leaving a rounded bead of water on top of the cap. If the pycnometer leaks water, place a piece of fine grain carborundum cloth on a smooth, solid, plane surface and pour a small amount of turpentine on the cloth. Hold the jar as shown in Figure 2, smooth and true the rim by rotating the jar. Apply force and continue the grinding action until the rim of the jar appears to

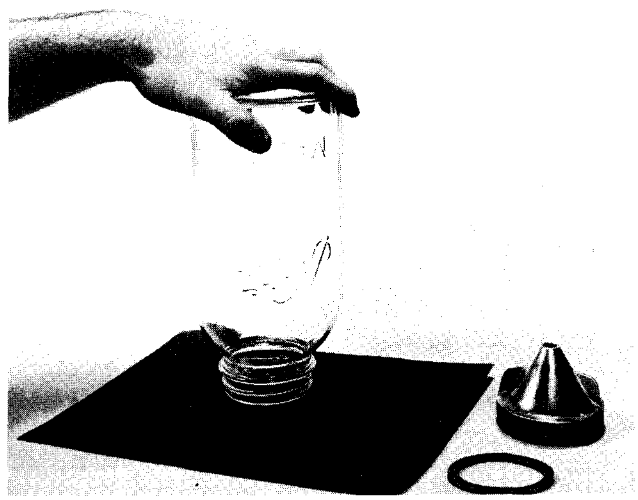


Figure 2

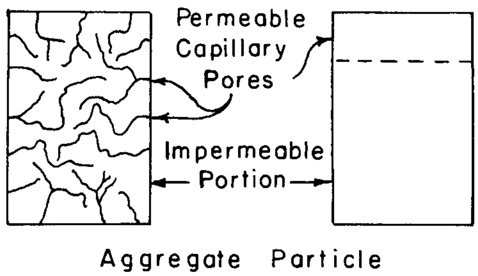
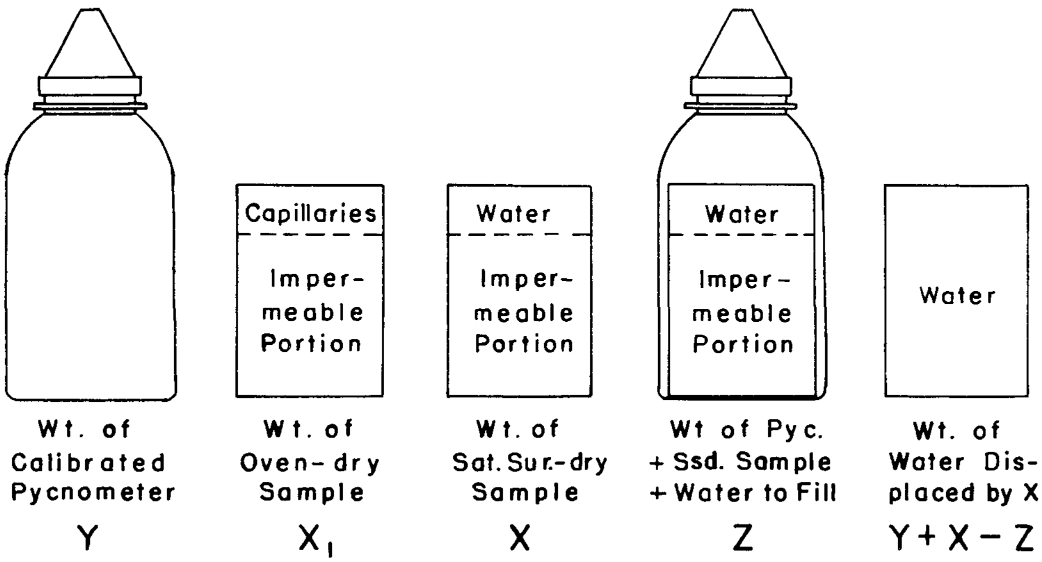


Figure 1a



$$\text{Vol. } X_1 = \text{Vol. } X = \text{Vol. } Y + X - Z; \quad \text{Bulk Sp. Gr.} = \frac{X_1}{Y + X - Z}$$

Figure 1b

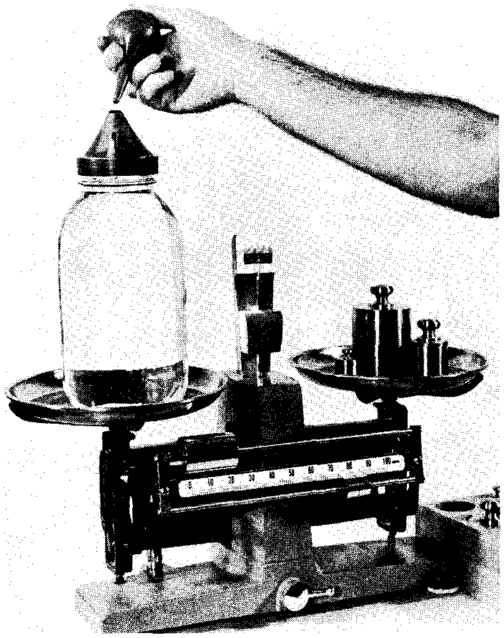


Figure 3

be perfectly smooth. Weigh the pycnometer filled with water to the nearest estimated 0.1 gram, Figure 3, and record weight as Y each time pycnometer is used.

Preparation of Sample

1. Secure a quantity of representative material proposed for use and reduce to laboratory test size by quartering.

2. Use the procedure outlined in Test Method Tex-200-F for sieve analysis and divide the material classified as coarse aggregate (material retained on the No. 10 sieve) into sizes to conform with the requirements of the specification. Sieve the fine aggregate (material passing the No. 10 sieve) over the No. 80 sieve. Save the material passing the No. 80 sieve and determine the specific gravity in accordance with Test Method Tex-202-F.

3. After the aggregates have been separated into the proper sizes, rinse or wash with clean water to remove any fine materials that might have existed as a coating on particles or in the form of lumps. The coarse aggregates are washed over a No. 10 sieve.

4. Place approximately 1500 - 2000 grams of each size aggregate, obtained from step 2 above, in separate milk pans; cover with water and saturate for 24 hours, or boil the aggregate for four hours. Keep the aggregate inundated throughout the soaking period or while boiling to thoroughly saturate all of the material with water. After this period of saturation, re-wash the coarse aggregates over the No. 10 sieve to remove slaked material.

BULK SPECIFIC GRAVITY

Procedure

1. Surface-dry each aggregate portion as follows:

a. Surface-dry all aggregate particles retained on the No. 10 sieve by means of the lint-free cloth. Drain the water from the sample, transfer a portion of the material to the cloth and roll in the cloth until all surface moisture has been removed. Do not dry past the surface-dry condition. Place the surface-dry aggregate in a small pan and cover with lid. Continue this operation until the total sample has been surface-dried and weigh immediately to prevent loss of moisture by evaporation.

b. Carefully drain the water from the aggregate passing the No. 10 sieve and retained on the No. 80 sieve. Then place the wet material on a smooth non-absorbent surface, such as a metal or tile topped work bench, and allow to air dry (Figure 4). An air circulating type fan may be used as an aid in decreasing time required for drying but do not apply artificial heat or sunlight. Use a small trowel to stir and mix the sample frequently so that the particles on top will not become drier than the surface-dry condition. Determine the saturated, surface-dry condition as follows:

Method (1): Place a small amount of aggregate of the same grading as that being tested, which is obviously drier than surface-dry, into a dry milk pan with smooth bottom. Tilt the pan to an approximately 45° angle with table and tap lightly on the bottom observing the manner in which the dry material slides down the bottom of the tilted pan. Place a portion of the sample which is near to surface-dry condition in another dry milk pan, tilt and tap while observing how the material flows or slides (Figure 5). When the aggregate being tested ceases to adhere to the bottom of the pan and flows freely, as the dry sample did, it is judged to be surface dry.

Method (2): Scoop up on a small masonry pointing trowel some of the same aggregate that is being tested that is obviously drier than surface-dry. Tilt the trowel slowly to one side, observing how the dry material flows freely from the trowel. Then scoop up the same amount of the nearly surface-dry sample being tested and tilt the trowel in the same manner watching it flow from the edge of the trowel. When the material being tested ceases to adhere to the trowel surface and flows off freely as individual particles, as the dry sample did, it is said to be in a saturated, surface-dry condition.

Note: Be certain that the trowel is completely dry before each check on the material.

2. Transfer the saturated, surface-dry material to the balance and weigh immediately to prevent the loss of moisture by evaporation. Weigh the sample to the nearest estimated 0.1 gram and record weight as X.

3. Place the saturated, surface-dry sample into the pycnometer jar approximately one-fourth full of water by means of the wide-mouth funnel, taking care to lose none of the sample. Rinse the funnel thoroughly so that any clinging particles will be washed into the jar.

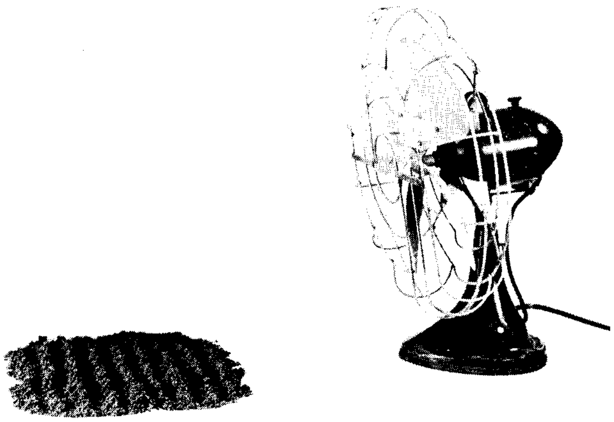


Figure 4

Figure 5

4. Fill the jar with water to within approximately one-half inch of the rim, screw the cap on the jar and fill completely with water. Place finger over hole in the cap and roll the pycnometer to free all entrapped air. When the sample contains large pieces of coarse aggregate (retained on 3/8" sieve), the pycnometer should be rolled gently to prevent breaking the glass jar. The material should be gently tossed from one end of the jar to the other with a swinging motion while rolling. When a quantity of air bubbles has accumulated, refill the pycnometer, washing out the air and roll again. Repeat this process until all of the entrapped air has been removed. To facilitate the removal of the air, a water-aspirator may be used, but care should be exercised to prevent siphoning out any of the finer particles.

5. Dry the outside of the pycnometer thoroughly, use ear syringe to carefully fill with water, leaving a rounded bead of water on top of pycnometer cap, and weigh to nearest estimated 0.1 gram. (Figure 3). Record weight as Z.

6. Remove the cap from the pycnometer and pour the sample into a clean, tared milk pan. Use plenty of water to rinse jar, cap and hands thoroughly. Allow the material to remain undisturbed until the water becomes perfectly clear, then decant or siphon the water from the sample. Take care to lose none of the material while pouring or draining the water from sample.

7. Dry the aggregate to constant weight at a temperature of 220° to 400°F. and cool to room temperature before weighing. Record the net oven-dry weight of sample to the nearest estimated 0.1 gram as X_1.

Calculations

1. Calculate the bulk specific gravity of the aggregate by the following formula:

$$G = \frac{X_1}{X + Y - Z}$$

Where:

G = Bulk (oven-dry) specific gravity of aggregate

X_1 = Weight (grams) of oven-dry sample

X = Weight (grams) of saturated, surface-dry sample

Y = Weight (grams) of calibrated pycnometer filled with water

Z = Weight (grams) of pycnometer containing saturated, surface-dry sample and water to fill at approximately the same temperature at which the pycnometer was calibrated.

2. Calculate the average bulk specific gravity of combined sizes of aggregate or combination of materials as follows:

$$G = \frac{100}{\frac{W_1}{G_1} + \frac{W_2}{G_2} + \text{etc.}}$$

Where:

G = Average bulk specific gravity of combination

G_1 = Bulk specific gravity of Material No. 1

G_2 = Bulk specific gravity of Material No. 2

W_1 = Percentage of Material No. 1 from screen analysis or based on total weight of combination

W_2 = Percentage of Material No. 2 from screen analysis or based on total weight of combination

$W_1 + W_2 + W_3$, etc., should total 100%

3. Using the test data secured in determining the bulk specific gravity, calculate the water absorption of the aggregate as follows:

$$A = 100\,\frac{X - X_1}{X_1}$$

Where:

A = Percent water absorption (24 hours) of aggregate based on the oven-dry weight of sample

X = Weight (grams) of saturated, surface-dry sample

X_1 = Weight (grams) of oven-dry aggregate

4. Calculate the average percent water absorption of combined materials as follows:

$$A = \frac{A_1 W_1 + A_2 W_2 + \text{etc.}}{100}$$

Where:

A = Average percent water absorption (24 hours) of combined materials based on the total weight of oven-dry combination

A_1 = Percent water absorption of Material No. 1

A_2 = Percent water absorption of Material No. 2

W_1 and W_2 are the same as defined under step 2

Notes

Water temperature for weights Y and Z should be approximately the same. Repeated results should check within $\pm$ 0.02.

Texas Highway Department

Materials and Tests Division

DETERMINATION FOR UNIT WEIGHT OF AGGREGATE

Scope

This method of test, which is a modification of A.S.T.M. Designation: C 29 , describes a procedure for determining the loose weight per cubic foot of both coarse and fine aggregates. The unit weight of aggregate in a saturated surface-dry loose condition is intended for use in portland cement concrete mix design.

Apparatus

1. A small square-point scoop
2. Quartering cloth or large flat metal pan
3. A scale of 106 pounds capacity, sensitive to 0.01 pound meeting requirements of Class IV-C scales of Test Method Tex-901-K.
4. A metal straight edge

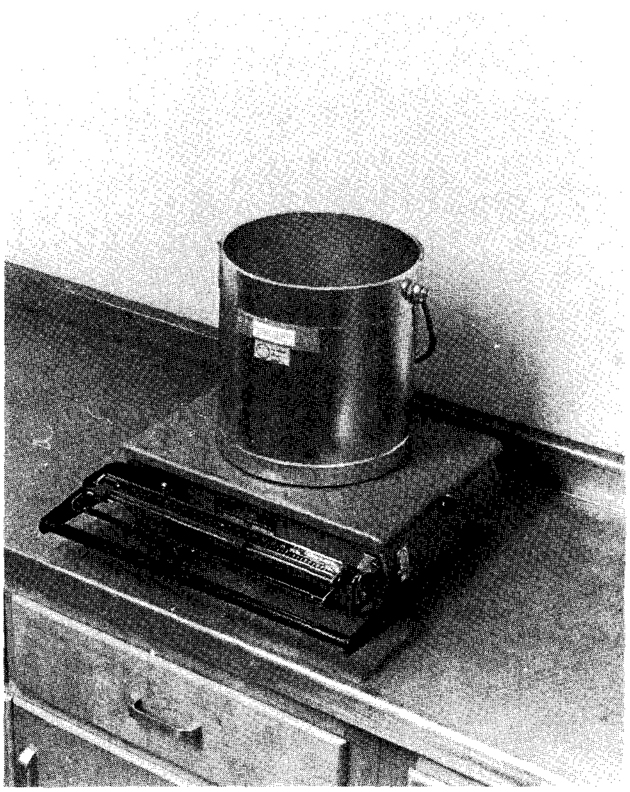


Figure 1

5. Two, metal measures, cylindrical in form and provided with handles. The containers shall be watertight with the top and bottom true and even, preferably machined to accurate dimensions on the inside, and of sufficient rididity to retain their form under rough usage. The measures required shall have capacities (volume) of 1/2 and 1/10 cubic foot and shall conform to the following requirements:

Capacity cu. ft.	Inside Diam. in Inches	Inside Height in Inches	Size Aggregate
1/2	10.0 ± 0.1	11.0 ± 0.1	Coarse
1/10	6.0 ± 0.1	6.1 ± 0.1	Fine

6. A piece of plate glass large enough to cover the top of measure.
7. Rubber bulb or wash bottle.
8. A denim cloth sleeve 8-1/2 in. by 30 in. long (flat measurement)
9. Fahrenheit thermometer calibrated by Test Method Tex-906-K.

Calibration of Measure

Calibrate the measure by accurately determining the weight of water at a convenient temperature (degrees F) that is required to fill the measure as follows:

1. Place the measure on the scale and cover with a piece of plate glass. Use a spirit level to perfectly level the measure.
2. Obtain the weight of the measure and glass cover to the nearest 0.01 pound and record the weight as W_M.
3. Fill the measure with water until the water level barely reaches the rim of the measure. Then use the piece of glass as a cover plate. If the measure is almost full, the surface tension will cause the water to adhere to the cover plate. Start the glass plate at one side and carefully slide it over the measure. While the cover plate is moved across the measure, use the rubber bulb or a wash bottle and continue adding water enough to fill the large air bubble which forms under the edge of the cover plate. When the operation is nearly complete, fill the small remaining air space with a few drops of water to exactly fill the measure.
4. Weigh the measure filled with water to the nearest 0.01 pound and record the weight as W_W. Use the Fahrenheit thermometer to obtain the temperature of the water at T_F.

5. Calculate the volume of the water which is also the volume of the measure from temperature-density relation of the water and obtain the factor for the measure as follows:

$$V = \frac{W_W - W_M}{U_W}$$

$$F = \frac{1}{V} = \frac{U_W}{W_W - W_M}$$

Where:

- F = Factor for measure (reciprocal of volume
- V = Volume of measure in cu. ft.
- W_W = Weight of measure filled with water and glass cover
- W_M = Weight of measure empty and glass plate
- U_W = Unit weight of water at temperature T_F from Table I
- T_F = Temperature of the water in the measure

6. Secure the tare weight of the measure and record the weight as T to the nearest 0.01 pound.

Sample Preparation

Secure a representative sample of sufficient quantity to fill measure and either air dry at room temperature to the saturated surface-dry condition or dry in oven to constant weight at a temperature of 230 ± 9°F. depending on whether oven-dry or saturated surface-dry unit weight per cubic foot value is desired. Place the sample on a quartering canvas or in the large flat pan and thoroughly mix.

Procedure

A. Coarse Aggregate

1. Place the 1/2 cubic foot measure on a level surface near the aggregate sample. Take a scoop full of the aggregate from the thoroughly mixed sample pile and holding the scoop two inches above the measure, pour the aggregate into the measure. Pour the material uniformly over the entire area in such a manner that each layer placed is nearly level and the surface of the material when the measure is full will be practically level with the rim of the measure.

2. Level off the surface of the aggregate with the fingers, taking care not to jar the measure, in such a way that slight projections of the larger particles above the rim shall balance the larger voids in the surface below the top of measure (Figure 4).

3. Weigh the measure full of aggregate, and subtract the tare weight of the empty measure to obtain the net weight of material required to fill the measure. Repeat the above steps two additional times to obtain an average weight. Record the average net weight of aggregate as W.

Figure 4

B. Fine Aggregate

1. The fine aggregate sample should be of sufficient size (after drying) to fill the 1/10 cubic foot measure to overflowing. A slight amount of free moisture causes sand to bulk, thus introducing an error in the test result. Use the small scoop to place the sample of sand into the denim sleeve.

2. Place the 1/10 cubic foot measure in a large flat pan so that the excess material may be recovered for check tests.

3. Thoroughly mix the fine aggregate in the sleeve by closing the ends with both hands and then alternately raising and lowering one end of the sleeve and then the other. Close the open end of the sleeve with one hand, allowing several inches of the empty part of the sleeve to extend beyond the hand, place this end on the bottom of the measure and remove the hand (Figure 2). Hold the measure firmly with one hand while steadily withdrawing the sleeve with the other hand.

4. Use the straight edge to strike off the excess material even with the top of the measure. Tap the side of the measure lightly to settle the material slightly to prevent loss of any material when weighing (Figure 3).

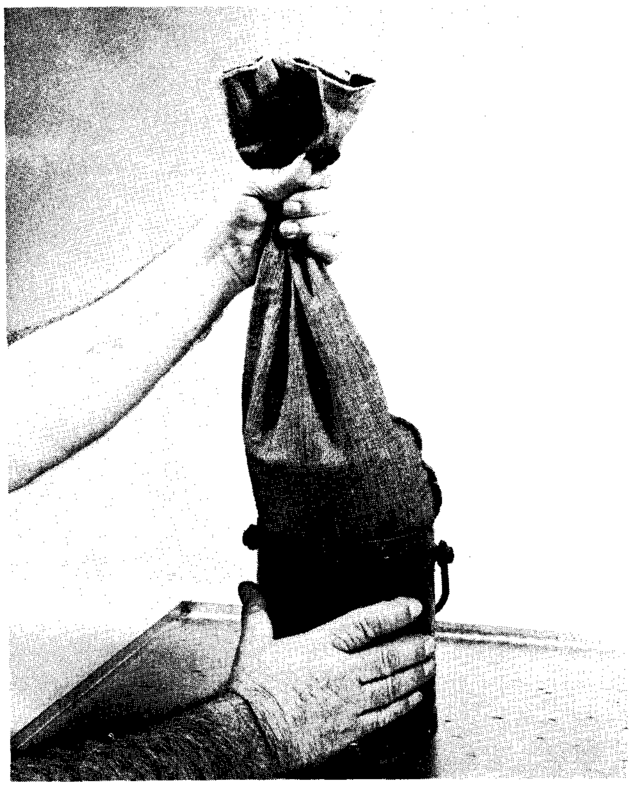


Figure 2

5. Obtain the weight of the measure filled with fine aggregate and record the net weight as W to the nearest estimated 0.01 pound. Repeat this process to obtain an average net weight for the aggregate.

Figure 3

C. Lightweight Aggregate, Coarse

TENTATIVE, December 1970

It is desirable to standardize the gradation on which the dry loose unit weight determination is made when this unit weight is used as a quality acceptance criteria as noted under the Article "Materials" in the governing specification.

When used as a volume measure for weight–volume conversion, distribution rate, pay item or when the standardized grading cannot be obtained, the dry loose unit weight determination shall be made on the total sample as received.

1. Dry the material to a constant weight at a temperature of 230 ± 9°F.

2. Standard Gradation: Material, more than sufficient to fill the 1/2 cubic foot measure, shall be sized as follows:

Size	Retained, Percent by Wt.
1/2	0
3/8	40 - 60
No. 4	100

3. The remainder of this procedure shall be in accordance with Part A, Coarse Aggregate.

Calculations

1. U = FW

Where:

U = Unit weight in pounds per cubic foot
F = Factor for the measure (1/V)
W = Average net weight of aggregate to fill measure

2. If the aggregate was dry when tested and the saturated surface-dry loose unit weight is desired, determine the absorption A as specified in Test Method Tex-403-A and calculate the unit weight as follows:

$$U = FW\left(1+\frac{A}{100}\right) = \text{saturated surface-dry unit weight}$$

3. If the free moisture has been removed but the aggregate still contains some absorbed moisture when tested and the oven-dry unit weight is desired, calculate the value by the following expression:

$$U = \frac{FW}{1 + \frac{A_1}{100}}$$

Where:

A_1 = Absorbed moisture at the test condition of the aggregate

Notes

1. Avoid unnecessary delays when testing saturated surface-dry material in order to prevent excessive loss of moisture by evaporation.

2. Mix the aggregates thoroughly and take precautions to prevent segregation of the particles when filling the unit weight measures.

3. Results by an operator using the same sample and procedure should check within 1 percent.

TABLE I

UNIT WEIGHT OF DISTILLED WATER AT VARIOUS FAHRENHEIT TEMPERATURES

Temp. °F.	Unit Weight	Temp. °F.	Unit Weight	Temp. °F.	Unit Weight
32	62.418	55	62.390	78	62.234
33	62.420	56	62.386	79	62.225
34	62.422	57	62.382	80	62.216
35	62.423	58	62.377	81	62.206
36	62.424	59	62.372	82	62.196
37	62.425	60	62.366	83	62.186
38	62.425	61	62.360	84	62.176
39	62.426	62	62.355	85	62.166
40	62.426	63	62.349	86	62.156
41	62.425	64	62.342	87	62.145
42	62.425	65	62.336	88	62.134
43	62.424	66	62.329	89	62.124
44	62.423	67	62.322	90	62.113
45	62.421	68	62.316	91	62.101
46	62.419	69	62.308	92	62.090
47	62.417	70	62.301	93	62.079
48	62.415	71	62.294	94	62.067
49	62.412	72	62.286	95	62.055
50	62.409	73	62.277	96	62.043
51	62.406	74	62.269	97	62.031
52	62.402	75	62.261	98	62.018
53	62.399	76	62.252	99	62.006
54	62.395	77	62.243	100	61.993

Texas Highway Department

Materials and Tests Division

ABRASION OF COARSE AGGREGATE BY USE OF THE LOS ANGELES MACHINE

Scope

This Test Method covers the procedure for testing conventional and lightweight coarse aggregate for resistance to abrasion in the Los Angeles testing machine with an abrasive charge. The apparatus and procedure used in this test are identical with A.S.T.M. Designation: C 131.

Procedure

Use the apparatus specified to prepare and test the required gradings of aggregate in accordance with the procedure described in A.S.T.M. Designation: C 131.

Reporting Test Results

Report the test data and type grading and the wear to the nearest whole percent on Form No. 272.

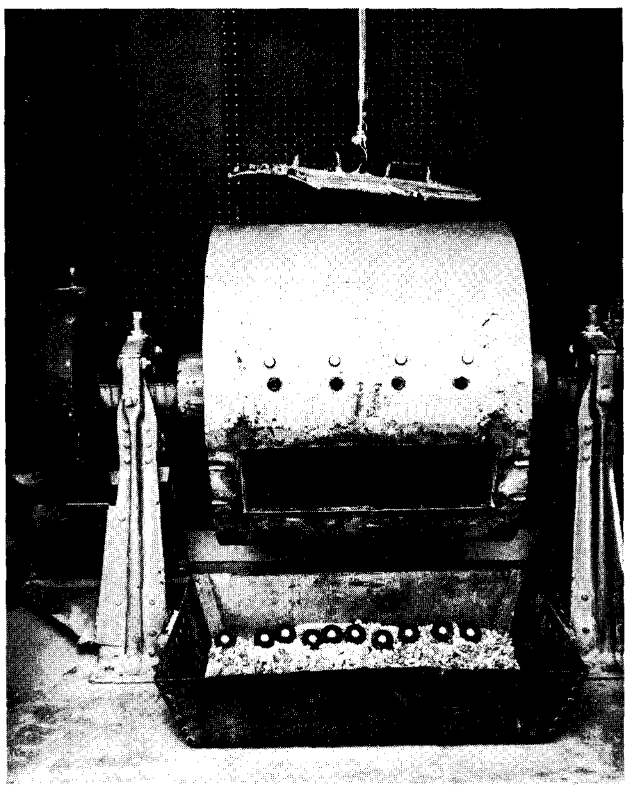


Figure 1

Texas Highway Department

Materials and Tests Division

PRESSURE-SLAKING TEST OF SYNTHETIC COARSE AGGREGATE

Scope

The test method described here is intended to be used to evaluate the amount of dehydration that has occurred in the production of synthetic aggregates fired in a Rotary Kiln.

Apparatus

The apparatus shall consist of the following:

1. Pressure cooker (common kitchen type with 6 quart capacity with 15 psi pressure regulator)

Note: Centrifuge bottles will require a pan depth of approximately 7 inches. Presto Stainless Steel Pressure Cooker Model PCS6 has been found to have a satisfactory inside height.

2. Centrifuge bottles - 500 ml. Pyrex

3. Balance - having capacity of at least 4500 grams and accurate within 0.1 percent of the test load at any point within the range of use and sensitive to 0.1 gram

4. Heavy duty shaker - Equipoise Model No. 5855

5. Sieves - U. S. Standard woven wire—sizes 3/4-inch, No. 10, and No. 40. (Conforming to ASTM Designation E-11)

6. Drying oven maintained at 230 $\pm$ 9F.

Sample

An unwashed representative sample of sufficient volume to half fill the centrifuge bottle should be chosen. The sample material is that which passes a 3/4" sieve and is retained on a No. 10 sieve. Any material retained on the 3/4" sieve should be crushed to pass this sieve using a minimum amount of crushing. Since synthetic aggregates vary widely as to specific gravity, a volumetric measure of the sample is used rather than weight.

Procedure

1. Place the sample into the centrifuge bottle and add 200 ml. of distilled water. It is not necessary to determine the initial weight of the sample.

2. Place the centrifuge bottles containing the aggregates into the pressure cooker, adding approximately 1/2" of distilled water to the pressure cooker and seal the lid tightly.

3. Heat the pressure cooker until full pressure is indicated by the pressure regulator.

4. Adjust heat to allow only a slight escape of steam and maintain pressure for 15 minutes. Remove the heat, release the pressure, and remove the centrifuge bottles.

5. After cooling to approximately 100^{o}F., place corks in the centrifuge bottles and place the bottles in the Equipoise shaker. Shake the aggregates for 15 minutes.

6. Upon removing the bottles from the shaker, wash the sample over a No. 40 sieve, taking care not to lose any of either fraction.

7. Dry both fractions to a constant weight at 230 $\pm$ 9F. Due to rehydration, the final total weight of the sample may be greater than the initial weight.

ALTERNATE METHOD

Apparatus

1. Pressure cooker (common kitchen type with 6 quart capacity with 15 psi pressure regulator).

Note: Centrifuge bottles will require a pan depth approximately 7 inches. Presto Stainless Steel Pressure Cooker Model PCS6 has been found to have a satisfactory inside height.

2. Centrifuge bottles - 500 ml. Pyrex.

3. Balance with at least 4,500 gram capacity, sensitive to 0.1 gram.

4. Sieve Shaker - Tyler Portable Sieve Shaker or equivalent - motor driven. Shaker shaft speed = 260 $\pm$ 25 r.p.m. (1725 r.p.m. motor with 1-1/2 inch pulley, shaker shaft with 10 inch pulley = 259 r.p.m.) (Figure 2).

5. Sieves - U. S. Standard woven wire—sizes 3/4-inch, No. 10, and No. 40. (Conforming to ASTM Designation E-11)

6. Drying oven capable of attaining a temperature of 200^{o}F. or more.

7. Bracket for clamping centrifuge bottles in a side-by-side, horizontal position in the Tyler sieve shaker (Figure 1).

Sample

An unwashed representative sample of sufficient volume to half fill the centrifuge bottle should be chosen. The sample material is that which passes a 3/4" sieve and is retained on a No. 10 sieve. Any material retained on the 3/4" sieve should be crushed to pass this sieve using a minimum amount of crushing. Since synthetic aggregates vary widely as to specific gravity, a volumetric measure of the sample is used rather than weight.

Procedure

1. Place the sample into the centrifuge bottle and add 200 ml. of distilled water. It is not necessary to determine the initial weight of the sample.

2. Place the centrifuge bottles containing the aggregates into the pressure cooker, adding approximately 1/2" of distilled water to the pressure cooker and seal the lid tightly.

3. Heat the pressure cooker until full pressure is indicated by the pressure regulator.

4. Adjust heat to allow only a slight escape of steam and maintain pressure for 15 minutes. Remove the heat, release the pressure, and remove the centrifuge bottles.

5. After cooling to approximately 100°F, place stoppers in the centrifuge bottles and place the bottles in the horizontal shaking bracket securely clamping them in place. (Prior to placing the bottles, make certain that the bracket is securely fastened to the Tyler sieve shaker.) (Figure 3)

6. Shake the samples in the Tyler sieve shaker horizontal bracket for 35 minutes at 260 ± 25 r.p.m. (See Apparatus, 4., for shaker details).

7. Remove the bottles from the shaking bracket and wash the sample over a No. 40 sieve, taking care to lose none of either fraction.

8. Dry both fractions to a constant weight at 220° - 400°F. and cool to room temperature.

9. Weigh the material retained on the No. 40 sieve and the material passing the No. 40 sieve to the nearest 0.1 gram.

Calculations

The pressure slaking value is the material passing the No. 40 sieve expressed as a percentage of the total sample weight:

Pressure Slaking Value =

$$\frac{\text{Weight of minus No. 40 material}}{\text{Weight of minus No. 40 + ret. No. 40}} \times 100$$

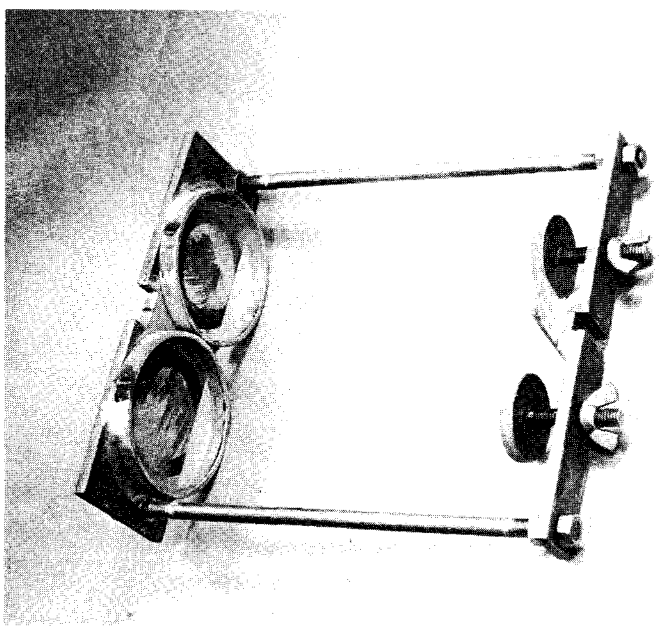


Figure 1

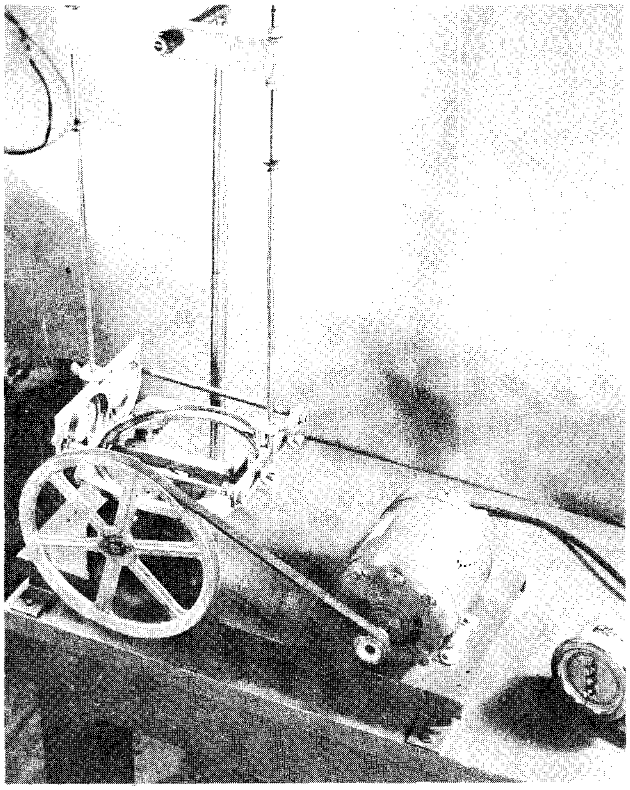


Figure 2

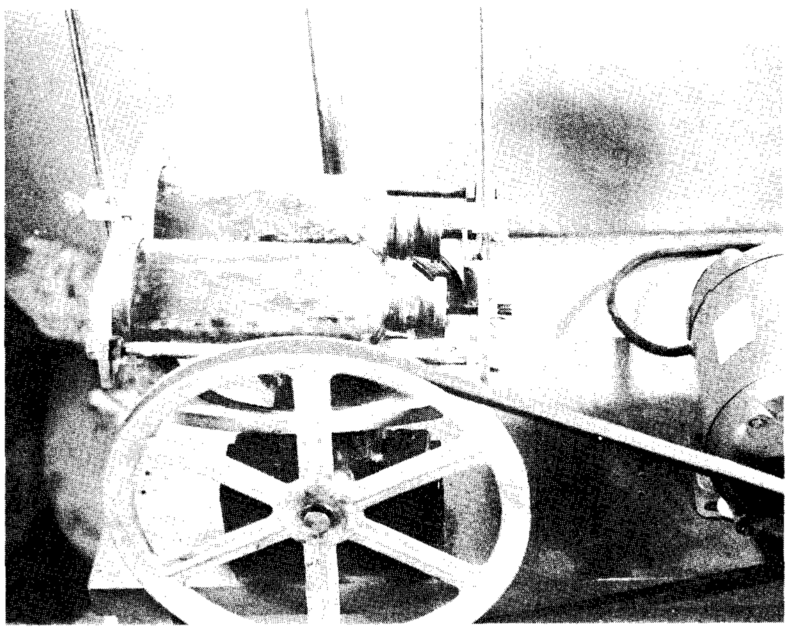


Figure 3

Texas Highway Department

Materials and Tests Division

COARSE AGGREGATE FREEZE-THAW TEST

Scope

This method of test describes a procedure to be followed in testing synthetic coarse aggregate to determine their resistance to disintegration by freezing and thawing. It furnishes information helpful in judging the soundness of aggregates subjected to weathering action.

Apparatus

The apparatus shall consist of the following:

1. The freezing chamber - the freezing chamber shall be any commercial type freezer of suitable dimensions and shall be capable of maintaining a constant temperature of -10°C. or lower.
2. Trays and containers - shallow metal trays approximately one (1) inch in depth and of suitable dimensions to contain the aggregate sample in a single layer.
3. Sieves - sizes 3/4 inch, 5/8 inch, 1/2 inch, 3/8 inch, No. 4, and No. 10 conforming to the Specifications for Sieves for Testing Purposes (A.S.T.M. Designation: E 11).
4. Balance of at least 800 grams capacity, sensitive to 0.05 gram, accurate to 0.05 gram, meeting requirements of Test Method Tex-901-K Class II-A balance.
5. Drying oven - the drying oven shall provide a free circulation of air through the oven and shall be capable of maintaining a temperature of 230°F ± 9°F.

Sample

The test sample shall be prepared from aggregate representative of that being furnished. The aggregate shall be washed and dried at 230°F ± 9° to constant weight, separated into individual size fractions as follows:

Size of Aggregate		Weight of Individual Sizes - grams			
		Test Grade			
Passing	Ret'd	A	B	C	D
3/4 in.	5/8 in.	400 ± 10			
5/8 in.	1/2 in.	250 ± 10	250 ± 10		
1/2 in.	3/8 in.	200 ± 10	200 ± 10	200 ± 10	
3/8 in.	#4	100 ± 5	100 ± 5	100 ± 5	100 ± 5
#4	#10	30 ± 5		30 ± 5	30 ± 5

Should the sample contain less than 5 percent of any of the sizes specified in grades above, that size shall not be tested, but for the purpose of calculating the test results, it shall be considered to have the same loss during the treatment as the next smaller size or the next adjacent size where 5 percent or more exists.

Procedure

1. The oven-dry weight of each fraction of the prepared sample shall be obtained to the nearest estimated 0.1 gram.

2. Each fraction of the sample shall then be placed in a separate tray, and enough distilled water shall be added to each tray to adjust the water level to approximately three-fourths (3/4) of the average stone depth.

3. The trays shall be immediately placed in the freezing chamber and allowed to remain there until the water is completely frozen (about two hours).

4. The trays containing the sample shall be removed from the freezing chamber and allowed to thaw at room temperature until no ice is evident in the water. Distilled water shall be added to each tray when required to maintain the proper water level.

5. Steps 3 and 4 shall be repeated until 50 cycles have been obtained. One cycle shall be defined as one series of freezing and thawing.

6. After 50 cycles, the sample (remaining in the trays) shall be dried to a constant weight at 230°F.

7. The oven-dry fraction in each tray shall be passed over the same sieve used in the original separation and the weight retained on each sieve obtained to the nearest estimated 0.1 gram. The number of par-

ticles retained on sieve shall also be obtained for qualitative examination.

Report

The report shall include the following data:

1. Weight of each fraction of each sample before test.

2. Weight of each fraction of each sample after test.

3. The percentage loss of each fraction of each sample as a percent of the original dry weight.

4. Weighted average calculated from the percent loss for each fraction, based on the grading of the sample received for examination or, preferably on the average grading of the material from that portion of the supply of which the sample is representative.

Note:

The sieve used to separate the original fractions for test must be the identical sieve used to examine the same fractions after the test. This is necessary since sieve sizes include a tolerance in mesh openings. For example, all sieves of a given size, say 3/8 inch, do not have exactly the same size opening. The A.S.T.M. tolerance between different sieves of the same size cannot be accepted in this test.

Sieve Size	Grading of Original Sample	Actual Loss Percent	Weighted Loss Percent
5/8-1/2 in.	11.2	5.2	0.58
1/2-3/8 in.	37.0	9.3	3.44
3/8 in.-No. 4	51.8	2.2	1.14
	TOTAL WEIGHTED LOSS		5.16

Texas Highway Department

Materials and Tests Division

ABSORPTION AND DRY BULK SPECIFIC GRAVITY OF SYNTHETIC COARSE AGGREGATE

Scope

This method of test is intended for use in determining the absorption and dry bulk specific gravity of lightweight coarse aggregate.

Apparatus

The apparatus shall consist of the following:

1. Balance or scale of at least 4500 grams capacity, sensitive to 0.1 gram, accurate to 0.5 gram, meeting requirements of Test Method Tex-901-K Class III-D balance or Class IV-A scales.

2. Container - a glass Mason jar fitted with a pycnometer cap.

3. Wide-mouth funnel.

4. Distilled or demineralized water.

5. Rubber syringe.

6. Drying oven maintained at 230 ± 9F.

Sample

A sample of sufficient size to yield approximately 400 grams after being oven dried shall be selected, by the method of quartering, from the aggregate to be tested.

Procedure

1. The test shall be conducted in an environmental temperature of 72 ± 5°F.

2. The sample shall be dried in an oven at a temperature of 230°F. to constant weight. The sample shall then be allowed to cool to room temperature in a desiccator and weighed to the nearest estimated 0.1 gram. Record as X.

3. The weight of the pycnometer completely filled with distilled water shall be obtained to the nearest estimated 0.1 gram. Record as Y.

4. a) Place the dry sample in the pycnometer jar by means of the wide mouth funnel, taking care not to lose any of the material. Fill the jar with water to within about 1/2 inch of the rim, screw the cap on the jar and then fill completely with water. Begin the timing of the test the instant the water is introduced into the pycnometer jar containing the sample.

b) Cover the hole in the cap with a finger and agitate the sample by rolling and shaking the pycnometer jar. Place the pycnometer jar on the balance or scale and dry the outside of the pycnometer jar thoroughly. Immediately prior to weighing the pycnometer jar use the rubber syringe to fill the pycnometer jar level full. The pycnometer jar with the sample and water shall be weighed to the nearest estimated 0.1 gram.

c) Weighings shall be taken at 2, 4, 6, 8, 10, 20, 30, 60, 90 and 120 minutes from the beginning of the test. Repeat step b, above, prior to each weighing and record the weight as Z_2, Z_4, Z_6, etc.

Calculations

A curve with time (to at least 10 minutes) as the abscissa and weight of pycnometer plus sample plus water as the ordinate shall be plotted on rectangular coordinate paper. This curve shall be extended back to include zero time and the weight of pycnometer plus sample plus initial water read from the curve. A curve with time as the abscissa and percent absorption as the ordinate shall be plotted on rectangular coordinate paper. The percent absorption at 100-minutes can then be read from the curve.

$$A_t\text{, \% absorption at given time} = \frac{Z_t - Z_0}{X} 100$$

$$G_b\text{, Dry bulk specific gravity} = \frac{X}{X + Y - Z_0}$$

Where:

X = Weight of oven-dry sample

Y = Weight of calibrated pycnometer filled with water.

Z_t = Weight of pycnometer containing sample and water to fill (t = time from beginning of test in minutes).

100-Minute Saturation

The 100-minute saturation value is calculated from absorption, dry bulk specific gravity and absolute specific gravity. The absolute specific gravity (G_a) is determined by Test Method Tex-109-E, Part I.

S_{100}, % 100-minute saturation =

$$\frac{A_{100} \circ G_b}{1 - \frac{G_b}{G_a}}$$

A_{100} = 100-minute absorption in percent.

G_a = Absolute specific gravity.

G_b = Dry bulk specific gravity.

The porosity of the aggregate is determined by the following equation:

$$N = 1 - \frac{G_b}{G_a}$$

Where:

N = Porosity of the aggregate expressed as a decimal

TABLE I

FEATHERLITE - RANGER

Test Method & Size	R3-71-139	R3-71-663	R3-72-152	R3-72-158	R3-72-172	R3-72-193	R3-73-61	72-1385-F Gr. 4	72-1400-F	72-1401-F	72-1452-F	72-1520-F Gr. 4	72-1604-F Gr. 4	72-1661-F Gr. 4	72-1678- Gr. 4
Tex-200-F, Sieve Analysis (% by Wt.)															
Ret. 5/8"	0	0	0	0	0	0	0	These tests							
Ret. 1/2"	2.3	0	0.2	0.6	0.5	0.1	1.6	not perform-							
Ret. 3/8"	38.5	46.6	22.9	33.4	23.9	34.0	56.3	ed on routine							
Ret. 1/4"	82.2	92.7	80.2	87.6	81.9	87.0	95.3	samples.	-	-	-	-	-	-	-
Ret. No. 4	94.6	97.7	94.5	92.3	92.4	96.0	98.6								
Ret. No. 10	99.7	99.0	98.8	96.3	98.6	99.0	99.6								
Tex-201-F- 3/8"-1/4" Specific Gravity	1.528	1.556	1.467	1.415	1.495	1.521	1.420	"	-	-	-	-	-	-	-
Water Absorption (% by Wt.)	8.3	6.6	7.5	7.1	7.6	7.0	6.9	"							
Tex-433-A- 3/8"-1/4" Specific Gravity	1.575	1.611	1.477	1.410	1.528	1.553	1.444	"	-	-	-	-	-	-	-
Water Absorption (% by Wt.)	5.9	4.8	5.2	5.4	5.3	4.9	4.8	"							
Tex-109-E- 3/8"-1/4" Specific Gravity	2.236	2.170	2.218	2.144	2.192	2.148	2.092	"	-	-	-	-	-	-	-
Water Absorption (% by Wt.)	16.3	15.8	16.6	20.6	16.2	16.5	15.7	"							
Tex-404-A, Unit Weight ($lbs./ft.^3$)															
Standard- 3/8"-1/4"	51.22	52.17	49.25	46.17	51.69	48.03	47.35	"	-	-	-	-	-	-	-
Rodded- 3/8"-1/4"	52.69	53.66	50.91	48.35	52.80	50.69	51.11	"	-	-	-	-	-	-	-
Standard- As received.	52.17	52.63	50.09	46.75	49.99	48.83	46.91	46.23	48.07	50.85	47.45	48.39	47.01	45.85	50.09
Rodded- As received.	54.34	54.76	51.81	49.95	54.75	51.31	50.75	-	-	-	-	-	-	-	-
Tex-431-A, Pressure Slaking															
Standard Method															
3/4"-No. 10 (Loss, % by Wt.)	1.9	2.4	2.1	3.0	1.9	1.6	1.3	2.6	1.7	1.4	1.9	2.0	1.9	1.9	1.7
3/8"-1/4" (Loss, % by Wt.)	1.9	1.8	2.1	2.8	1.9	1.7	1.1	-	-	-	-	-	-	-	-
Alternate Method															
3/4"-No. 10 (Loss, % by Wt.)	1.8	2.3	2.8	2.6	2.1	1.6	1.5	-	-	-	-	-	-	-	-
3/8"-1/4" (Loss, % by Wt.)	1.5	1.5	2.2	2.3	1.6	1.8	1.5	-	-	-	-	-	-	-	-

-1604-F Gr. 4	72-1661-F Gr. 4	72-1678-F Gr. 4	72-1699-F Gr. 4	72-1771-F Gr. 4	72-1825-F Gr. 5	72-1862-F Gr. 4	72-2329-F Gr. 4	72-2607-F Gr. 4	73-1-F	73-43-F	73-44-F	73-68-F	73-69-F	73-216-F	Statistical Analysis for Trends			
															$\bar{X}$	σ	CV(%)	R
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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47.01	45.85	50.09	46.47	44.26	49.41	47.99	50.49	52.05	44.00	52.77	49.85	50.77	50.43	50.87	48.91	2.44	4.99	8.77
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.9	1.9	1.7	2.6	1.5	1.5	1.9	1.9	1.5	4.4	1.9	2.0	2.2	1.8	1.6	2.00	0.62	30.81	3.1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE I continued

FEATHERLITE - RANGER

Test Method & Size	R3-71-139 A	B	Avg.	R3-71-663 A	B	Avg.	R3-72-152 A	B	Avg.	R3-72-158 A	B	Avg.	R3-72-172 A	B	Avg.	R3-72-193 A	B	Avg.	R3-73-61 A	B	Avg.	72-1385-F	72-1400-F	7
Tex-432-A, Freeze & Thaw Test (% by Wt.)																								
5/8"-1/2" Sample																								
Actual Loss, Pass 1/2"	42.5	25.7	34.1	Size not avail-			Size not avail-			14.4	23.5	19.0	Size not avail-			15.9	One	15.9	11.6	16.5	14.1	Size not avail-		
Pass 1/4"	2.3	1.2	1.8	able in sample.			able in sample.			0.4	1.1	0.8	able in sample.			0.5	sam-	0.5	1.2	0.5	0.9	able in sample.	-	
Pass No.10	1.1	0.6	0.9							0.2	1.0	0.6				0.3	ple	0.3	0.6	0.2	0.4			
Pass No.40	0.6	0	0.3							0.2	0.9	0.6				0	only		0.2	0	0.1			
1/2"-3/8" Sample																								
Actual Loss, Pass 3/8"	11.2	11.8	11.5	9.5	9.8	9.7	18.7	10.8	14.8	5.3	3.9	4.6	10.5	5.5	8.0	7.0	5.7	6.4	3.4	5.8	4.6	No sieve	3.5	N
Pass 1/4"	1.6	2.8	2.2	1.1	1.7	1.4	1.3	0.4	0.9	0.4	0.5	0.5	1.6	0.4	1.0	1.3	1.3	1.3	1.2	0.4	0.8	analysis.	0	a
Pass No.10	1.1	1.1	1.1	0.6	1.1	0.9	0.6	0.3	0.5	0.3	0.3	0.3	1.1	0.1	0.6	0.7	1.2	1.0	0.5	0.2	0.4	"	0	
Pass No.40	0	0	0	0	0.6	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.8	0.1	0.5	0.5	0.8	0.7	0.1	0.1	0.1	"	0	
3/8"-No.4 Sample																								
Actual Loss, Pass No.4	4.2	6.2	5.2	1.8	1.8	1.8	1.1	2.0	1.6	0.4	0.5	0.5	1.1	2.1	1.6	2.3	2.0	2.2	0.6	1.3	1.0	"	0	
Pass 1/4"	100.0	100.0	100.0	8.0	9.1	8.6	21.0	15.2	18.1	4.9	7.0	6.0	24.3	24.4	24.4	8.8	21.9	15.4	5.9	7.0	6.5	"	5.0	
Pass No.10	1.4	2.5	2.0	0.9	0	0.5	0.3	0.6	0.5	0.3	0.3	0.3	0.4	0.8	0.6	1.3	1.0	1.2	0.5	0.6	0.6	"	0	
Pass No.40	0	0	0	0	0	0	0.2	0.1	0.2	0.2	0.1	0.2	0.3	0.4	0.4	0.3	0.5	0.4	0.2	0.1	0.2	"	0	
Total Weighted Loss	-	-	8.3	-	-	5.5	-	-	5.3	-	-	3.5	-	-	7.5	-	-	4.5	-	-	3.7	- - 0.3	1.4	
3/8"-1/4" Sample																								
Actual Loss, Pass 1/4"	14.5	15.4	15.0	6.7	7.4	7.1	1.7	3.6	2.7	2.0	2.0	2.0	3.9	0.4	2.2	3.5	3.9	3.7	2.3	2.4	2.4	This size not		
Pass 1/4"	14.5	15.4	15.0	6.7	7.4	7.1	1.7	3.6	2.7	2.0	2.0	2.0	3.9	0.4	2.2	3.5	3.9	3.7	2.3	2.4	2.4	tested on rou-	-	
Pass No.10	3.6	4.9	4.3	1.0	0.9	1.0	0.3	0.2	0.3	0.5	0.6	0.6	0.6	0.1	0.4	1.5	1.4	1.5	1.1	0.5	0.8	tine samples.		
Pass No.40	0.9	0	0.5	0	0	0	0.2	0.1	0.2	0.4	0.5	0.5	0.3	0	0.2	0.5	0.9	0.7	0.3	0	0.2			
Tex-410-A, Los Angeles Abrasion Test (% by Wt.)																								
3/8"-No.4, L. A. Abrasion Value	21.6	21.7	21.7	22.2	22.2	22.2	19.6	19.6	19.6	20.6	20.8	20.7	20.0	19.6	19.8	19.2	19.5	19.4	20.3	19.7	20.0	19.7	20.0	2
Pass 1/4"	85.9	86.2	86.1	85.4	85.4	85.4	80.0	81.6	80.8	80.9	80.5	80.7	85.0	84.9	85.0	80.2	78.6	79.4	80.2	78.1	79.2	No sieve	94.8	9
Pass No.10	24.6	24.8	24.7	25.8	25.9	25.9	22.4	22.8	22.6	23.8	23.9	23.9	23.0	23.1	23.1	22.8	23.1	23.0	23.2	22.9	23.1	analysis.	23.4	2
Pass No.40	10.8	10.7	10.8	11.3	11.4	11.4	11.9	10.9	11.4	12.2	11.7	12.0	9.8	9.8	9.8	9.9	9.6	9.8	10.0	9.1	9.6	"	10.0	1
3/8"-1/4", L. A. Abrasion Value	20.2	20.3	20.3	21.4	21.4	21.4	19.3	19.1	19.2	18.9	19.6	19.3	19.7	19.8	19.8	19.4	19.2	19.3	20.4	21.0	20.7	These tests		
Pass 1/4"	71.5	72.3	71.9	70.0	70.1	70.1	74.4	66.6	70.5	63.1	63.2	63.2	71.9	71.7	71.8	65.0	65.3	65.2	63.5	64.7	64.1	not perform-		
Pass No.10	23.5	23.7	23.6	24.9	25.0	25.0	22.1	21.8	22.0	21.3	22.2	21.8	23.2	23.3	23.3	22.2	22.3	22.3	23.9	24.7	24.3	ed on routine	-	
Pass No.40	19.8	19.8	19.8	11.5	11.4	11.5	11.4	11.4	11.4	11.2	11.8	11.5	10.2	10.2	10.2	10.2	10.1	10.2	9.5	10.2	9.9	samples.		
3,000 gms. - 500 rev.																								
3/8"-No.4, L. A. Abrasion Value	29.6	29.5	29.6	31.2	31.2	31.2	28.0	28.2	28.1	31.0	31.1	31.1	28.8	28.7	28.8	28.7	29.1	28.9	38.8	30.0	34.4	"		
Pass 1/4"	93.3	93.3	93.3	92.3	92.6	92.5	88.8	90.0	89.4	91.0	90.8	90.9	91.0	91.0	91.0	90.0	90.1	90.1	87.8	92.0	89.9	"		
Pass No.10	34.3	34.3	34.3	36.7	36.6	36.7	33.0	32.9	33.0	35.6	35.7	35.7	33.6	33.7	33.7	33.3	33.1	33.2	43.8	35.3	39.6	"		
Pass No.40	13.2	13.2	13.2	15.4	15.6	15.5	15.0	14.7	14.9	16.4	16.1	16.3	13.3	13.1	13.2	23.2	13.4	18.3	26.7	13.5	20.1	"	-	
3/8"-1/4", L. A. Abrasion Value	28.6	28.7	28.7	30.5	30.5	30.5	26.9	27.5	27.2	28.7	29.2	29.0	27.7	27.6	27.7	27.1	27.4	27.3	29.1	28.8	29.0	"		
Pass 1/4"	85.0	86.1	85.6	83.2	83.3	83.3	79.1	79.4	79.3	80.2	79.6	79.9	82.0	82.1	82.1	80.7	80.5	80.6	82.1	82.1	82.1	"		
Pass No.10	33.2	33.7	33.5	34.9	35.0	35.0	31.2	31.3	31.3	33.0	33.1	33.1	32.2	32.3	32.3	31.0	31.1	31.1	34.8	33.2	34.0	"		
Pass No.40	13.2	13.0	13.1	15.5	15.5	15.5	14.7	14.4	14.6	15.2	15.9	15.6	13.1	12.9	13.0	12.7	13.3	13.0	12.2	12.7	12.5	"	-	

	72-1400-F	72-1401-F	72-1452-F	72-1520-F	72-1604-F	72-1661-F	72-1678-F	72-1699-F	72-1771-F	72-1825-F	72-1862-F	72-2329-F	72-2607-F	73-1-F
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3.5	No sieve	9.1	3.5	14.5	17.0	Not	6.0	7.5	Size not	3.5	9.2	6.0	2.0
	0	analysis	0.5	4.5	4.5	1.0	tested.	0.5	0.5	available	0.5	1.0	0.3	0.6
	0	"	0.5	0	0	0	"	0.5	0	in sample.	0.5	0.5	0.2	0.5
	0	"	0	0	0	0	"	0	0		0	0.2	0.1	0.1
	0	"	0	0	1.0	2.0	"	1.0	2.0	5.0	1.0	0.4	0.9	1.1
	5.0	"	1.0	6.0	23.8	8.8	"	12.0	31.0	77.0	20.0	4.5	37.9	40.1
	0	"	0	0	0	0	"	0	1.0	1.0	0	0.7	0.2	0.3
	0	"	0	0	0	0	"	0	0	0	0	0.5	0.1	0.1
	1.4	1.9	4.2	1.4	6.6	6.6	"	2.4	4.0	4.5	2.2	3.5	2.2	1.7
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20.0	21.0	20.1	20.9	20.3	19.7	20.0	20.0	19.2	18.0	17.8	19.8	21.6	22.1
	94.8	94.8	94.9	No	72.2	71.1	74.0	63.6	66.9	82.0	76.9	79.1	No sieve	No sieve
	23.4	23.8	24.0	sieve	22.9	22.5	21.8	21.4	21.7	20.8	20.7	22.3	analysis.	analysis.
	10.0	10.1	10.2	analysis.	11.1	11.1	10.2	11.1	10.3	8.4	8.9	10.1	"	"
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-

72-1699-F	72-1771-F	72-1825-F	72-1862-F	72-2329-F	72-2607-F	73-1-F	73-43-F	73-44-F	73-68-F	73-69-F	73-216-F	Statistical A[illegible]	
												X	σ
-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.0	7.5	Size not	3.5	9.2	6.0	2.0	11.8	6.9	14.1	1.8	7.8		
0.5	0.5	available	0.5	1.0	0.3	0.6	1.2	4.6	0.7	0.7	0.3		
0.5	0	in sample.	0.5	0.5	0.2	0.5	0.5	0.4	0.4	0.4	0.2	0.46	0.36
0	0		0	0.2	0.1	0.1	0.3	0.3	0.3	0.3	0.1		
1.0	2.0	5.0	1.0	0.4	0.9	1.1	0.8	0.6	1.3	1.2	0.5		
12.0	31.0	77.0	20.0	4.5	37.9	40.1	31.1	13.1	22.2	14.7	16.7		
0	1.0	1.0	0	0.7	0.2	0.3	0.4	0.5	0.5	0.5	0.3	0.53	0.54
0	0	0	0	0.5	0.1	0.1	0.2	0.4	0.4	0.4	0.1		
2.4	4.0	4.5	2.2	3.5	2.2	1.7	5.3	3.1	8.5	1.5	2.3	3.92	2.25
-	-	-	-	-	-	-	-	-	-	-	-		
												1.23	1.37
20.0	19.2	18.0	17.8	19.8	21.6	22.1	17.8	17.8	19.2	18.2	18.6	19.95	1.25
63.6	66.9	82.0	76.9	79.1	No sieve	No sieve	74.0	69.4	70.6	70.1	75.5		
21.4	21.7	20.8	20.7	22.3	analysis.	analysis.	21.6	20.8	21.6	21.5	22.6	22.85	1.35
11.1	10.3	8.4	8.9	10.1	"	"	9.3	9.6	10.4	9.8	8.6		
												19.98	0.83
-	-	-	-	-	-	-	-	-	-	-	-	23.15	1.20
												30.29	2.70
-	-	-	-	-	-	-	-	-	-	-	-	35.14	2.82
												28.45	1.15
-	-	-	-	-	-	-	-	-	-	-	-	32.86	1.41

F	73-69-F	73-216-F	Statistical Analysis For Trends $\bar{X}$	σ	CV(%)	R
	-	-	-	-	-	-
	1.8	7.8				
	0.7	0.3				
	0.4	0.2	0.46	0.36	78.40	1.2
	0.3	0.1				
	1.2	0.5				
	14.7	16.7				
	0.5	0.3	0.53	0.54	103.00	2.5
	0.4	0.1				
	1.5	2.3	3.92	2.25	57.51	8.2
	-	-				
			1.23	1.37	111.58	4.8
	18.2	18.6	19.95	1.25	6.27	4.4
	70.1	75.5				
	21.5	22.6	22.85	1.35	5.91	5.2
	9.8	8.6				
			19.98	0.83	4.17	2.5
	-	-	23.15	1.20	5.19	3.7
			30.29	2.70	8.92	10.8
	-	-	35.14	2.82	8.02	10.9
			28.45	1.15	4.04	3.6
	-	-	32.86	1.41	4.31	4.0

TABLE I continued

FEATHERLITE - RANGER

Test Method and Size	R3-71-139 A	B	Avg.	R3-71-663 A	B	Avg.	R3-72-152 A	B	Avg.	R3-72-158 A	B	Avg.	R3-72-172 A	B	Avg.	R3-72-193 A	B	Avg.	R3-73-61 A	B	Avg.
Bituminous Section Mill 3/8"-1/4" (% by Wt.)																					
Ribbed bucket- 1 hr. Pass 1/4"	23.0	20.6	22.2	19.6	20.8	20.2	12.7	14.6	13.7	18.1	17.7	17.9	13.5	15.7	14.6	14.7	14.6	14.7	10.3	10.3	10.3
@ 72 r.p.m. Sample dry. Pass No. 10	5.9	5.9	5.9	5.9	5.7	5.8	6.9	6.6	6.8	7.8	8.1	8.0	5.3	5.6	5.5	5.5	5.2	5.4	5.7	5.8	5.8
Pass No. 40	5.4	5.4	5.4	5.4	5.3	5.4	6.6	6.4	6.5	7.2	7.7	7.5	5.0	5.2	5.1	5.2	4.8	5.0	5.1	5.2	5.2
Bituminous Section Motorized Press 3/8"-1/4" (% by Wt.) 50 gyr. @ constant 150 p.s.i.																					
Pass 1/4"	64.1	65.8	65.0	56.6	59.2	57.9	59.4	60.3	59.9	59.0	58.1	58.6	64.4	65.2	64.8	53.3	52.4	52.9	60.2	60.2	60.2
Pass No. 10	27.9	28.1	28.0	26.7	29.2	28.0	27.9	28.4	28.2	29.8	26.7	28.3	26.8	24.7	25.8	24.9	25.4	25.2	31.8	32.0	31.9
Pass No. 40	13.3	13.7	13.5	13.2	14.9	14.1	15.0	15.7	15.4	17.5	14.6	16.1	13.3	11.9	12.6	12.2	13.0	12.6	15.9	16.0	16.0
50 gyr. @ constant 150 p.s.i., then applied 2,500 p.s.i.																					
Pass 1/4"	66.0	63.6	64.8	63.1	64.4	63.8	62.3	61.7	62.0	63.2	64.7	64.0	68.9	68.6	68.8	61.9	61.3	61.6	67.3	66.6	67.0
Pass No. 10	29.0	27.3	28.2	29.0	29.2	29.1	29.0	27.8	28.4	31.2	31.5	31.4	29.0	30.7	29.9	30.4	30.2	30.3	35.5	35.2	35.4
Pass No. 40	13.3	12.2	12.8	14.0	13.6	13.8	15.4	14.3	14.9	17.5	17.5	17.5	14.0	15.5	14.8	15.7	16.3	16.0	17.7	17.4	17.6
Applied 2,500 p.s.i., then 50 gyr. @ constant 150 p.s.i.																					
Pass 1/4"	83.0	78.7	80.9	80.6	80.5	80.6	76.2	76.2	76.2	79.0	79.0	79.0	81.6	82.0	81.8	79.4	79.2	79.3	77.7	78.0	77.9
Pass No. 10	41.3	39.8	40.6	41.0	41.0	41.0	40.1	39.7	39.9	44.6	43.6	44.1	40.7	40.3	40.5	41.6	42.6	41.1	43.4	43.6	43.5
Pass No. 40	19.8	19.0	19.4	19.7	20.0	19.9	21.9	21.5	21.7	26.1	25.1	25.6	20.7	19.9	20.3	21.5	22.8	22.2	21.9	22.3	22.1
Sandblast Test (% by Wt.) Standard Procedure																					
1/2"-No.4 Sample	1.2	1.2	1.2	2.3	2.2	2.3	2.8	3.4	3.1	1.9	1.5	1.7	1.8	1.6	1.7	1.8	1.6	1.7	1.8	1.9	1.9
3/8"-1/4" Sample	1.5	2.0	1.8	3.1	2.6	2.9	3.4	3.6	3.5	1.9	2.2	2.1	2.4	2.4	2.4	2.4	2.5	2.5	2.7	2.5	2.6
2,400 gms. sand 3/8"-1/4" Sample	2.5	2.4	2.5	7.6	7.2	7.4	5.5	5.0	5.3	3.2	3.6	3.4	4.1	4.5	4.3	3.6	3.9	3.8	4.5	4.3	4.4
3,600 gms. sand 3/8"-1/4" Sample	4.6	5.1	4.9	10.4	9.2	9.8	6.1	5.8	6.0	5.3	4.9	5.1	5.6	5.4	5.5	5.2	4.8	5.0	5.3	5.3	5.3
British Aggregate Crushing Value Test-3/8"-1/4" (% by Wt.)																					
Pass 1/4"	78.6	79.4	79.0	74.3	72.5	73.4	73.8	75.8	74.8	75.3	73.0	74.2	79.4	79.0	79.2	75.9	76.2	76.1	76.1	76.5	76.3
Pass No. 10	33.0	34.2	33.6	32.0	31.4	31.7	34.5	36.3	35.4	37.4	37.2	37.3	33.5	34.5	34.0	33.8	34.1	34.0	35.4	35.2	35.3
Pass No. 40	10.3	12.1	11.2	11.0	11.4	11.2	13.3	14.4	13.9	16.3	15.4	15.9	11.3	12.1	11.7	11.3	11.4	11.4	11.2	11.1	11.2
British Aggregate Impact Value																					
1/2"-3/8" Sample, Aggr. Impact Value	24	26	25	36	37	37	24	25	25	31	30	31	30	29	30	31	31	31	34	34	34
Pass 1/4"	52.2	54.6	53.4	66.9	67.9	67.4	53.2	52.7	53.0	53.3	53.5	53.4	60.7	58.5	59.6	60.0	60.7	60.4	64.5	64.1	64.3
Pass No. 10	21.5	23.1	22.3	34.0	34.7	34.4	21.5	22.1	21.8	25.7	25.9	25.8	27.1	26.6	26.9	28.5	27.9	28.2	30.4	30.7	30.6
Pass No. 40	6.6	6.8	6.7	12.8	13.1	13.0	8.1	7.7	7.9	10.6	10.3	10.5	9.5	8.9	9.2	10.0	9.8	9.9	10.7	10.0	10.4
3/8"-1/4" Sample, Aggr. Impact Value	32	33	33	36	35	36	26	28	27	37	36	37	29	29	29	34	35	35	33	33	33
Pass 1/4"	76.3	76.0	76.2	75.7	76.0	75.9	61.0	64.8	62.9	71.9	73.0	72.5	69.5	68.3	68.9	67.9	68.6	68.3	69.2	69.3	69.3
Pass No. 10	28.3	29.8	29.1	33.3	32.1	32.7	22.8	24.4	23.6	33.8	32.5	33.2	28.3	25.9	27.1	31.2	31.6	31.4	30.6	28.6	29.6
Pass No. 40	9.3	9.6	9.5	11.8	11.1	11.5	8.9	9.8	9.4	14.1	14.2	14.2	9.3	8.7	9.0	10.8	11.1	11.0	10.2	9.8	10.0

-61		72-1385-F			72-1400-F			72-1401-F			72-1452-F			72-1520-F			72-1604-F			72-1661-F			72-1678-F			72-1699-F		
	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.
		This test not																										
		performed on																										
.3	10.3	routine sam-																										
.8	5.8	ples.				-			-			-			-			-			-			-			-	
.2	5.2	"																										
.2	60.2	53.5	52.3	52.9	59.0	59.8	59.4	Insufficient			55.8	57.2	56.5	54.6	52.4	56.0	54.5	51.1	52.8	58.9	54.5	56.7	59.7	60.8	60.3	54.8	53.0	53.9
.0	31.9	28.8	25.7	27.3	28.2	28.4	28.3	material for			26.0	26.4	26.2	25.4	26.3	25.9	26.7	24.0	25.4	27.9	26.5	27.2	27.2	26.5	26.9	28.5	26.0	27.3
.0	16.0	15.8	13.0	14.4	14.3	14.5	14.4	test.			13.2	13.2	13.2	13.4	13.8	13.6	14.2	12.2	13.2	14.4	13.6	14.0	13.5	13.5	13.5	15.9	13.6	14.8
		This test not																										
.6	67.0	performed on																										
.2	35.4	routine sam-				-			-			-			-			-			-			-			-	
.4	17.6	ples.																										
.0	77.9	76.0	71.6	73.8	76.2	78.3	77.2	Insufficient			77.9	75.9	76.9	79.0	77.2	78.1	75.6	76.6	76.1	78.7	78.2	78.5	80.9	80.2	80.6	74.4	74.7	74.6
.6	43.5	41.3	39.3	40.3	40.1	41.5	40.8	material for			41.3	40.9	41.1	42.8	40.7	41.8	39.4	39.3	39.4	41.5	42.3	41.9	40.7	42.0	41.4	38.2	40.3	39.3
.3	22.1	22.7	21.8	22.3	20.8	21.4	21.1	test.			22.4	22.8	22.6	23.7	22.2	23.0	20.9	20.8	20.9	23.0	24.0	23.5	21.1	22.7	21.9	21.1	22.5	21.8
1.9	1.9	These tests not																										
2.5	2.6	performed on																										
		routine samples.				-			-			-			-			-			-			-			-	
4.3	4.4	"																										
5.3	5.3	"																										
5.5	76.3	"																										
5.2	35.3	"				-			-			-			-			-			-			-			-	
1.1	11.2	"																										
34	34	"																										
4.1	64.3	"																										
0.7	30.6	"				-			-			-			-			-			-			-			-	
0.0	10.4	"																										
33	33	36	34	35	34	33	34	33	30	32	34	34	34	32	31	32	26	24	25	32	31	32	30	32	31	23	22	23
9.3	69.3	70.2	68.6	69.4	70.9	70.4	70.7	79.1	76.9	78.0	70.1	70.8	70.5	69.7	68.7	69.2	69.1	70.2	69.7	70.8	67.9	69.4	69.5	69.2	69.4	58.7	52.7	55.7
8.6	29.6	32.0	30.1	31.1	30.3	29.3	29.8	30.2	28.3	29.3	30.8	31.2	31.0	29.7	26.3	28.0	29.7	29.1	29.4	28.1	27.7	27.9	27.1	28.5	27.8	22.7	19.9	21.3
9.8	10.0	13.7	12.5	13.1	11.2	10.4	10.8	10.6	10.1	10.4	12.2	12.2	12.2	11.6	10.4	11.0	11.5	10.5	11.0	11.8	12.1	12.0	9.9	10.8	10.4	9.5	8.2	8.9

-F	72-1699-F			72-1771-F			72-1825-F			72-1862-F			72-2329-F			72-2607-F			73-1-F			73-43-F			73-44-F			73-68-F		
Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.
		-			-			-			-			-			-			-			-			-			-	
60.3	54.8	53.0	53.9	59.0	58.1	58.6	78.9	78.5	78.7	57.6	56.6	57.1	54.9	55.2	55.1	65.0	63.7	64.4	56.8	56.8	56.8	62.8	62.8	62.8	62.0	62.7	62.4	57.4	57.4	57.4
26.9	28.5	26.0	27.3	27.9	26.8	27.4	24.1	25.9	25.0	28.6	28.5	28.6	26.8	26.5	26.7	28.4	27.4	27.9	25.5	26.0	25.8	29.7	29.6	29.7	28.4	28.4	28.4	28.0	27.5	27.8
13.5	15.9	13.6	14.8	13.9	13.2	13.6	13.2	13.3	13.3	13.8	13.6	13.7	14.0	13.8	13.9	13.9	13.3	13.6	14.3	14.4	14.4	15.6	15.8	15.7	14.6	14.6	14.6	14.8	14.2	14.5
		-			-			-			-			-			-			-			-			-			-	
80.6	74.4	74.7	74.6	81.3	81.3	81.3	88.3	87.8	88.1	80.8	80.0	80.4	77.4	78.1	77.8	81.1	81.8	81.5	76.7	77.1	76.9	81.9	82.0	82.0	81.7	81.2	81.5	77.0	78.2	77.6
41.4	38.2	40.3	39.3	42.1	41.8	42.0	41.5	40.7	41.1	41.7	40.5	41.1	38.5	40.0	39.3	40.8	39.8	40.3	41.4	41.2	41.3	42.4	41.7	42.1	43.8	43.0	43.4	40.1	39.5	39.8
21.9	21.1	22.5	21.8	21.0	19.8	20.4	21.5	20.8	21.2	20.3	19.5	19.9	19.2	20.7	20.0	20.8	20.7	20.8	22.3	22.4	22.4	24.1	22.1	23.1	22.7	22.1	22.4	20.8	20.4	20.6
		-			-			-			-			-			-			-			-			-			-	
		-			-			-			-			-			-			-			-			-			-	
		-			-			-			-			-			-			-			-			-			-	
31	23	22	23	31	32	32	34	34	34	34	34	34	31	30	31	31	32	32	36	36	36	31	31	31	33	34	34	30	31	31
69.4	58.7	52.7	55.7	72.6	69.8	71.2	82.8	81.6	82.2	75.1	75.0	75.1	69.6	69.0	69.3	74.6	77.3	76.0	73.8	72.3	73.1	71.6	71.3	71.5	71.9	73.0	72.5	70.4	70.6	70.5
27.8	22.7	19.9	21.3	27.9	29.5	28.7	30.2	29.3	29.8	31.5	31.7	31.6	28.4	27.9	28.2	30.5	31.2	30.9	33.4	32.2	32.8	27.4	27.7	27.6	31.0	32.3	31.7	27.0	28.7	27.9
10.4	9.5	8.2	8.9	9.0	10.0	9.5	10.8	10.8	10.8	11.2	11.7	11.5	10.1	10.2	10.2	11.4	11.0	11.2	12.7	12.6	12.9	9.1	9.4	9.3	11.6	11.3	11.5	9.5	10.6	10.1

73-68-F			73-69-F			73-216-F			Statistical Analysis for Trends			
A	B	Avg.	A	B	Avg.	A	B	Avg.	X	σ	CV(%)	R
	-			-		-			6.14	0.89	14.54	2.9
57.4	57.4	57.4										
28.0	27.5	27.8	58.0	59.0	58.5	67.8	64.1	66.0				
14.8	14.2	14.5	27.9	28.1	28.0	33.6	32.0	32.8	27.58	1.97	7.13	9.5
			14.0	14.4	14.2	17.6	16.6	17.1				
	-			-		-			-	-	-	-
77.0	78.2	77.6										
40.1	39.5	39.8	80.8	81.0	80.5	82.4	82.3	82.4				
20.8	20.4	20.6	38.6	40.3	39.5	42.3	42.5	42.4	41.14	1.42	3.45	6.4
			19.1	21.0	20.1	21.1	21.3	21.2				
	-			-		-			-	-	-	-
	-			-		-			34.46	1.76	5.09	6.0
									30.14	4.24	14.07	13
	-			-		-			27.12	4.29	15.82	13.2
30	31	31	34	35	35	35	34	35	32.04	3.28	10.24	15
70.4	70.6	70.5	68.3	67.3	67.8	79.8	74.3	77.1				
27.0	28.7	27.9	28.2	26.3	27.3	30.7	30.2	30.5	29.21	2.73	9.35	13.9
9.5	10.6	10.1	10.0	7.8	8.9	10.8	10.5	10.7				

TABLE II
TEXAS INDUSTRIES - EASTLAND

Test Method and Size	R3-70-1363	R3-71-661	R3-72-159	R3-72-171	R3-72-192	R3-73-60	72-1386-F Gr. 4	72-1521-F Gr. 4	72-1662-F Gr. 4	72-1785-F
Tex-200-F, Sieve Analysis										
(% by Wt.) Ret. 5/8"	0	0	0	0	0	0				
Ret. 1/2"	0.3	0	0	0	0	0	These tests not performed on routine samples.			
Ret. 3/8"	21.1	52.8	35.1	38.5	33.4	45.8		-	-	-
Ret. 1/4"	74.8	97.0	92.8	97.6	95.7	98.0				
Ret. No. 4	91.0	97.9	95.5	99.1	98.3	99.0				
Ret. No. 10	98.1	98.7	97.7	99.6	99.0	99.8	"			
Tex-201-F - 3/8"-1/4"										
Specific Gravity	1.588	1.493	1.616	1.600	1.575	1.581	"	-	-	-
Water Absorption (% by Wt.)	6.3	7.0	6.6	6.3	7.5	6.5				
Tex-433-A - 3/8"-1/4"										
Specific Gravity	1.627	1.516	1.631	1.617	1.607	1.613	"	-	-	-
Water Absorption (% by Wt.)	5.3	5.4	5.6	5.2	5.8	4.7	"			
Tex-109-E - 3/8"-1/4"										
Specific Gravity	2.163	2.127	2.178	2.173	2.173	2.174	"	-	-	-
Water Absorption (% by Wt.)	16.0	17.3	13.2	9.7	14.3	13.0	"			
Tex-404-A, Unit Weight (lbs./ft.^{3})										
Standard - 3/8"-1/4"	52.87	49.58	53.77	49.31	51.19	51.45	"	-	-	-
Rodded - 3/8"-1/4"	54.70	51.67	56.88	55.82	54.80	55.48	"	-	-	-
Standard - As received.	53.61	49.49	53.81	50.23	51.83	51.89	54.09	55.22	51.47	55.48
Rodded - As received.	55.76	51.59	57.58	56.00	54.12	55.96	-	-	-	-
Tex-431-A, Pressure Slaking.										
Standard Method										
3/4"-No. 10 (Loss, % by Wt.)	1.4	1.8	1.3	1.5	1.4	1.4	1.2	1.5	1.0	0.8
3/8"-1/4" (Loss, % by Wt.)	1.1	1.9	1.2	1.1	1.4	1.1	-	-	-	-
Alternate Method										
3/4"- No. 10 (Loss, % by Wt.)	1.4	1.6	1.4	1.3	1.2	1.3	-	-	-	-
3/8"-1/4" (Loss, % by Wt.)	1.5	1.5	1.2	1.4	1.4	1.0	-	-	-	-

2-1785-F	72-2386-F	72-2608-F Gr. 5	72-2609-F Gr. 4	72-2718-F	72-2836-F	73-89-F	73-225-F	73-347-F Gr. 4	73-349-F Gr. 4	73-385-F	73-461-F	73-477-F Gr. 4	73-987-F	73-1 G
-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	.
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55.48	55.36	54.81	51.75	57.22	50.79	50.95	56.74	49.91	51.41	49.81	54.42	49.85	54.08	53.
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.8	1.1	1.2	1.6	1.3	1.3	1.5	0.7	1.0	1.1	1.3	1.8	1.9	1.5	1.3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

73-987-F	73-1096-F Gr. 4	73-1098-F Gr. 4	Statistical Analysis for Trends $\bar{X}$	σ	CV(%)	R
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
54.08	53.13	53.36	52.83	2.28	4.31	7.73
-	-	-	-	-	-	-
1.5	1.3	1.1	1.32	0.29	22.19	1.2
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

TABLE II continued

TEXAS INDUSTRIES - EASTLAND

Test Method & Size	R3-70-1363 A	B	Avg.	R3-71-661 A	B	Avg.	R3-72-159 A	B	Avg.	R3-72-171 A	B	Avg.	R3-72-192 A	B	Avg.	R3-73-60 A	B	Avg.	72-1386-F	72-1521-F
Tex-432-A, Freeze & Thaw Test (% by Wt.)																				
5/8"-1/2" Sample																				
Actual Loss, Pass 1/2"	28.4	27.4	27.9	Size not																
Pass 1/4"	15.3	14.5	14.9	available				-			-			-			-		-	-
Pass No. 10	2.2	2.7	2.5	in sample.																
Pass No. 40	1.1	0.5	0.8																	
1/2"-3/8" Sample																				
Actual Loss, Pass 3/8"	6.0	7.0	6.5	31.6	32.2	31.9	16.6	13.8	15.2	16.5	16.8	16.7	7.5	10.7	9.1	20.1	16.4	18.3	4.3	3.5
Pass 1/4"	2.0	5.0	3.5	2.9	2.9	2.9	3.3	1.7	2.5	1.5	1.0	1.3	2.3	3.6	3.0	2.4	3.3	2.9	1.5	2.5
Pass No. 10	1.5	2.0	1.8	1.8	1.8	1.8	1.4	1.0	1.2	0.5	0.5	0.5	1.6	1.7	1.7	1.3	1.2	1.3	0.6	0.5
Pass No. 40	0.5	0.5	0.5	0.6	0.6	0.6	0.3	0.3	0.3	0.2	0.2	0.2	1.2	1.1	1.2	0.6	0.2	0.4	0.1	0
3/8"-No. 4 Sample																				
Actual Loss, Pass No. 4	7.0	9.8	8.4	3.4	3.7	3.6	1.3	3.1	2.2	0.9	1.5	1.2	3.1	2.1	2.6	2.0	0.8	1.4	4.3	1.0
Pass 1/4"	97.9	95.2	96.6	5.4	6.7	6.1	5.6	4.6	5.1	8.2	4.0	6.1	7.1	5.4	6.3	3.0	2.3	2.7	47.0	3.0
Pass No. 10	2.3	4.9	3.6	2.0	1.5	1.8	0.6	1.6	1.1	0.6	0.9	0.8	2.6	1.9	2.3	0.7	0.5	0.6	2.8	1.0
Pass No. 40	0	2.4	1.2	0.7	0.7	0.7	0.3	0.4	0.4	0.5	0.2	0.4	1.8	1.8	1.8	0.2	0.2	0.2	0.6	0
Total Weighted Loss	-	-	8.1	-	-	18.9	-	-	7.6	-	-	8.4	-	-	6.8	-	-	10.3	3.1	2.2
3/8"-1/4" Sample																				
Actual Loss, Pass 1/4"	5.9	4.3	5.1	1.3	1.8	1.6	2.5	5.0	3.8	2.8	3.5	3.2	6.6	4.9	5.8	3.2	3.9	3.6	This size	
Pass 1/4"	5.9	4.3	5.1	1.3	1.8	1.6	2.5	5.0	3.8	2.8	3.5	3.2	6.6	4.9	5.8	3.2	3.9	3.6	not tested	
Pass No. 10	1.0	1.7	1.4	0.7	1.2	1.0	0.4	1.7	1.1	0.6	0.5	0.6	3.4	2.0	2.7	1.2	1.5	1.4	on routine	-
Pass No. 40	0	0	0	0	0.6	0.3	0.2	1.2	0.7	0.2	0.2	0.2	2.8	1.9	2.4	0.1	0.2	0.2	samples.	
Tex-410-A, Los Angeles Abrasion Test (% by Wt.)																				
3/8"-No. 4, L. A. Abrasion Value	22.1	22.5	22.3	20.8	20.8	20.8	20.6	20.8	20.7	20.4	20.6	20.5	19.4	19.9	19.7	21.1	20.9	21.0	21.8	22.0
Pass 1/4"	85.3	85.5	85.4	81.2	81.2	81.2	82.1	81.9	82.0	77.4	77.5	77.5	75.4	77.2	76.3	77.2	73.2	75.2	No sieve	78.3
Pass No. 10	25.5	25.4	25.5	24.0	23.9	24.0	24.8	24.9	24.9	24.4	24.3	24.4	23.1	23.6	23.4	24.6	24.4	24.5	analysis.	24.8
Pass No. 40	9.8	9.8	9.8	9.5	9.4	9.5	8.8	8.8	8.8	8.9	9.1	9.0	9.1	8.5	8.8	8.1	8.7	8.4	"	8.7
3/8"-1/4", L. A. Abrasion Value	21.9	22.4	22.2	20.1	20.0	20.1	21.5	19.9	20.7	20.3	20.4	20.4	19.0	20.3	19.7	21.0	21.3	21.2	These tests	
Pass 1/4"	73.5	73.0	73.3	64.4	64.4	64.4	68.8	67.6	68.2	67.4	67.8	67.6	64.3	64.2	64.3	65.6	65.9	65.8	not performed	
Pass No. 10	25.5	25.2	25.4	23.4	23.4	23.4	25.2	23.1	24.2	23.6	23.5	23.6	22.7	23.6	23.2	24.8	24.6	24.7	on routine	-
Pass No. 40	10.5	9.9	10.2	9.8	9.8	9.8	9.8	8.8	9.3	9.1	8.9	9.0	8.6	8.7	8.7	9.5	8.3	8.9	samples.	
3,000 gms. - 500 rev.																				
3/8"-No. 4, L. A. Abrasion Value	31.1	31.2	31.2	30.2	30.2	30.2	30.1	28.6	29.4	27.9	One	27.9	28.6	29.8	29.2	28.6	29.2	28.9	"	
Pass 1/4"	93.4	93.0	93.2	90.1	90.1	90.1	89.6	90.0	89.8	88.0	sam-	88.0	89.0	89.9	89.5	86.8	86.8	86.8	"	
Pass No. 10	35.3	35.9	35.6	35.4	35.3	35.4	35.7	34.3	35.0	32.2	ple	32.2	33.2	35.8	34.5	34.1	34.2	34.2	"	-
Pass No. 40	14.0	14.2	14.1	13.4	13.1	13.3	12.5	12.0	12.3	11.0	only.	11.0	12.7	12.0	12.4	12.3	12.0	12.2	"	
3/8"-1/4", L. A. Abrasion Value	31.5	32.1	31.8	28.3	28.4	28.4	27.8	27.9	27.9	26.7	26.8	26.8	28.4	27.5	28.0	25.5	33.2	29.4	"	
Pass 1/4"	86.0	85.9	86.0	77.9	77.9	77.9	79.9	78.8	79.3	77.7	77.4	77.6	77.5	79.3	78.4	74.6	78.3	76.5	"	
Pass No. 10	35.3	35.7	35.5	33.3	33.4	33.4	32.5	32.2	32.4	31.4	31.6	31.5	32.9	31.9	33.4	30.4	53.8	42.1	"	-
Pass No. 40	14.1	14.0	14.1	12.8	12.7	12.8	11.9	11.7	11.8	11.4	11.6	11.5	11.6	11.6	11.6	10.9	11.3	11.1	"	

72-1521-F	72-1662-F	72-1785-F	72-2386-F	72-2608-F	72-2609-F	72-2718-F	72-2836-F	73-89-F	73-225-F	73-347-F	73-349-F	73-385-F	73-461-F	73-477-F
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.5	18.5	Size not available in sample.	16.6	Size not available in sample.	15.1	8.7	Size not available in sample.	21.1	Not Tested.	10.3	11.4	44.3	33.0	52.4
2.5	1.0		2.9		2.2	1.6		5.4	"	2.5	3.6	2.8	3.1	1.4
0.5	0.5		0.9		1.0	0.4		2.5	"	1.0	1.6	1.3	1.2	0.5
0	0		0.2		0.3	0.2		0.3	"	0.2	1.1	0.6	0.5	0.3
1.0	1.0	9.9	2.6	4.8	1.5	1.5	2.5	2.7	"	1.5	1.7	1.9	1.2	1.9
3.0	7.0	55.4	17.7	58.7	5.0	4.5	25.9	9.6	"	3.8	5.3	13.0	4.1	10.1
1.0	1.0	4.0	0.7	1.7	0.9	0.8	1.7	1.8	"	0.8	1.1	0.3	0.4	0.9
0	0	3.0	0.3	0.4	0.4	0.3	0.4	0.3	"	0.2	0.3	0	0	0.3
2.2	8.4	7.7	6.9	4.1	7.0	4.7	4.9	12.7	2.8	5.5	7.4	24.5	18.8	31.1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22.0	20.3	21.2	19.1	21.4	20.0	20.1	22.4	19.9	18.5	20.6	22.1	21.0	21.6	21.7
78.3	70.1	84.3	72.3	No sieve analysis.	No sieve analysis.	73.8	No sieve analysis.	88.0	No sieve analysis.	No sieve analysis.	No sieve analysis.	No sieve analysis.	68.9	No sieve analysis.
24.8	24.5	24.3	22.9			22.7		24.5					25.0	
8.7	9.0	11.3	8.0	"	"	8.6	"	8.2	"	"	"	"	9.2	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

73-477-F	73-987-F	73-1096-F Gr. 4	73-1098-F Gr. 4	Statistical Analysis for Trends $\bar{X}$	σ	CV(%)	R
-	-	-	-	-	-	-	-
52.4	7.0	No	No				
1.4	1.3	sieve	sieve				
0.5	0.3	analysis.	analysis.	1.14	0.58	50.97	2.2
0.3	0.2	"	"				
1.9	1.2	"	"				
10.1	2.4	"	"				
0.9	0.6	"	"	1.45	1.09	75.02	4.6
0.3	0.3	"	"				
31.1	4.7	3.3	4.3	8.97	7.14	79.61	28.9
-	-	-	-	1.33	0.83	62.99	3.0
21.7	20.0	22.0	23.0	20.92	1.05	5.03	4.5
No	86.0	No	No				
sieve	23.2	sieve	sieve	24.24	0.80	3.28	2.8
analysis.	8.8	analysis.	analysis.				
				20.68	0.96	4.66	3.4
-	-	-	-	24.05	0.95	3.94	2.8
				29.59	1.09	3.68	3.3
-	-	-	-	34.67	1.19	3.43	6.6
				28.68	2.35	8.19	7.7
-	-	-	-	34.53	6.26	18.12	23.4

TABLE II continued

TEXAS INDUSTRIES - EASTLAND

Test Method & Size		R3-70-1363			R3-71-661			R3-72-159			R3-72-171			R3-72-192			R3-73-60			72-1386-F			72-15	
		A	B	Avg.	A	B	Avg.	A	B -	Avg.	A	B.	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	
Bituminous Section Mill																								
3/8"-1/4" (% by Wt.)																								
Ribbed bucket - 1 hr.	Pass 1/4"	25.5	22.5	24.1	7.5	7.4	7.5	11.7	10.3	11.0	10.8	12.5	11.7	8.3	8.6	8.5	8.5	7.9	8.2	This test not performed on routine samples.				
@ 72 r.p.m. Sample	Pass No.10	4.9	4.9	4.9	5.2	5.3	5.3	4.3	4.6	4.5	4.3	4.4	4.4	4.2	4.3	4.3	4.9	5.2	5.1					
dry.	Pass No.40	4.2	4.2	4.2	4.6	4.8	4.7	3.8	3.8	3.8	3.8	3.8	3.8	3.7	3.8	3.8	4.3	4.5	4.4					
Bituminous Section Motorized Press																								
3/8"-1/4" (% by Wt.)																								
50 gyr. @ constant 150 p.s.i.																								
	Pass 1/4"	68.4	65.4	66.9	52.2	49.9	51.1	54.7	53.7	54.2	53.9	53.7	53.8	54.5	53.6	54.1	53.8	54.1	54.0	52.0	50.9	51.5	55.2	52
	Pass No.10	30.2	28.7	29.5	29.5	27.0	28.3	29.0	28.0	28.5	26.3	27.3	26.8	27.5	28.0	27.8	30.6	30.6	30.6	27.5	26.8	27.2	27.4	27
	Pass No.40	14.5	13.4	14.0	14.5	13.1	13.8	14.0	13.1	13.6	11.9	12.6	12.3	13.2	13.0	13.1	14.8	15.2	15.0	12.4	12.0	12.2	12.4	12
50 gyr. @ constant 150 p.s.i., then applied 2,500 p.s.i.																								
	Pass 1/4"	71.6	72.0	71.8	57.7	57.9	57.8	60.5	60.1	60.3	63.4	60.9	62.2	59.3	60.0	59.7	58.3	57.8	58.1	This test not performed on routine samples.				
	Pass No.10	30.8	31.8	31.3	30.7	30.3	30.5	30.7	30.5	30.6	30.9	30.7	30.8	31.3	30.7	31.0	31.7	31.1	31.4					
	Pass No.40	14.3	14.6	14.5	14.4	14.0	14.2	13.8	14.3	14.1	14.0	14.0	14.0	14.6	14.4	14.5	14.8	14.7	14.8					
Applied 2,500 p.s.i., then 50 gyr. @ constant 150 p.s.i.																								
	Pass 1/4"	83.1	83.6	83.4	74.6	75.3	75.0	75.1	75.0	75.1	76.7	77.4	77.1	77.0	76.7	76.9	76.4	77.5	77.0	76.8	77.1	77.0	76.4	76
	Pass No.10	41.1	41.1	41.1	40.1	40.1	40.1	37.9	38.6	38.3	39.2	39.8	39.5	40.9	41.5	41.2	39.0	39.7	39.4	40.4	40.9	40.7	39.0	38
	Pass No.40	18.9	18.6	18.8	19.4	19.3	19.4	18.1	17.5	17.8	18.5	19.2	18.9	19.4	20.7	20.1	17.8	19.8	18.8	19.4	19.5	19.5	18.7	18
Sandblast Test (% by Wt.)																								
Standard Procedure																								
1/2"-No.4 sample		1.3	1.3	1.3	1.7	1.8	1.8	1.3	1.3	1.3	1.1	1.1	1.1	1.5	1.7	1.6	1.9	1.9	1.9	These tests not performed on routine samples.				
3/8"-1/4" sample		2.2	2.5	2.4	2.2	2.4	2.3	1.9	2.1	2.0	1.3	1.4	1.4	2.0	1.9	2.0	2.7	2.4	2.6					
2,400 gms. sand 3/8"-1/4" sample		3.8	3.3	3.6	4.2	3.8	4.0	3.4	3.2	3.3	2.6	2.4	2.5	3.2	2.9	3.1	3.7	3.6	3.7					
3,600 gms. sand 3/8"-1/4" sample		6.4	6.0	6.2	5.5	5.5	5.5	5.5	5.5	5.5	3.8	4.0	3.9	4.9	4.8	4.9	5.6	5.5	5.6	"				
British Aggregate Crushing Value Test - 3/8"-1/4" (% by Wt.)																								
	Pass 1/4"	76.8	77.0	76.9	75.4	74.6	75.0	75.5	75.7	75.6	74.7	73.5	74.1	75.4	75.6	75.5	72.2	73.8	73.0	"				
	Pass No.10	33.3	34.4	33.9	34.3	34.0	34.2	32.2	33.5	32.9	32.1	30.0	31.1	33.4	35.3	34.4	32.6	33.3	33.0	"				
	Pass No.40	9.8	11.0	10.4	11.2	10.9	11.1	9.0	9.6	9.3	9.2	9.0	9.1	10.0	10.1	10.1	10.3	10.2	10.3	"				
British Aggregate Impact Value																								
1/2"-3/8" Sample, Aggr. Impact Value		24	28	26	31	31	31	26	26	26	31	31	31	30	30	30	31	31	31	"				
	Pass 1/4"	50.5	54.1	52.3	56.7	56.0	56.4	51.8	53.2	52.5	70.9	70.2	70.6	58.8	58.7	58.8	58.9	59.8	59.4	"				
	Pass No.10	21.0	24.7	22.9	27.5	27.4	27.5	22.9	23.4	23.2	28.7	28.4	28.6	25.6	27.2	26.4	27.8	29.2	28.5	"				
	Pass No.40	6.6	8.0	7.3	9.3	9.2	9.3	7.0	7.4	7.2	9.4	8.8	9.1	9.1	8.9	9.0	9.7	10.9	10.3	"				
3/8"-1/4" Sample, Aggr. Impact Value		34	34	34	33	34	34	29	28	29	30	29	30	29	28	29	33	33	33	33	34	34	30	31
	Pass 1/4"	72.3	73.7	73.7	64.1	66.7	65.4	66.9	62.0	64.5	62.3	60.4	61.4	63.8	63.1	63.5	71.5	70.5	71.0	69.8	69.5	69.7	68.6	68.
	Pass No.10	29.8	30.7	30.7	29.2	31.1	30.2	25.7	24.8	25.3	27.2	26.3	26.8	24.2	24.3	24.3	31.3	30.0	30.7	30.1	31.2	30.7	25.5	27.
	Pass No.40	8.9	10.2	10.2	10.3	11.3	10.8	8.2	8.0	8.1	8.6	8.6	8.6	7.9	7.9	7.9	11.2	10.9	11.1	10.1	10.3	10.2	8.4	8.

	-1386-F			72-1521-F			72-1662-F			72-1785-F			72-2386-F			72-2608-F			72-2609-F			72-2718-F			72-2836-F			73-89-F			
		B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A
is test not rformed on tine nples.					-			-			-			-			-			-			-			-			-		
	0	50.9	51.5	55.2	52.9	54.1	52.9	51.7	52.3	64.7	62.4	63.6	59.4	59.6	59.5	70.7	70.6	70.7	56.6	56.9	56.8	52.2	53.4	52.8	77.5	77.4	77.5	58.6	58.2	58.4	71.0
	5	26.8	27.2	27.4	27.7	27.6	25.5	25.2	25.4	26.0	27.1	26.6	28.5	26.3	27.4	27.6	27.4	27.5	28.1	29.1	28.6	27.5	29.0	28.3	29.2	29.9	29.6	29.0	29.4	29.2	27.7
	4	12.0	12.2	12.4	12.8	12.6	11.5	11.3	11.4	11.6	13.0	12.3	13.2	11.6	12.4	12.5	12.0	12.3	13.0	13.5	13.3	12.4	13.7	13.1	13.8	14.3	14.1	13.8	13.9	13.9	13.3
is test not rformed on tine nples.					-			-			-			-			-			-			-			-			-		
	3	77.1	77.0	76.4	76.9	76.7	78.3	75.9	77.1	84.4	82.7	83.6	78.2	78.8	78.5	86.5	86.9	86.7	79.7	79.3	79.5	73.7	73.9	73.8	90.5	89.6	90.1	78.4	79.1	78.8	87.8
	4	40.9	40.7	39.0	38.1	38.6	39.8	38.9	39.4	41.8	40.3	41.1	40.5	41.8	41.2	41.0	40.3	40.7	40.9	40.1	40.5	38.2	37.0	37.6	39.7	42.4	41.1	40.1	39.7	39.9	42.7
	4	19.5	19.5	18.7	18.2	18.5	18.3	18.1	18.2	19.8	18.6	19.2	18.9	19.4	19.2	18.1	17.7	17.9	18.4	18.4	18.4	18.2	17.0	17.6	17.1	18.3	17.7	19.2	19.1	19.2	21.1
se tests performed routine oles.					-			-			-			-			-			-			-			-			-		
		"																													
		" " "			-			-			-			-			-			-			-			-			-		
		" " " "			-			-			-			-			-			-			-			-			-		
		34	34	30	31	31	32	33	33	29	30	30	31	31	31	30	31	31	34	34	34	33	33	33	34	35	35	24	23	24	27
		69.5	69.7	68.6	68.7	68.1	70.2	69.8	70.0	72.2	71.4	71.8	64.1	67.2	65.7	81.5	82.1	81.8	70.8	70.0	70.4	65.5	64.2	64.9	83.2	86.2	84.7	62.2	62.4	62.3	78.7
		31.2	30.7	25.5	27.2	26.4	28.9	29.4	29.2	25.9	25.1	25.5	28.8	28.3	28.6	27.6	27.5	27.6	30.9	30.8	30.9	24.3	24.1	24.2	30.3	31.2	30.8	20.7	20.4	20.6	23.9
		10.3	10.2	8.4	8.6	8.5	8.8	9.2	9.0	8.2	7.7	8.0	9.5	8.9	9.2	7.9	8.2	8.1	9.8	10.3	10.1	8.9	7.2	8.1	8.7	9.3	9.0	5.8	5.5	5.7	7.1

73-89-F			73-225-F			73-347-F			73-349-F			73-385-F			73-461-F			73-477-F			73-987-F			73-1096-F	
A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B
	-			-			-			-			-			-			-			-			-
58.6	58.2	58.4	71.0	77.1	74.1	58.0	57.6	57.8	58.6	58.7	58.7	56.6	58.1	57.4	57.4	57.9	57.7	57.0	57.0	57.0	59.8	59.2	59.5	55.7	53.0
29.0	29.4	29.2	27.7	28.2	28.0	29.9	31.8	30.9	33.6	31.4	32.0	30.1	30.3	30.2	31.0	30.7	30.9	29.6	29.4	29.5	29.4	29.3	29.4	30.2	28.2
13.8	13.9	13.9	13.3	13.5	13.4	14.3	15.6	15.0	15.8	15.1	15.5	14.4	14.6	14.5	15.1	14.8	15.0	13.8	14.2	14.0	14.2	14.0	14.1	14.8	13.7
	-			-			-			-			-			-			-			-			-
78.4	79.1	78.8	87.8	85.7	86.8	78.0	77.9	78.0	75.9	74.4	75.2	78.6	76.3	77.5	80.0	80.0	80.0	78.3	77.4	77.9	78.2	79.4	78.8	78.5	80.1
40.1	39.7	39.9	42.7	40.7	41.7	40.8	37.9	40.4	40.6	39.1	39.9	42.8	40.8	41.8	42.0	41.5	41.8	41.8	41.1	41.5	40.4	40.6	40.5	41.7	41.7
19.2	19.1	19.2	21.1	20.2	20.7	20.1	18.6	19.4	20.0	18.8	19.4	20.9	19.5	20.2	21.0	20.6	20.8	20.0	18.6	19.3	19.8	19.8	19.8	20.8	21.2
	-			-			-			-			-			-			-			-			-
	-			-			-			-			-			-			-			-			-
	-			-			-			-			-			-			-			-			-
			27	28	28	31	31	31	34	34	34	35	36	36	31	30	31	30	30	30	33	34	34	33	32
24	23	24	78.7	80.5	79.6	74.7	73.7	74.2	69.3	68.4	68.9	72.4	72.8	72.6	68.0	70.2	69.1	68.7	68.4	68.6	73.8	73.4	73.6	70.2	70.0
62.2	62.4	62.3	23.9	26.9	25.4	29.0	30.1	29.6	29.9	29.8	29.9	32.2	33.4	32.8	27.8	27.0	27.4	27.6	27.2	27.4	29.9	30.2	30.1	29.7	29.0
20.7	20.4	20.6	7.1	8.4	7.8	8.5	9.5	9.0	9.4	9.2	9.3	10.6	11.0	10.8	8.6	8.5	8.6	9.5	9.0	9.3	9.1	9.3	9.2	9.8	9.8
5.8	5.5	5.7																							

73-987-F			73-1096-F			73-1098-F			Statistical Analysis for Trends			
A	B	Avg.	A	B	Avg.	A	B	Avg.	X	σ	CV(%)	R
	-			-			-		5.22	1.34	25.63	3.8
59.8	59.2	59.5	55.7	53.0	54.4	55.3	51.7	53.5				
29.4	29.3	29.4	30.2	28.2	29.2	27.6	24.4	26.0	28.70	1.92	6.70	9.2
14.2	14.0	14.1	14.8	13.7	14.3	13.3	10.5	11.9				
	-			-			-		-	-	-	-
78.2	79.4	78.8	78.5	80.1	79.3	79.7	78.9	79.3				
40.4	40.6	40.5	41.7	41.7	41.7	41.8	40.7	41.3	40.70	2.19	5.38	13.0
19.8	19.8	19.8	20.8	21.2	21.0	20.7	18.9	19.8				
-			-					-	-	-	-	-
-			-				-		34.03	2.62	7.70	9.5
									31.17	3.79	12.15	14
-			-					-	27.93	3.32	11.89	12.1
33	34	34	33	32	33	32	35	34	31.76	3.24	10.21	18
73.8	73.4	73.6	70.2	70.0	70.1	70.1	75.7	72.9				
29.9	30.2	30.1	29.7	29.0	29.4	29.2	32.4	30.8	28.44	3.37	11.84	17.5
9.1	9.3	9.2	9.8	9.8	9.8	9.9	11.2	10.6				

TABLE III

TEXAS INDUSTRIES - CLODINE

Test Method & Size	R3-70-535	R3-71-659	R3-72-153	R3-72-160	R3-72-169	R3-72-194	R3-73-90	72-1614-F	72-1637-F Gr. 4	72-1826-F	72-1827-F
Tex-200-F, Sieve Analysis											
(% by Wt.) Ret. 5/8"	0	0	0	0	0	0	0				
Ret. 1/2"	3.9	0	0	0	0	0	0	These tests			
Ret. 3/8"	72.6	8.7	14.5	11.4	6.9	30.0	6.1	not performed			
Ret. 1/4"	95.8	59.4	70.1	63.5	59.7	82.0	58.2	on routine	-	-	-
Ret. No. 4	97.7	86.2	94.2	88.8	90.0	96.0	86.8	samples.			
Ret. No. 10	99.0	97.4	98.9	97.2	99.2	99.0	96.7	"			
Tex-201-F - 3/8"-1/4"											
Specific Gravity	1.409	1.630	1.417	1.427	1.478	1.369	1.414	"	-	-	-
Water Absorption (% by Wt.)	19.2	12.7	15.7	15.8	13.7	19.2	17.4	"			
Tex-433-A - 3/8"-1/4"											
Specific Gravity	1.576	1.788	1.538	1.555	1.590	1.515	1.563	"	-	-	-
Water Absorption (% by Wt.)	10.8	6.9	9.3	9.6	8.7	10.9	9.7	"			
Tex-109-E - 3/8"-1/4"											
Specific Gravity	2.223	2.301	2.207	2.159	2.191	2.210	2.215	"	-	-	-
Water Absorption (% by Wt.)	27.9	15.5	17.0	19.1	17.8	25.3	22.4	"			
Tex-404-A, Unit Weight (lbs./ft.^{3})											
Standard - 3/8"-1/4"	46.25	54.36	47.61	47.39	49.69	43.70	45.79	"	-	-	-
Rodded - 3/8"-1/4"	47.71	56.30	49.59	49.98	51.89	45.68	47.45	"	-	-	-
Standard - As received.	47.45	56.60	46.87	48.09	50.05	45.42	47.31	50.99	48.95	55.76	45.97
Rodded - As recieved.	48.87	58.15	49.39	51.03	51.35	47.27	49.09	-	-	-	-
Tex-431-A, Pressure Slaking											
Standard Method											
3/4"-No. 10 (Loss, % by Wt.)	3.1	2.9	3.5	3.5	2.4	3.0	3.4	1.7	1.7	1.8	2.5
3/8"-1/4" (Loss, % by Wt.)	2.7	2.4	3.1	3.7	2.3	3.1	4.2	-	-	-	-
Alternate Method											
3/4"-No. 10 (Loss, % by Wt.)	3.6	3.1	2.9	3.4	2.3	2.8	2.8	-	-	-	-
3/8"-1/4" (Loss, % by Wt.)	3.3	3.1	2.9	2.5	2.2	3.3	3.9	-	-	-	-

72-1827-F	72-1868-F Gr. 4	72-2203-F	72-2311-F	72-2731-F	73-222-F	73-469-F	73-479-F	Statistical Analysis for Trends X	σ	CV(%)	R
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
45.97	46.13	51.05	50.75	53.21	54.14	41.76	50.75	49.51	3.85	7.77	14.84
-	-	-	-	-	-	-	-	-	-	-	-
2.5	2.2	3.0	2.6	2.8	2.2	3.8	2.3	2.69	0.64	23.83	2.1
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-

TABLE III continued

TEXAS INDUSTRIES - CLODINE

Test Method & Size	R3-70-535 A	B	Avg.	R3-71-659 A	B	Avg.	R3-72-153 A	B	Avg.	R3-72-160 A	B	Avg.	R3-72-169 A	B	Avg.	R3-72-194 A	B	Avg.	R3-73-90 A	B	Avg.	72-1614-F
Tex-432-A, Freeze & Thaw Test (% by Wt.)																						
5/8"-1/2" Sample																						
Actual Loss, Pass 1/2"	72.5	78.7	75.6	Size not available																		
Pass 1/4"	33.7	40.4	37.1	in sample.				-			-			-			-			-		-
Pass No. 10	18.5	20.8	19.7	"																		
Pass No. 40	6.7	7.7	7.2																			
1/2"-3/8" Sample																						
Actual Loss, Pass 3/8"	64.7	69.6	67.2	51.2	43.4	47.3	45.3	32.6	39.0	20.9	14.9	17.9	25.1	28.6	26.9	21.2	22.8	22.0	24.8	23.5	24.2	Size not
Pass 1/4"	43.3	49.5	46.4	8.7	6.6	7.7	7.7	7.3	7.5	5.5	4.8	5.2	7.9	8.5	8.2	11.8	7.6	9.7	8.7	9.2	9.0	available
Pass No. 10	18.4	29.4	23.9	4.1	3.1	3.6	2.9	3.1	3.0	2.3	2.0	2.2	3.8	3.5	3.7	6.2	3.5	4.9	2.9	3.9	3.4	in sample
Pass No. 40	7.0	11.3	9.2	1.7	1.0	1.4	1.2	1.2	1.2	1.0	0.9	1.0	1.4	1.3	1.4	2.6	0.8	1.7	1.3	2.2	1.8	
3/8"-No. 4 Sample																						
Actual Loss, Pass No. 4	44.3	42.5	43.4	7.2	8.9	8.1	5.9	7.7	6.8	12.9	7.3	10.1	9.0	9.5	9.3	11.6	11.7	11.7	10.8	10.6	10.7	23.0
Pass 1/4"	51.9	54.5	53.2	43.5	38.0	40.8	39.0	46.2	42.6	48.9	40.9	44.9	51.6	1.3	26.5	39.5	36.6	38.1	44.1	46.3	45.2	53.0
Pass No. 10	32.1	27.6	29.9	2.9	3.8	3.4	3.2	3.2	3.2	6.1	2.9	4.5	3.1	3.9	3.5	6.1	6.9	6.5	5.1	4.9	5.0	6.0
Pass No. 40	16.0	14.9	15.5	1.4	1.3	1.4	1.4	1.5	1.5	1.9	1.3	1.6	2.3	1.4	1.9	3.9	3.6	3.8	2.5	2.2	2.4	0
Total Weighted Loss	-	-	61.4	-	-	12.1	-	-	17.3	-	-	12.6	-	-	13.5	-	-	12.3	-	-	12.5	15.7
3/8"-1/4" Sample																						
Actual Loss, Pass 1/4"	55.0	55.8	55.4	18.4	19.8	19.1	18.0	15.8	16.9	9.6	16.7	13.2	16.6	13.5	15.1	27.1	14.3	20.7	11.1	13.4	12.3	This si
Pass 1/4"	55.0	55.8	55.4	18.4	19.8	19.1	18.0	15.8	16.9	9.6	16.7	13.2	16.6	13.5	15.1	27.1	14.3	20.7	11.1	13.4	12.3	not tes
Pass No. 10	13.1	36.7	33.9	3.1	5.2	4.2	5.0	3.3	4.2	5.6	5.0	5.3	5.6	3.0	4.3	19.4	6.4	12.9	3.7	4.4	4.1	on routi
Pass No. 40	11.9	15.6	13.8	1.0	1.0	1.0	2.0	1.6	1.8	2.8	2.3	2.6	1.6	1.5	1.6	16.5	2.9	9.7	1.6	2.0	1.8	samples.
Tex-410-A, Los Angeles Abrasion Test (% by Wt.)																						
3/8"-No. 4, L. A. Abrasion Value	28.0	28.4	28.2	26.0	26.0	26.0	25.7	25.5	25.6	25.4	25.4	25.4	25.4	25.2	25.3	23.0	23.4	23.2	26.2	26.0	26.1	27.1
Pass 1/4"	89.4	89.9	89.7	91.0	90.9	91.0	90.9	90.9	90.9	88.8	87.8	88.3	89.9	90.5	90.2	89.2	89.2	89.2	88.9	88.8	88.9	90.4
Pass No. 10	31.6	31.9	31.8	30.8	30.8	30.8	30.0	29.6	29.8	30.9	29.6	30.3	30.6	29.4	30.0	27.1	27.3	27.2	29.6	29.2	29.4	31.1
Pass No. 40	13.7	14.0	13.9	11.9	11.9	11.9	12.2	11.7	12.0	11.9	12.1	12.0	11.2	10.8	11.0	11.6	11.5	11.6	12.8	12.7	12.8	11.7
3/8"-1/4", L. A. Abrasion Value	28.6	28.8	28.7	26.6	26.6	26.6	25.7	25.2	25.5	26.1	25.5	25.8	25.7	25.6	25.7	23.4	23.7	23.6	25.7	26.0	25.9	These
Pass 1/4"	80.1	79.3	79.7	84.2	84.3	84.3	90.1	90.2	90.2	83.0	80.8	81.9	83.9	92.1	88.0	76.8	77.0	76.9	82.0	81.8	81.9	tests n
Pass No. 10	32.1	31.9	32.0	31.2	31.1	31.2	29.8	29.5	29.7	30.5	30.0	30.3	30.6	29.4	30.0	26.2	26.9	26.6	26.6	26.8	26.7	perform
Pass No. 40	14.3	14.4	14.4	12.2	12.2	12.2	12.8	12.3	12.6	12.6	12.1	12.4	11.4	12.1	11.8	12.0	11.8	11.9	13.0	13.1	13.1	on rout
3,000 gms. - 500 rev.																						samples
3/8"-No. 4, L. A. Abrasion Value	41.7	42.6	42.2	32.0	31.9	32.0	38.9	39.5	39.2	36.8	36.9	36.9	36.2	37.1	36.7	36.3	36.7	36.5	21.5	21.5	21.5	"
Pass 1/4"	97.7	98.0	97.9	96.9	97.0	97.0	97.8	98.3	98.1	97.4	98.0	97.7	97.4	97.4	97.4	96.4	96.3	96.4	97.1	97.4	97.3	"
Pass No. 10	46.4	48.3	47.4	39.3	39.2	39.3	44.6	46.1	45.4	43.8	44.2	44.0	43.5	43.4	43.5	41.3	40.8	41.1	29.0	28.3	28.7	"
Pass No. 40	19.7	20.0	19.9	13.3	13.2	13.3	16.7	16.9	16.8	16.1	16.2	16.2	32.9	16.0	24.5	16.1	15.8	16.0	17.8	18.2	18.0	"
3/8"-1/4", L. A. Abrasion Value	42.0	41.3	41.7	32.7	32.6	32.7	39.1	37.7	38.4	38.7	36.5	37.6	36.3	37.3	36.8	34.6	35.1	34.9	38.3	38.4	38.4	"
Pass 1/4"	94.5	94.5	94.5	92.8	92.9	92.9	93.8	94.4	94.1	95.1	94.6	94.9	95.3	94.0	94.7	90.8	90.9	90.9	94.5	94.9	94.7	"
Pass No. 10	45.7	46.1	45.9	38.4	38.3	38.4	44.9	44.5	44.7	45.6	43.1	44.4	42.7	42.9	42.8	39.8	40.5	40.2	44.1	44.3	44.2	"
Pass No. 40	19.6	19.8	19.7	14.7	14.6	14.7	17.4	17.2	17.3	16.5	16.6	16.6	16.6	16.4	16.5	15.4	15.8	15.6	17.5	17.6	17.6	"

R3-73-90			72-1614-F	72-1637-F	72-1826-F	72-1827-F	72-1868-F	72-2203-F	72-311-F	72-2731-F	73-222-F	73-469-F	73-479-F	Statistical Analysis for Trends			
A	B	Avg.												X	σ	CV(%)	R
-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24.8	23.5	24.2	Size not	22.3	No	37.5	9.6	15.4	No	49.6	Size not	No	25.4				
8.7	9.2	9.0	available	5.9	sieve	4.5	5.5	6.3	sieve	9.7	available	sieve	9.2				
2.9	3.9	3.4	in sample.	2.0	analysis.	2.5	1.4	2.8	analysis.	3.6	in sample.	analysis.	4.7	5.31	6.69	126.07	28.0
1.3	2.2	1.8		1.0	"	0.5	0.3	2.1	"	1.1		"	2.5				
10.8	10.6	10.7	23.0	6.0	"	7.9	8.9	7.4	"	16.4	5.8	"	11.1				
44.1	46.3	45.2	53.0	45.0	"	33.7	26.8	46.1	"	59.8	21.4	"	48.7				
5.1	4.9	5.0	6.0	2.0	"	2.0	2.8	3.6	"	7.1	3.2	"	4.9	6.52	7.73	118.63	30.1
2.5	2.2	2.4	0	0	"	1.0	1.5	1.8	"	3.4	1.3	"	2.3				
-	-	12.5	15.7	6.9	7.9	15.2	9.0	8.4	15.5	18.7	20.9	12.6	11.8	15.79	11.97	75.82	54.5
11.1	13.4	12.3	This size														
11.1	13.4	12.3	not tested														
3.7	4.4	4.1	on routine	-	-	-	-	-	-	-	-	-	-	9.82	11.04	112.37	33.7
1.6	2.0	1.8	samples.														
26.2	26.0	26.1	27.1	27.6	20.8	25.8	22.0	22.6	23.1	25.0	26.1	23.4	26.9	25.20	1.90	7.56	6.4
88.9	88.8	88.9	90.4	90.7	100.0	82.6	82.8	91.8	No	91.0	87.2	No	88.5				
29.6	29.2	29.4	31.1	30.9	26.6	29.6	26.4	32.1	sieve	29.6	31.3	sieve	32.0	29.91	1.69	5.64	5.7
12.8	12.7	12.8	11.7	11.7	8.7	10.9	10.9	12.1	analysis.	11.5	11.7	analysis.	12.4				
25.7	26.0	25.9	These											25.94	1.48	5.72	5.4
82.0	81.8	81.9	tests not														
26.6	26.8	26.7	performed	-	-	-	-	-	-	-	-	-	-	29.47	2.04	6.91	5.9
13.0	13.1	13.1	on routine														
			samples.														
21.5	21.5	21.5	"											34.97	6.44	18.40	21.1
97.1	97.4	97.3	"														
29.0	28.3	28.7	"	-	-	-	-	-	-	-	-	-	-	41.30	5.96	14.43	20.0
17.8	18.2	18.0	"														
38.3	38.4	38.4	"											37.19	2.81	7.55	9.4
94.5	94.9	94.7	"														
44.1	44.3	44.2	"	-	-	-	-	-	-	-	-	-	-	42.92	2.66	6.20	7.8
17.5	17.6	17.6	"														

TABLE III continued

TEXAS INDUSTRIES - CLODINE

Test Method & Size		R3-70-535 A	R3-70-535 B	R3-70-535 Avg.	R3-71-659 A	R3-71-659 B	R3-71-659 Avg.	R3-72-153 A	R3-72-153 B	R3-72-153 Avg.	R3-72-160 A	R3-72-160 B	R3-72-160 Avg.	R3-72-169 A	R3-72-169 B	R3-72-169 Avg.	R3-72-194 A	R3-72-194 B	R3-72-194 Avg.	R3-73-90 A	R3-73-90 B	R3-73-90 Avg.	A
Bituminous Section Mill 3/8"-1/4" (% by Wt.)																							T
Ribbed bucket - 1 hr.	Pass 1/4"	13.9	13.6	13.8	27.7	28.4	28.1	24.6	26.1	25.4	30.0	29.8	29.9	36.9	42.5	39.7	26.8	27.1	27.0	21.8	21.9	21.9	E
@ 72 r.p.m. Sample Dry.	Pass No. 10	7.9	8.0	8.0	7.3	7.4	7.4	7.8	7.6	7.7	7.3	7.8	7.6	7.3	7.4	7.4	7.9	7.9	7.9	8.3	8.2	8.3	r
	Pass No. 40	7.2	7.4	7.3	6.4	6.1	6.3	6.9	6.7	6.8	6.5	6.9	6.7	6.4	6.6	6.5	7.2	7.2	7.2	7.3	7.3	7.3	s
Bituminous Section Motorized Press 3/8"-1/4" (% by Wt.)																							
50 gyr. @ constant 150 p.s.i.	Pass 1/4"	67.5	67.1	67.3	73.2	72.0	72.6	71.8	70.4	71.1	72.4	72.9	72.7	79.0	77.6	78.3	77.0	75.0	76.0	83.2	82.2	82.7	74.
	Pass No. 10	33.1	31.1	32.1	31.0	31.7	31.4	32.8	30.3	31.6	32.9	35.2	34.1	34.8	36.7	35.8	34.5	32.9	33.7	36.5	34.7	35.6	33.
	Pass No. 40	16.8	15.3	16.1	15.4	15.5	15.5	16.4	14.4	15.4	15.7	17.3	16.5	17.5	19.0	18.3	17.7	17.1	17.4	19.5	17.7	18.6	16.
50 gyr. @ constant 150 p.s.i., then applied 2,500 p.s.i.																							Th
	Pass 1/4"	71.2	72.5	71.9	74.4	72.8	73.6	75.1	75.6	75.4	74.8	73.7	74.3	77.8	77.8	77.8	76.5	76.7	76.6	82.6	84.6	83.6	pe
	Pass No. 10	35.1	36.4	35.8	32.3	33.7	33.0	36.0	37.2	36.6	36.9	35.6	36.3	36.1	35.5	35.8	36.0	35.5	35.8	38.3	38.4	38.4	ro
	Pass No. 40	18.1	18.5	18.3	15.8	16.6	16.2	18.0	18.7	18.4	18.8	17.6	18.2	17.7	17.4	17.6	18.8	17.9	18.4	20.2	20.2	20.2	sa
Applied 2,500 p.s.i., then 50 gyr. @ constant 150 p.s.i.																							
	Pass 1/4"	85.0	83.8	84.4	84.6	85.6	85.1	87.7	87.9	87.8	87.5	87.4	87.5	86.4	87.2	86.8	87.3	87.4	87.4	91.2	89.7	90.5	87.
	Pass No. 10	48.4	50.0	49.2	45.7	45.4	45.6	50.9	51.4	51.2	52.3	51.2	51.8	49.4	50.2	49.8	49.6	50.2	49.9	51.0	49.6	50.3	50.
	Pass No. 40	24.3	25.4	24.9	21.3	21.7	21.5	25.1	25.1	25.1	26.8	25.2	26.0	23.6	24.7	24.2	26.4	27.0	26.7	26.8	26.5	26.7	24.
Sandblast Test (% By Wt.) Standard Procedure																							
1/2"-No. 4 Sample		3.5	3.6	3.6	2.2	2.4	2.3	2.3	2.6	2.5	2.3	2.2	2.3	2.9	3.0	3.0	2.2	2.1	2.2	2.6	2.4	2.5	Th
3/8"-1/4" Sample		3.4	3.1	3.3	2.3	2.6	2.5	3.7	3.5	3.6	2.4	2.6	2.5	2.7	2.7	2.7	2.7	2.5	2.6	3.0	3.1	3.1	no
2,400 gms. sand																							or
3/8"-1/4" Sample		7.2	5.9	6.6	4.5	4.7	4.6	5.5	5.6	5.6	5.0	5.3	5.2	4.6	4.4	4.5	4.3	4.1	4.2	4.9	4.8	4.9	sa
3,600 gms. sand																							
3/8"-1/4" Sample		7.4	8.0	7.7	6.2	5.6	5.9	8.7	8.6	8.7	5.5	5.5	5.5	5.9	5.7	5.8	6.7	6.5	6.6	7.5	7.7	7.6	
British Aggregate Crushing Value Test - 3/8"-1/4" (% by Wt.)	Pass 1/4"	75.8	75.2	75.5	77.5	82.4	80.0	83.2	83.8	83.5	80.6	80.8	80.7	84.2	83.8	84.0	85.4	84.3	84.9	86.3	86.1	86.2	
	Pass No. 10	38.2	39.5	38.9	35.5	37.5	36.5	42.0	41.8	41.9	38.3	38.7	38.5	41.2	38.6	39.9	42.4	41.3	41.9	42.1	41.7	41.9	
	Pass No. 40	14.4	15.0	14.7	12.3	12.9	12.6	15.2	15.2	15.2	13.3	14.0	13.7	13.9	13.1	13.5	16.2	15.5	15.9	15.9	15.4	15.7	
British Aggregate Impact Value 1/2"-3/8" Sample, Aggr. Impact	Value	36	40	38.0	37	36	37	40	39	40	38	38	38	35	36	36	38	37	38	41	41	41	
	Pass 1/4"	68.1	70.7	69.4	66.7	64.9	65.8	71.8	70.2	71.0	71.9	71.6	71.8	64.3	63.7	64.0	69.7	68.7	69.2	74.1	74.8	74.5	
	Pass No. 10	32.0	35.0	33.5	33.3	33.1	33.2	36.2	34.2	35.2	34.4	34.9	34.7	32.1	32.4	32.3	32.8	33.1	33.0	37.2	35.9	36.6	
	Pass No. 40	11.2	12.2	11.7	12.1	11.8	12.0	13.3	12.6	13.0	11.9	12.3	12.1	11.2	10.9	11.1	12.0	11.3	11.7	14.1	13.3	13.7	
3/8"-1/4" Sample, Aggr. Impact	Value	40	41	41	35	37	36	42	42	42	40	40	40	36	37	37	40	40	40	42	42	42	38
	Pass 1/4"	76.5	76.0	76.3	80.2	80.5	80.4	79.5	81.7	80.6	81.4	81.3	81.4	79.0	78.2	78.6	78.4	78.8	78.6	85.6	84.6	85.1	74.
	Pass No. 10	36.5	37.9	37.2	32.8	33.8	33.3	37.0	38.8	37.9	36.6	35.3	36.0	33.3	35.5	34.4	36.2	35.7	36.0	38.3	36.9	37.6	33.
	Pass No. 40	14.0	14.1	14.1	11.2	11.8	11.5	13.7	13.8	13.8	13.2	12.5	12.9	11.3	12.3	11.8	13.2	13.4	13.3	14.4	13.1	13.8	12.

	194	R3-73-90			72-1614-F			72-1637-F			72-1826-F			72-1827-F			72-1868-F			72-2203-F			72-2311-F			72-2731-F			
	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A
1	27.0	21.8	21.9	21.9	This test not performed on routine samples.																								
9	7.9	8.3	8.2	8.3					-			-			-			-			-			-			-		
2	7.2	7.3	7.3	7.3																									
0	76.0	83.2	82.2	82.7	74.8	74.4	74.6	74.4	74.7	74.6	Size not available in sample.			69.9	73.3	71.6	77.7	77.8	77.8	72.5	73.1	72.8	74.5	74.5	74.5	78.2	77.8	78.0	72
9	33.7	36.5	34.7	35.6	33.2	34.2	33.7	34.6	34.3	34.5				32.1	33.2	32.7	35.7	35.4	35.6	34.1	34.3	34.2	36.3	36.5	36.4	33.1	34.9	34.0	30
1	17.4	19.5	17.7	18.6	16.1	16.7	16.4	16.8	16.8	16.8				15.2	16.0	15.6	17.6	17.9	17.8	16.6	16.2	16.4	18.4	18.6	18.5	16.7	18.4	17.6	14
7	76.6	82.6	84.6	83.6	This test not performed on routine samples.																								
5	35.8	38.3	38.4	38.4					-			-			-			-			-			-			-		
9	18.4	20.2	20.2	20.2																									
4	87.4	91.2	89.7	90.5	87.0	85.3	86.2	87.7	89.0	88.4	"			87.7	87.3	87.5	87.6	89.3	88.5	87.2	87.9	87.6	87.2	86.6	86.9	87.2	87.7	87.5	89
2	49.9	51.0	49.6	50.3	50.1	48.0	49.1	50.9	50.5	50.7	"			47.7	52.1	49.9	52.5	53.0	52.8	51.5	53.0	52.3	50.0	51.3	50.7	48.5	48.4	48.5	49
0	26.7	26.8	26.5	26.7	24.6	23.2	23.9	24.2	24.1	24.2	"			25.4	25.4	25.4	26.6	26.3	26.5	25.8	26.6	26.2	24.3	25.6	25.0	23.9	24.2	24.1	24
1	2.2	2.6	2.4	2.5	These tests not performed on routine samples.																								
5	2.6	3.0	3.1	3.1					-		"				-			-			-			-			-		
1	4.2	4.9	4.8	4.9																									
5	6.6	7.5	7.7	7.6																									
3	84.9	86.3	86.1	86.2																									
3	41.9	42.1	41.7	41.9		"			-		"				-			-			-			-			-		
5	15.9	15.9	15.4	15.7																									
'	38	41	41	41																									
7	69.2	74.1	74.8	74.5																									
1	33.0	37.2	35.9	36.6		"			-		"				-			-			-			-			-		
3	11.7	14.1	13.3	13.7																									
)	40	42	42	42	38	37	38	38	36	37	"			39	39	39	39	40	40	39	40	40	38	38	38	39	38	39	3
.8	78.6	85.6	84.6	85.1	74.8	75.1	75.0	73.8	73.0	73.4	"			80.0	78.9	79.5	82.5	81.9	82.2	75.8	76.8	76.3	77.4	78.4	77.9	77.3	78.3	77.8	80
.7	36.0	38.3	36.9	37.6	33.8	33.6	33.7	34.0	32.3	33.2	"			37.6	37.3	37.5	36.8	37.4	37.1	34.1	36.3	35.2	34.6	35.5	35.1	35.7	37.1	36.4	34
.4	13.3	14.4	13.1	13.8	12.5	12.5	12.5	11.8	10.8	11.3	"			13.7	13.7	13.7	12.4	13.6	13.0	10.1	12.0	11.1	12.4	12.9	12.7	12.6	13.1	12.9	11

72-2731-F			73-222-F			73-469-F			73-479-F			Statistical Analysis for Trends			
A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	X	σ	CV(%)	R
	-			-			-			-		7.72	0.34	4.40	1.0
78.2	77.8	78.0	72.3	81.5	76.9	76.8	76.7	76.8	77.6	77.2	77.4				
33.1	34.9	34.0	30.7	34.3	32.5	37.6	39.1	38.4	35.8	34.4	35.1	34.17	2.01	5.88	8.8
16.7	18.4	17.6	14.8	16.5	15.7	20.1	21.1	20.6	18.4	17.8	18.1				
	-			-			-			-		-	-	-	-
87.2	87.7	87.5	89.0	88.7	88.9	89.7	91.0	90.4	88.0	88.1	88.1				
48.5	48.4	48.5	49.9	49.6	49.8	51.9	54.6	53.3	51.8	51.6	51.7	50.36	1.97	3.90	9.2
23.9	24.2	24.1	24.9	24.4	24.7	27.2	27.3	27.3	27.2	27.6	27.4				
	-			-			-			-		-	-	-	-
	-			-			-			-		39.91	2.15	5.38	6.9
												38.00	1.96	5.16	6
	-			-			-			-		34.04	1.63	4.78	5.2
39	38	39	38	40	39	40	40	40	37	38	38	38.97	1.80	4.62	7
77.3	78.3	77.8	80.6	79.1	79.9	81.8	79.8	80.8	76.8	78.2	77.5				
35.7	37.1	36.4	34.9	35.9	35.4	36.5	37.2	36.9	34.6	35.1	34.9	35.73	1.63	4.57	6.5
12.6	13.1	12.9	11.6	13.1	12.4	13.8	14.6	14.2	13.0	13.5	13.3				

TABLE IV

TEXAS INDUSTRIES - DALLAS

Test Method & Size		R3-71-513	R3-71-660	R3-72-157	R3-72-170	R3-72-191	R3-73-59	72-1690-F Gr. 4	72-1982-F	72-2008-F	72-2220-F	72-2479-
Tex-200-F, Sieve Analysis	Ret. 3/4"					Ret. 3/4"	0					
(% by Wt.)	Ret. 5/8"	0	0	0	0	0	2.1	These tests				
	Ret. 1/2"	4.3	0.8	0	1.7	1.2	15.6	not performed				
	Ret. 3/8"	35.1	55.5	25.7	50.4	78.4	55.5	on routine				
	Ret. 1/4"	77.8	92.6	61.1	82.1	95.1	85.4	samples.	-	-	-	-
	Ret. No. 4	88.7	96.5	79.0	90.3	97.5	92.3	"				
	Ret. No. 10	97.1	99.1	97.0	98.3	99.4	97.9	"				
Tex-201-F - 3/8"-1/4"												
Specific Gravity		1.082	1.113	1.222	1.229	1.165	1.248	"	-	-	-	-
Water Absorption (% by Wt.)		21.9	21.4	18.5	18.3	20.4	21.1					
Tex-433-A - 3/8"-1/4"												
Specific Gravity		1.163	1.202	1.305	1.304	1.253	1.354	"	-	-	-	-
Water Absorption (% by Wt.)		15.7	14.5	13.0	13.3	14.1	14.2	"				
Tex-109-E - 3/8"-1/4"												
Specific Gravity		2.073	2.039	2.160	2.152	2.102	2.156	"	-	-	-	-
Water Absorption (% by Wt.)		34.7	32.4	29.3	12.1	32.7	29.8	"				
Tex-404-A, Unit Weight ($lbs./ft.^3$)												
Standard - 3/8"-1/4"		35.60	35.75	40.00	40.54	37.33	39.52	"	-	-	-	-
Rodded - 3/8"-1/4"		37.99	36.71	42.24	42.38	40.42	43.46	"	-	-	-	-
Standard - As received.		38.72	36.54	42.76	40.64	37.25	40.94	42.00	50.39	46.01	44.96	45.77
Rodded - As received.		40.11	38.40	45.31	42.82	40.16	44.98	-	-	-	-	-
Tex-431-A Pressure Slaking												
Standard Method												
3/4"-No. 10 (Loss, % by Wt.)		3.9	1.8	3.3	3.5	3.6	3.6	2.9	3.0	2.3	2.6	2.6
3/8"-1/4" (Loss, % by Wt.)		2.5	2.5	3.3	3.3	3.0	2.9	-	-	-	-	-
Alternate Method												
3/4"-No. 10 (Loss, % by Wt.)		3.6	2.7	3.6	3.5	3.3	3.7	-	-	-	-	-
3/8"-1/4" (Loss, % by Wt.)		2.8	3.0	2.7	3.3	2.6	2.8	-	-	-	-	-

72-2220-F	72-2479-F	Statistical Analysis for Trends			
		$\bar{X}$	σ	CV(%)	R
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
44.96	45.77	42.36	4.18	9.87	13.85
-	-	-	-	-	-
2.6	2.6	3.01	0.64	21.35	2.1
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

TABLE IV continued

TEXAS INDUSTRIES - DALLAS

Test Method & Size	R3-71-513			R3-71-660			R3-72-157			R3-72-170			R3-72-191			R3-73-59			72-1690-F	72-1982-F	72-2008-F
	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.			
Tex-432-A, Freeze & Thaw Test (% by Wt.)																					
5/8"-1/2" Sample																					
Actual Loss, Pass 1/2"	69.3	69.1	69.2	73.6	70.5	72.1	Size not avail-			59.0	61.0	60.0	84.3	79.2	81.8	73.7	63.9	68.8	Size not		
Pass 1/4"	23.3	24.3	23.8	26.4	27.1	26.8	able in sample.			22.5	23.5	23.0	31.2	27.0	29.1	34.1	28.5	31.3	available	-	-
Pass No. 10	8.0	8.6	8.3	10.4	10.1	10.3	"			6.8	18.0	12.4	10.1	9.8	10.0	14.9	11.3	13.1	in sample.		
Pass No. 40	2.0	2.0	2.0	3.2	3.1	3.2				1.8	1.8	1.8	3.1	4.4	3.8	4.4	3.9	4.2			
1/2"-3/8" Sample																					
Actual Loss, Pass 3/8"	73.0	72.5	72.8	59.7	62.1	60.9	41.2	37.4	39.3	48.1	52.7	50.4	63.0	68.0	65.5	62.6	61.5	62.1	50.5	Size not	Size not
Pass 1/4"	34.3	34.1	34.2	26.6	28.0	27.3	23.6	21.6	22.6	24.2	20.2	22.2	33.0	32.1	32.6	32.2	40.1	36.2	28.5	available	available
Pass No. 10	12.4	12.3	12.4	10.1	10.6	10.4	7.4	7.6	7.5	7.0	6.9	7.0	12.8	10.7	11.8	10.9	14.5	12.7	8.0	in sample.	in sample.
Pass No. 40	3.6	4.3	4.0	3.6	3.0	3.3	2.0	2.3	2.2	1.7	1.2	1.5	4.3	3.6	4.0	3.2	3.5	3.4	2.5		
3/8"-No. 4 Sample																					
Actual Loss, Pass No. 4	33.3	36.3	34.8	22.7	21.3	22.0	26.2	24.2	25.2	28.1	18.3	23.2	30.5	40.2	35.4	32.3	45.3	38.8	38.0	30.0	30.7
Pass 1/4"	53.8	56.3	55.1	36.1	35.1	35.6	52.9	45.2	49.1	51.0	50.1	50.6	45.6	59.5	52.6	47.8	65.9	56.9	60.8	51.0	55.4
Pass No. 10	14.1	16.2	15.2	9.3	9.6	9.5	11.0	10.3	10.7	12.0	7.2	9.6	13.2	18.1	15.7	13.4	19.6	16.5	17.0	15.0	14.9
Pass No. 40	5.1	8.7	6.9	3.1	3.2	3.2	3.1	2.9	3.0	2.8	2.4	2.6	4.7	4.4	4.6	4.2	5.2	4.7	5.0	4.0	3.0
Total Weighted Loss	-	-	49.7	-	-	44.5	-	-	40.6	-	-	39.4	-	-	61.0	-	-	54.2	37.3	26.2	29.2
3/8"-1/4" Sample																					
Actual Loss, Pass 1/4"	53.5	55.0	54.3	35.0	35.8	35.4	34.3	31.5	32.9	25.6	33.3	29.5	44.0	46.3	45.2	40.1	44.4	42.3	This size		
Pass 1/4"	53.5	55.0	54.3	35.0	35.8	35.4	34.3	31.5	32.9	25.6	33.3	29.5	44.0	46.3	45.2	40.1	44.4	42.3	not tested		
Pass No. 10	12.8	12.5	12.7	11.0	9.5	10.3	11.0	9.4	10.2	8.8	9.7	9.3	15.0	14.7	14.9	14.4	14.8	14.6	on routine	-	-
Pass No. 40	4.7	5.0	4.9	6.0	5.3	5.7	4.2	4.3	4.3	2.2	2.9	2.6	9.0	6.2	7.6	4.6	4.7	4.7	samples.		
Tex-410-A, Los Angeles Abrasion Test (% by Wt.)																					
3/8"-No. 4, L. A. Abrasion Value	20.5	20.6	20.6	20.7	20.8	20.8	22.2	21.1	21.7	20.2	20.1	20.2	20.9	21.1	21.0	23.6	23.2	23.4	22.2	23.0	22.0
Pass 1/4"	87.0	87.0	87.0	86.6	86.5	86.6	92.3	87.9	90.1	87.1	87.6	87.4	86.0	86.1	86.1	87.6	88.6	88.1	82.8	90.4	87.3
Pass No. 10	24.5	24.6	24.6	24.9	24.8	24.7	26.8	24.6	25.7	24.4	24.2	24.3	25.4	25.3	25.4	28.6	28.1	28.4	25.4	27.1	26.0
Pass No. 40	8.1	8.1	8.1	8.0	7.9	8.0	0	8.3	4.2	8.6	7.9	8.3	8.3	8.4	8.4	9.8	9.7	9.8	8.0	6.8	8.3
3/8"-1/4", L. A. Abrasion Value	19.8	19.8	19.8	20.1	20.0	20.1	28.1	25.8	27.0	20.3	19.5	19.9	21.3	21.4	21.4	21.5	24.7	23.1	These tests		
Pass 1/4"	74.3	74.3	74.3	76.0	75.9	76.0	79.7	77.1	78.4	74.0	76.0	75.0	69.3	69.4	69.4	73.7	78.6	76.2	not performed		
Pass No. 10	23.8	23.9	23.9	24.8	24.9	24.9	31.7	29.8	30.8	23.9	23.3	23.6	24.8	24.7	24.8	25.3	29.3	27.3	on routine	-	-
Pass No. 40	7.1	7.1	7.1	8.1	8.0	8.1	16.4	13.5	15.0	8.5	7.2	7.9	9.5	9.3	9.4	8.6	9.9	9.3	samples.		
3,000 gms. @ 500 rev.																					
3/8"-No. 4, L. A. Abrasion Value	31.8	31.8	31.8	31.3	31.3	31.3	35.4	35.0	35.2	31.7	31.5	31.6	33.0	one	33.0	35.6	36.7	36.2	"		
Pass 1/4"	95.3	95.3	95.3	94.6	94.7	94.7	96.4	95.4	95.9	95.9	95.4	95.7	95.6	sam-	95.6	95.9	97.3	96.6	"		
Pass No. 10	37.9	38.0	38.0	36.9	36.7	36.8	42.4	41.3	41.9	37.3	47.0	42.2	39.4	ple	39.4	41.9	44.0	43.0	"	-	-
Pass No. 40	15.0	11.7	13.4	9.0	8.9	9.0	14.7	14.4	14.6	12.4	12.0	12.2	12.1	only.	12.1	13.2	12.8	13.0	"		
3/8"-1/4", L. A. Abrasion Value	31.8	31.8	31.8	31.5	31.6	31.6	38.0	36.1	37.1	29.7	31.2	30.5	32.7	32.8	32.8	33.7	36.3	35.0	"		
Pass 1/4"	90.4	90.3	90.4	89.8	89.8	89.8	92.2	92.5	92.4	87.3	90.5	88.9	90.3	90.2	90.3	90.1	91.8	91.0	"		
Pass No. 10	37.9	37.8	37.9	37.4	37.2	37.3	44.6	42.0	43.3	35.4	38.7	37.1	37.1	37.7	37.4	39.5	42.1	40.8	"		
Pass No. 40	11.8	11.7	11.8	10.1	10.0	10.1	17.8	16.2	17.0	12.7	13.1	12.9	13.0	12.8	12.9	11.6	14.0	12.8	"	-	-

72-2008-F	72-2220-F	72-2479-F	Statistical Analysis for Trends			
			$\bar{X}$	σ	CV(%)	R
-	-	-	-	-	-	-
Size not available in sample.	80.9 41.1 15.6 4.2	Size not available in sample.	10.52	2.83	26.86	8.7
30.7 55.4 14.9 3.0	36.6 54.5 18.1 6.8	44.2 75.7 20.7 5.2	14.10	3.88	27.51	13.5
29.2	37.5	38.3	41.63	10.26	24.64	34.8
-	-	-	11.97	2.36	19.73	6.2
22.0	23.2	21.5	21.58	1.14	5.29	3.5
87.3	No sieve	87.1				
26.0	analysis.	26.7	25.71	1.37	5.32	4.4
8.3	"	7.8				
			21.86	2.80	12.81	8.6
-	-	-	25.85	2.78	10.74	8.4
			33.19	2.06	6.20	5.4
-	-	-	40.25	3.35	8.31	7.3
			33.09	2.46	7.44	8.3
-	-	-	38.95	2.65	6.79	9.2

TABLE IV continued

TEXAS INDUSTRIES - DALLAS

Test Method and Size	R3-71-513			R3-71-660			R3-72-157			R3-72-170			R3-72-191			R3-73-59			72-1690-F			72-
	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A
Bituminous Section Mill																						
3/8"-1/4" (% by Wt.)																				This test		
Ribbed bucket - 1 hr. Pass 1/4"	19.5	18.5	19.0	15.0	14.2	14.6	18.3	18.3	18.3	24.5	24.5	24.5	22.6	22.4	22.5	16.1	17.8	17.0		not performed		
@ 72 r.p.m. Sample dry. Pass No. 10	3.3	3.1	3.2	3.9	4.1	4.0	3.3	3.3	3.3	4.4	4.4	4.4	4.4	4.4	4.4	3.0	3.0	3.0		on routine		
Pass No. 40	2.6	2.4	2.5	2.9	3.0	3.0	2.7	2.7	2.7	3.6	3.7	3.7	3.2	3.2	3.2	2.2	1.8	2.0		samples.		
Bituminous Section Motorized Press																						
3/8"-1/4" (% by Wt.)																						
50 gyr. @ constant 150 p.s.i.																						
Pass 1/4"	77.5	76.6	77.1	77.6	77.6	77.6	77.0	75.9	76.5	75.1	75.4	75.3	75.2	74.5	74.9	77.7	77.6	77.7	78.0	76.9	77.5	76.8
Pass No. 10	36.9	37.2	37.1	37.8	37.2	37.5	35.8	34.0	34.9	37.6	36.4	37.0	41.2	41.4	41.3	39.2	39.1	39.2	36.9	36.8	36.9	31.0
Pass No. 40	17.1	16.6	16.9	15.6	15.1	15.4	15.9	14.8	15.4	16.7	15.9	16.3	17.7	16.9	17.3	17.8	17.8	17.8	15.9	16.0	16.0	12.2
50 gyr. @ constant 150 p.s.i., then																						
applied 2,500 p.s.i.																				This test		
Pass 1/4"	78.1	76.6	77.4	73.6	75.6	74.6	80.1	79.8	80.0	76.6	75.0	75.8	78.9	76.1	77.5	77.5	78.7	78.1		not performed		
Pass No. 10	40.8	39.1	40.0	35.7	37.8	36.8	38.7	38.4	38.6	39.0	37.6	38.3	44.7	43.5	44.1	41.1	40.2	40.7		on routine		
Pass No. 40	18.5	17.2	17.9	14.7	14.2	14.5	17.2	16.9	17.1	16.9	15.7	16.3	18.0	17.3	17.7	18.2	16.0	17.1		samples.		
Applied 2,500 p.s.i., then 50 gyr.																						
@ constant 150 p.s.i.																						
Pass 1/4"	90.2	90.2	90.2	90.9	91.8	91.4	91.6	92.1	91.9	91.2	91.2	91.2	91.1	90.4	90.8	91.5	91.4	91.5	91.9	91.8	91.9	95.1
Pass No. 10	56.3	57.3	56.8	57.1	59.7	58.4	55.3	56.3	55.8	55.3	55.8	55.6	63.1	62.0	62.6	59.3	59.2	59.3	56.8	55.7	56.3	56.5
Pass No. 40	24.2	24.7	24.5	24.1	25.4	24.8	23.7	24.4	24.0	23.8	24.3	24.1	26.1	25.5	25.8	27.3	26.9	27.1	24.6	22.8	23.7	22.3
Sandblast Test (% by Wt.)																						
Standard Procedure																						
1/2"-No. 4 Sample	3.7	2.5	3.1	2.6	2.7	2.7	2.4	2.3	2.4	2.9	2.7	2.8	2.3	2.6	2.5	2.4	2.7	2.6		These tests		
3/8"-1/4" Sample	3.2	2.8	3.0	2.3	1.9	2.1	2.1	2.2	2.2	2.7	2.8	2.8	2.6	2.6	2.6	2.6	2.5	2.6		not performed		
2,400 gms. sand																				on routine		
3/8"-1/4" Sample	5.2	6.1	5.7	7.3	6.8	7.1	3.4	3.6	3.5	4.5	4.7	4.6	5.5	5.5	5.5	6.2	5.9	6.1		samples.		
3,600 gms. sand																						
3/8"-1/4" Sample	7.0	6.8	6.9	9.3	10.1	9.7	6.3	6.4	6.4	7.5	7.3	7.4	7.1	7.7	7.4	9.5	9.3	9.4		"		
British Aggregate Crushing Value																						
Test - 3/8"-1/4" (% by Wt.)																						
Pass 1/4"	89.7	90.0	89.9	87.4	87.7	87.6	89.5	88.7	89.1	88.8	89.5	89.2	90.9	90.1	90.5	87.8	88.4	88.1		"		
Pass No. 10	49.3	49.4	49.4	49.7	49.6	49.7	49.2	48.2	48.7	48.0	47.6	47.8	52.6	51.1	51.9	49.7	51.0	50.4		"		
Pass No. 40	16.6	16.5	16.6	15.4	15.7	15.6	15.3	15.4	15.4	14.9	14.1	14.5	15.6	16.2	15.9	16.3	16.7	16.5		"		
British Aggregate Impact Value																						
1/2"-3/8" Sample, Aggr, Impact Value	45	44	45	43	44	44	42	41	42	43	43	43	33	34	34	41	42	42		"		
Pass 1/4"	76.4	73.7	75.1	75.1	74.2	74.7	73.6	71.9	72.8	77.1	75.3	76.2	63.3	64.8	64.1	71.2	71.9	71.6		"		
Pass No. 10	40.3	38.4	39.4	39.1	39.4	39.3	36.8	34.7	35.8	39.6	36.5	38.1	32.9	33.3	33.1	35.1	36.0	35.6		"		
Pass No. 40	14.8	13.7	14.3	12.3	13.1	12.7	12.0	10.6	11.3	13.1	12.5	12.8	8.7	11.0	9.9	10.5	10.9	10.7		"		
3/8"-1/4" Sample, Aggr. Impact Value	48	50	49	42	42	42	42	42	42	42	43	43	46	45	46	41	41	41	42	42	42	45
Pass 1/4"	83.7	81.0	82.4	85.3	81.6	83.5	83.4	83.0	83.2	83.2	83.2	83.2	86.0	84.7	85.4	82.4	82.8	82.6	80.3	79.6	80.0	85.5
Pass No. 10	43.8	39.8	41.8	39.8	39.0	39.4	41.3	40.7	41.0	40.4	39.4	39.9	46.1	46.0	46.1	37.1	37.1	37.1	38.1	36.9	37.5	40.0
Pass No. 40	15.6	13.1	14.4	11.8	12.3	12.1	14.6	13.9	14.3	13.0	12.8	12.9	13.1	10.5	11.8	11.0	11.3	11.2	11.4	11.1	11.3	11.9

72-1690-F			72-1982-F			72-2008-F			72-2220-F			72-2479-F			Statistical Analysis for Trends			
A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	X	σ	CV(%)	R
This test not performed on routine samples.				-			-			-			-		3.72	0.60	16.18	1.4
78.0	76.9	77.5	76.8	79.8	78.3	84.8	82.2	85.5	None of these tests were made with this sample.			86.5	86.8	86.7				
36.9	36.8	36.9	31.0	32.9	32.0	36.5	35.9	36.2				32.7	34.4	33.6	36.55	2.65	7.26	10.4
15.9	16.0	16.0	12.2	13.6	12.9	14.8	15.3	15.1				12.0	14.6	13.3				
This test not performed on routine samples.				-			-			"			-		-	-	-	-
91.9	91.8	91.9	95.1	94.8	95.0	95.5	95.0	95.3		"		94.6	95.3	95.0				
56.8	55.7	56.3	56.5	55.5	56.0	58.4	57.5	58.0		"		55.9	57.4	56.7	57.52	2.18	3.79	7.8
24.6	22.8	23.7	22.3	21.0	21.7	23.0	22.9	23.0		"		22.7	23.3	23.0				
These tests not performed on routine samples.				-			-			"			-		-	-	-	-
	"																	
	"																	
	"			-			-			"			-		49.62	1.42	2.85	4.6
	"																	
	"														41.25	3.82	9.25	12
	"																	
	"			-			-			"			-		36.84	2.53	6.86	7.4
	"																	
42	42	42	45	44	45	41	43	42		"		42	41	42	43.20	2.46	5.70	9
80.3	79.6	80.0	85.5	85.0	85.3	83.3	87.3	85.3		"		89.2	84.5	86.9				
38.1	36.9	37.5	40.0	39.1	39.6	36.6	39.5	38.1		"		36.8	34.8	35.8	39.62	2.98	7.52	11.3
11.4	11.1	11.3	11.9	11.5	11.7	10.4	11.3	10.9		"		10.3	9.7	10.0				

TABLE V

SUPEROCK, INC.

Test Method & Size		R3-73-97	R3-72-268	R3-72-280	R3-72-288	73-66-F	73-177-F	73-487-F Gr. 4	73-616-F	73-617-F	73-618-F	73-767-F	Statistical $\bar{X}$	σ
Tex-200-F, Sieve Analysis														
(% by Wt.)	Ret. 5/8"	0												
	Ret. 1/2"	1.9	These tests											
	Ret. 3/8"	23.7	not performed											
	Ret. 1/4"	79.4	on routine	-	-	-	-	-	-	-	-	-	-	-
	Ret. No.4	94.6	samples.											
	Ret. No.10	98.5	"											
Tex-201-F - 3/8"-1/4"														
Specific Gravity		1.085	"	-	-	-	-	-	-	-	-	-	-	-
Water Absorption (% by Wt.)		13.0	"											
Tex-433-A - 3/8"-1/4"														
Specific Gravity		1.108	"	-	-	-	-	-	-	-	-	-	-	-
Water Absorption (% by Wt.)		9.2	"											
Tex-109-E - 3/8"-1/4"			"											
Specific Gravity		2.150	"	-	-	-	-	-	-	-	-	-	-	-
Water Absorption (% by Wt.)		33.7	"											
Tex-404-A, Unit Weight			"											
(lbs./ft.^{3})			"											
Standard - 3/8"-1/4"		37.89	"	-	-	-	-	-	-	-	-	-	-	-
Rodded - 3/8"-1/4"		38.76	"	-	-	-	-	-	-	-	-	-	-	-
Standard - As received.		39.76	44.30	None of these tests were made with this sample.	None of these tests were made with this sample.	42.38	44.08	39.66	40.94	39.21	42.80	38.80	41.33	2.1
Rodded - As received.		40.74	-			-	-	-	-	-	-	-	-	-
Tex-431-A, Pressure Slaking														
Standard Method														
3/4"-No. 10 (Loss, % by Wt.)		2.4	2.7			3.6	2.3	2.4	2.5	2.3	2.7	3.2	2.68	0.4
3/8"-1/4" (Loss, % by Wt.)		2.6	-	-	-	-	-	-	-	-	-	-	-	-
Alternate Method														
3/4"-No. 10 (Loss, % by Wt.)		2.0	-	-	-	-	-	-	-	-	-	-	-	-
3/8"-1/4" (Loss, % by Wt.)		2.7	-	-	-	-	-	-	-	-	-	-	-	-

73-767-F	Statistical Analysis for Trends $\bar{X}$	σ	CV(%)	R
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
38.80	41.33	2.12	5.13	5.50
-	-	-	-	-
3.2	2.68	0.45	16.68	1.3
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

TABLE V continued

SUPEROCK, INC.

Test Method & Size		R3-73-97 A	B	Avg.	R3-72-268	R3-72-280	R3-72-288	73-66-F	73-177-F	73-487-F	73-616-F	73-617-F	73-618-F	73-767-F
Tex-432-A, Freeze & Thaw Test (% by Wt.)														
5/8"-1/2" Sample														
Actual Loss,	Pass 1/2"	4.7	6.3	5.5	Size not									
	Pass 1/4"	0.2	1.3	0.8	available	-	-	-	-	-	-	-	-	-
	Pass No. 10	0.1	0.4	0.3	in sample.									
	Pass No. 40	0	0	0										
1/2"-3/8" Sample						None of								
Actual Loss,	Pass 3/8"	0.6	0.5	0.6	5.8	these tests	Size not	2.9	8.0	12.1	20.3	21.1	12.5	2.9
	Pass 1/4"	0.2	0.1	0.2	0.8	were made	available	0.4	1.2	0.4	0.5	0.6	1.0	0.3
	Pass No. 10	0.1	0	0.1	0.4	with this	in sample.	0.3	0.7	0.2	0.4	0.6	0.8	0.2
	Pass No. 40	0	0	0	0.1	sample.		0.1	0.4	0.2	0.4	0.6	0.7	0.2
3/8"-No. 4 Sample														
Actual Loss,	Pass No. 4	0.5	0.6	0.6	1.6	"	0.3	0.3	1.5	0.9	2.3	1.3	2.0	0.3
	Pass 1/4"	10.8	10.2	10.5	40.4	"	16.7	3.1	8.8	17.1	24.7	19.7	25.1	4.5
	Pass No. 10	0.3	0.2	0.3	0.7	"	0.1	0.1	0.8	0.6	1.8	0.6	0.6	0.2
	Pass No. 40	0.1	0.1	0.1	0,3	"	0	0	0.6	0.5	1.5	0.4	0.3	0.1
Total Weighted Loss		-	-	0.9	7.7	"	0.3	1.5	3.2	5.4	9.1	0.7	6.9	2.1
3/8"-1/4" Sample														
Actual Loss,	Pass 1/4"	0.9	1.1	1.0	This size	"								
	Pass 1/4"	0.9	1.1	1.0	not tested	"								
	Pass No. 10	0.1	0.4	0.3	on routine	"	-	-	-	-	-	-	-	-
	Pass No. 40	0	0.1	0.1	samples.									
Tex-410-A, Los Angeles Abrasion Test (% by Wt.)														
3/8"-No. 4, L. A. Abrasion Value		16.7	17.0	16.9	24.0	"	This test	15.6	16.2	19.0	17.4	18.1	18.6	24.0
	Pass 1/4"	72.6	72.5	72.6	No sieve	"	not performed	60.8	69.1	64.7	63.6	66.4	65.8	66.9
	Pass No. 10	18.7	18.5	18.6	analysis.	"	with this	18.1	18.5	21.8	18.2	20.4	20.6	46.1
	Pass No. 40	11.2	11.6	11.4	"	"	sample.	10.1	9.4	12.3	10.5	10.9	12.1	7.1
3/8"-1/4", L. A. Abrasion Value		17.0	17.0	17.0	These	"								
	Pass 1/4"	57.8	57.7	57.8	tests	"								
	Pass No. 10	19.2	19.1	19.2	not	"	-	-	-	-	-	-	-	-
	Pass No. 40	11.3	11.1	11.2	performed									
					on routine									
3,000 gms. @ 500 rev.					samples.									
3/8"-No. 4, L. A. Abrasion Value		28.0	28.1	28.1	"	"								
	Pass 1/4"	87.3	87.6	87.5	"	"								
	Pass No. 10	32.7	32.4	32.6	"	"	-	-	-	-	-	-	-	-
	Pass No. 40	16.0	16.2	16.1	"	"								
3/8"-1/4", L. A. Abrasion Value		27.5	27.9	27.7	"	"								
	Pass 1/4"	81.2	81.0	81.1	"	"								
	Pass No. 10	32.1	32.3	32.2	"	"	-	-	-	-	-	-	-	-
	Pass No. 40	15.7	16.5	16.1	"	"								

73-767-F	Statistical Analysis for Trends			
	X	σ	CV(%)	R
-	-	-	-	-
2.9				
0.3				
0.2	0.37	0.26	70.99	0.8
0.2				
0.3				
4.5				
0.2	0.61	0.52	84.81	1.7
0.1				
2.1	3.78	3.24	85.62	8.8
-	-	-	-	-
24.0	19.11	3.23	16.88	8.4
66.9				
46.1	22.32	9.01	40.36	28.0
7.1				
	-	-	-	-
-	-	-	-	-
	-	-	-	-
-	-	-	-	-
	-	-	-	-
-	-	-	-	-

TABLE V continued

SUPEROCK, INC.

Test Method & Size	R3-73-97			R3-72-268			R3-72-280			R3-72-288		
	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.
Bituminous Section Mill												
3/8"-1/4" (% by Wt.)				This test								
Ribbed bucket - 1 hr.. Pass 1/4"	18.3	18.6	18.5	not performed								
@ 72 r.p.m. Sample dry. Pass No. 10	7.7	7.6	7.7	on routine				-			-	
Pass No. 40	7.5	7.4	7.5	samples.								
Bituminous Section Motorized Press												
3/8"-1/4" (% by Wt.)												
50 gyr. @ constant 150 p.s.i.												
Pass 1/4"	67.0	67.0	67.0	56.2	60.5	58.4	59.3	59.0	59.2	65.5	67.1	66.3
Pass No. 10	31.7	31.7	31.7	26.7	28.9	27.8	29.7	29.3	29.5	26.2	27.2	26.7
Pass No. 40	19.2	18.9	19.1	13.6	15.2	14.4	15.1	15.3	15.2	14.2	14.8	14.5
50 gyr. @ constant 150 p.s.i., then												
applied 2,500 p.s.i.												
Pass 1/4"	71.7	71.8	71.8	This test								
Pass No. 10	37.4	37.3	37.4	not performed				-			-	
Pass No. 40	22.9	22.5	22.7	on routine								
Applied 2,500 p.s.i., then 50 gyr.				samples.								
@ constant 150 p.s.i.												
Pass 1/4"	84.4	84.5	84.5	79.1	81.8	80.5	79.9	79.6	79.8	83.6	82.8	83.2
Pass No. 10	49.6	50.3	50.0	44.4	43.4	43.9	42.3	42.3	42.3	40.6	39.5	40.1
Pass No. 40	31.3	31.5	31.4	23.8	22.4	23.1	21.9	22.1	22.0	22.0	22.1	22.1
Sandblast Test (% by Wt.)												
Standard Procedure												
1/2"-No. 4 Sample	2.8	2.9	2.9	These tests								
3/8"-1/4" Sample	3.6	3.3	3.5	not performed								
2,400 gms. sand				on routine				-			-	
3/8"-1/4" Sample	5.8	6.0	5.9	samples.								
3,600 gms. sand					"							
3/8"-1/4" Sample	10.2	10.0	10.1		"							
British Aggregate Crushing Value												
Test - 3/8"-1/4" (% by Wt.)												
Pass 1/4"	81.6	81.5	81.6		"							
Pass No. 10	43.0	43.3	43.2		"			-			-	
Pass No. 40	19.9	20.3	20.1		"							
British Aggregate Impact Value												
1/2"-3/8" Sample, Aggr. Impact Value	33	34	34		"							
Pass 1/4"	63.1	63.2	63.2		"							
Pass No. 10	33.2	33.5	33.4		"			-			-	
Pass No. 40	16.5	16.2	16.4		"							
3/8"-1/4" Sample, Aggr. Impact Value	29	30	30	28	28	28	31	31	31	31	32	32
Pass 1/4"	71.9	72.7	72.3	65.7	68.0	66.9	70.1	67.4	68.8	72.7	71.8	72.3
Pass No. 10	33.5	34.9	34.2	24.6	26.8	25.7	31.5	27.9	29.7	30.4	28.8	29.6
Pass No. 40	18.3	18.7	18.5	8.1	9.3	8.7	11.1	9.5	10.3	12.3	11.2	11.8

Test Method & Size	73-66-F			73-177-F			73-487-F			73-616-F	
	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B
Bituminous Section Mill											
3/8"-1/4" (% by Wt.)											
Ribbed bucket - 1 hr.. Pass 1/4"											
@ 72 r.p.m. Sample dry. Pass No. 10		-			-			-			-
Pass No. 40											
Bituminous Section Motorized Press											
3/8"-1/4" (% by Wt.)											
50 gyr. @ constant 150 p.s.i.											
Pass 1/4"	59.6	58.5	59.1	59.3	59.5	59.4	66.7	66.8	66.8	71.1	64.9
Pass No. 10	29.4	29.4	29.4	28.7	29.5	29.1	32.9	33.2	33.1	29.6	28.6
Pass No. 40	15.3	15.2	15.3	15.1	16.0	15.6	18.5	19.0	18.8	16.4	15.8
50 gyr. @ constant 150 p.s.i., then											
applied 2,500 p.s.i.											
Pass 1/4"											
Pass No. 10		-			-			-			-
Pass No. 40											
Applied 2,500 p.s.i., then 50 gyr.											
@ constant 150 p.s.i.											
Pass 1/4"	80.3	79.4	79.9	79.0	80.6	79.8	80.3	81.8	81.1	85.9	83.1
Pass No. 10	39.8	40.2	40.0	42.4	44.0	43.2	46.6	47.6	47.1	45.1	45.0
Pass No. 40	20.6	20.7	20.7	23.6	23.7	23.7	27.8	28.9	28.4	25.0	25.6
Sandblast Test (% by Wt.)											
Standard Procedure											
1/2"-No. 4 Sample											
3/8"-1/4" Sample											
2,400 gms. sand		-			-			-			-
3/8"-1/4" Sample											
3,600 gms. sand											
3/8"-1/4" Sample											
British Aggregate Crushing Value											
Test - 3/8"-1/4" (% by Wt.)											
Pass 1/4"											
Pass No. 10		-			-			-			-
Pass No. 40											
British Aggregate Impact Value											
1/2"-3/8" Sample, Aggr. Impact Value											
Pass 1/4"											
Pass No. 10		-			-			-			-
Pass No. 40											
3/8"-1/4" Sample, Aggr. Impact Value	33	34	34	32	32	32	31	33	32	34	32
Pass 1/4"	67.0	68.2	67.6	69.2	68.8	69.0	66.9	66.5	66.7	78.3	76.4
Pass No. 10	29.7	32.8	31.3	29.1	29.1	29.1	28.8	30.9	29.9	29.4	28.7
Pass No. 40	11.7	13.7	12.7	9.9	10.5	10.2	12.7	14.4	13.6	11.4	10.8

73-487-F			73-616-F			73-617-F			73-618-F			73-767-F			Statistical Analysis [illegible]s			
A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	$\bar{X}$	σ	CV(%)	R
	-			-			-			-			-		-	-	-	-
66.7	66.8	66.8	71.1	64.9	68.0	68.1	66.0	67.1	65.7	67.5	66.6	69.2	68.8	69.0				
32.9	33.2	33.1	29.6	28.6	29.1	30.5	32.1	31.3	32.9	30.4	31.7	35.8	34.3	35.1	30.40	2.45	8.06	9.6
18.5	19.0	18.8	16.4	15.8	16.1	17.3	18.3	17.8	19.7	18.1	18.9	21.4	20.5	21.0				
	-			-			-			-			-		-	-	-	-
80.3	81.8	81.1	85.9	83.1	84.5	83.3	80.6	82.0	81.9	82.9	82.4	82.9	82.1	82.5				
46.6	47.6	47.1	45.1	45.0	45.1	46.1	47.0	46.6	47.8	48.4	48.1	51.5	50.6	51.1	45.20	3.66	8.09	12.0
27.8	28.9	28.4	25.0	25.6	25.3	26.5	27.7	27.1	29.2	30.2	29.7	32.3	31.3	31.8				
	-			-			-			-			-		-	-	-	-
	-			-			-			-			-		-	-	-	-
	-			-			-			-			-		-	-	-	-
31	33	32	34	32	33	35	35	35	37	37	37	36	38	37	32.68	2.83	8.67	10
66.9	66.5	66.7	78.3	76.4	77.4	72.6	73.7	73.2	75.0	73.9	74.5	68.2	70.3	69.3				
28.8	30.9	29.9	29.4	28.7	29.1	31.0	31.5	31.3	34.3	32.9	33.6	33.1	33.9	33.5	30.62	2.62	8.56	10.3
12.7	14.4	13.6	11.4	10.8	11.1	13.0	13.4	13.2	15.9	14.1	15.0	14.8	15.5	15.2				

TABLE VI

Test Method & Size	R3-71-649 Bay Prairie, Wharton	R3-72-150 Trotti & Thompson "Burned Clay"	R3-70-210 Texas Crushed Stone Co. "Soft Rock"	R3-70-217 Servtex Materials Company	R3-70-245 Gifford-Hill Co., Bridgeport	R3-72-103 Trap Rock, Knippa	R3-7 Ford Grav Vict
Tex-200-F, Sieve Analysis							
(% by Wt.) Ret. 3/4"	0	0					
Ret. 5/8"	0	4.8	Natural				
Ret. 1/2"	0	11.0	aggregates				
Ret. 3/8"	48.8	28.9	submitted	-	-	-	
Ret. 1/4"	98.3	52.4	graded-				
Ret. No. 4	99.2	63.7	3/8"-1/4" &				
Ret. No. 10	99.4	85.4	1/4"-No. 4.				
Tex-201-F - 3/8"-1/4"							
Specific Gravity	1.800	1.992	2.286	2.419	2.676	3.121	2.5
Water Absorption (% by Wt.)	9.4	11.6	5.8	2.5	0.6	0.5	0.6
Tex-433-A - 3/8"-1/4"							
Specific Gravity	1.985	2.171	2.516	2.548	2.690	3.121	2.6
Water Absorption (% by Wt.)	3.7	7.1	1.4	0.9	0.2	0.4	0.3
Tex-109-E - 3/8"-1/4"							
Specific Gravity	2.346	2.616	These tests	-	-	-	
Water Absorption (% by Wt.)	12.4	12.2	not performed.				
Tex-404-A, Unit Weight (lbs./ft.^{3})			"				
Standard - 3/8"-1/4"	57.85	63.75	"				
Rodded - 3/8"-1/4"	60.78	68.16	"				
			"	-	-	-	
Standard - As received.	58.11	72.68	"				
Rodded - As received.	60.89	79.45	"				
Tex-431-A, Pressure Slaking							
Standard Method							
3/4"-No. 10 (Loss, % by Wt.)	4.3	2.6	"				
3/8"-1/4" (Loss, % by Wt.)	3.7	1.9	"	-	-	-	
Alternate Method							
3/4"-No. 10 (Loss, % by Wt.)	4.8	2.5	"				
3/8"-1/4" (Loss, % by Wt.)	4.1	2.5	"				

R3-72-103 Trap Rock, Knippa	R3-72-107 Fordyce Gravel, Victoria	R3-72-142 Rock Asphalt, White's Mines, Inc.
-	-	-
3.121	2.579	2.233
0.5	0.6	3.1
3.121	2.600	2.287
0.4	0.3	1.8
-	-	-
-	-	-
-	-	-

Test Method & Size	R3-71-649 Bay Prairie, Wharton			R3-72-150 Trotti & Thompson Burned Clay			R3-70-210 Texas Crushed Stone Co. "Soft Rock"			R3-70-217 Servtex Materials Company			R3-70-245 Gifford-Hill Co. Bridgeport			R3-72-103 Trap Rock, Knippa			R3-72-107 Fordyce Gravel, Victoria		
	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.
Tex-432-A, Freeze & Thaw Test (% by Wt.)																					
5/8"-1/2" Sample																					
Actual Loss, Pass 1/2"		Size not		48.2	52.8	50.5		These													
Pass 1/4"		available		22.1	19.5	20.8		tests not			-			-			-			-	
Pass No. 10		in sample.		5.1	3.9	4.5		performed													
Pass No. 40				1.3	1.0	1.2		"													
1/2"-3/8" Sample																					
Actual Loss, Pass 3/8"	21.0	19.7	20.4	52.1	42.7	47.4		"													
Pass 1/4"	8.2	7.6	7.9	28.2	28.6	28.4		"													
Pass No. 10	4.6	4.5	4.6	5.8	5.7	5.8		"			-			-			-			-	
Pass No. 40	1.4	1.8	1.6	1.4	1.3	1.4		"													
3/8"-No. 4 Sample								"													
Actual Loss, Pass No. 4	8.9	10.3	9.6	21.7	25.6	23.7		"													
Pass 1/4"	11.1	12.1	11.6	41.9	49.4	45.7		"													
Pass No. 10	5.8	7.0	6.4	5.7	6.5	6.1		"			-			-			-			-	
Pass No. 40	1.8	2.3	2.1	1.8	1.4	1.6		"													
Total Weighted Loss	-	-	14.9	-	-	34.7		"			-			-			-			-	
3/8"-1/4" Sample								"													
Actual Loss, Pass 1/4"	11.2	10.6	10.9	36.6	29.2	32.9		"													
Pass 1/4"	11.2	10.6	10.9	36.6	29.2	32.9		"													
Pass No. 10	5.9	6.6	6.3	5.2	4.2	4.7		"			-			-			-			-	
Pass No. 40	1.3	0.7	1.0	1.7	0.6	1.2		"													
Tex-410-A, Los Angeles Abrasion Test (% by Wt.)																					
3/8"-No. 4, L. A. Abrasion Value		Size not		25.1	25.8	25.5	35.4	35.2	35.3	31.0	31.0	31.0	23.3	23.4	23.4	10.6	10.6	10.6			
Pass 1/4"		available		94.0	93.5	93.8	90.9	90.9	90.9	91.2	91.2	91.2	85.5	85.4	85.5	60.1	60.2	60.2			
Pass No. 10		in sample.		31.6	31.2	31.4	39.5	39.4	39.5	34.8	35.3	35.1	26.7	26.9	26.8	12.1	12.4	12.3			
Pass No. 40				8.3	8.5	8.4	22.5	22.5	22.5	18.7	18.8	18.8	11.9	11.9	11.9	4.8	5.0	4.9			
3/8"-1/4", L. A. Abrasion Value	31.0	30.9	31.0	26.9	24.7	25.8	35.2	35.0	35.1	30.5	30.4	30.5	22.1	22.0	22.1	6.8	6.9	6.9			
Pass 1/4"	84.0	83.9	84.0	88.1	97.0	92.6	80.2	80.2	80.2	81.0	81.0	81.0	69.1	68.9	69.0	25.9	26.0	26.0			
Pass No. 10	35.1	35.1	35.1	32.4	30.1	31.3	38.8	38.8	38.8	35.9	36.0	35.9	24.9	24.9	24.9	7.9	7.9	7.9			
Pass No. 40	15.2	15.1	15.2	9.2	8.4	8.8	24.0	23.7	23.9	19.5	19.3	19.4	11.5	11.7	11.6	4.1	4.1	4.1			
3,000 gms. @ 500 rev.																					
3/8"-No. 4, L. A. Abrasion Value		Size not		30.1	30.1	30.1	35.6	35.8	35.7	29.3	29.0	29.2	20.9	20.8	20.9	10.7	10.5	10.6			
Pass 1/4"		available		95.8	96.7	96.3	90.1	90.0	90.1	86.0	85.8	85.9	87.0	83.1	85.1	61.5	61.5	61.5			
Pass No. 10		in sample.		38.0	36.8	37.4	39.2	38.6	38.9	32.6	33.0	32.8	24.1	24.1	24.1	12.8	12.3	12.6			
Pass No. 40				10.5	10.3	10.4	23.5	23.8	23.7	19.0	19.1	19.1	11.7	11.7	11.7	5.8	5.7	5.8			
3/8"-1/4", L. A. Abrasion Value	34.1	34.1	34.1	31.8	29.3	30.6	36.2	36.7	36.5	30.0	30.1	30.1	19.4	19.6	19.5	7.7	7.6	7.7			
Pass 1/4"	89.5	89.5	89.5	91.1	90.3	90.7	78.1	77.3	77.7	74.3	74.3	74.3	58.7	58.9	58.8	25.0	24.7	24.9			
Pass No. 10	39.4	39.3	39.4	37.0	36.1	36.6	39.5	39.8	39.7	32.2	32.3	32.3	21.7	21.8	21.8	8.5	8.4	8.5			
Pass No. 40	16.6	16.5	16.6	11.0	10.6	10.8	25.9	25.9	25.9	20.6	20.5	20.6	12.0	12.1	12.1	5.0	5.1	5.1			

R3-72-107 Fordyce Gravel, Victoria			R3-72-142 Rock Asphalt White's Mines, Inc.		
A	B	Avg.	A	B	Avg.
	-			These tests not performed with this aggregate.	
	-			"	
	-			"	
	-			"	
	-			"	
				"	
				"	
				"	
				"	
				"	
				"	
				"	
				"	
				"	
				"	
				"	
				"	
				"	
				"	
				"	
				"	

Test Method & Size	R3-71-649 Bay Prairie, Wharton			R3-72-150 Trotti & Thompson Burned Clay			R3-70-210 Texas Crushed Stone Co. "Soft Rock"			R3-70-217 Servtex Materials Company			R3-70-245 Gifford-Hill Co. Bridgeport			R3-72-103 Trap Rock, Knippa			R3-72-107 Fordyce Gravel, Victoria		
	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.	A	B	Avg.
Bituminous Section Mill 3/8"-1/4" (% by Wt.)																					
Ribbed bucket - 1 hr. Pass 1/4"	15.0	15.3	15.2	25.5	24.7	25.1	28.8	29.0	28.9	26.3	25.8	26.1	9.3	9.0	9.2	4.0	3.3	3.7	10.1	9.0	9.6
@ 72 r.p.m. Sample dry. Pass No.10	9.4	9.7	9.6	1.8	1.8	1.8	12.9	13.3	13.1	4.5	4.4	4.5	1.7	1.5	1.6	1.2	1.0	1.1	1.0	0.9	1.0
Pass No.40	8.3	8.8	8.6	1.1	1.1	1.1	12.7	13.1	12.9	4.4	4.3	4.4	1.5	1.3	1.4	1.1	0.9	1.0	0.7	0.7	0.7
Bituminous Section Motorized Press 3/8"-1/4" (% by Wt.)																					
50 gyr. @ constant 150 p.s.i.																					
Pass 1/4"	65.9	64.5	65.2	76.1	77.5	76.8	55.5	54.2	54.9	55.5	55.9	55.7	42.9	45.4	44.2	17.8	16.9	17.4	30.4	30.9	30.7
Pass No.10	33.9	33.3	33.6	32.8	33.7	33.3	30.3	28.7	29.5	26.0	24.7	25.4	14.5	18.5	16.5	7.7	7.4	7.6	11.0	10.3	10.7
Pass No.40	18.0	17.9	18.0	15.0	15.5	15.3	18.6	17.8	18.2	14.8	14.1	14.5	7.3	9.1	8.2	3.6	3.4	3.5	4.8	4.6	4.7
50 gyr. @ constant 150 p.s.i., then applied 2,500 p.s.i.																					
Pass 1/4"	68.6	69.1	68.9	79.9	80.2	80.1	60.4	60.3	60.4	68.6	67.7	68.2	58.1	58.5	58.3	25.5	23.3	24.4	38.9	38.0	38.5
Pass No.10	35.0	35.7	35.4	34.3	33.4	33.9	31.7	32.1	31.9	30.7	30.8	30.8	22.8	23.6	23.2	9.3	9.3	9.3	12.7	11.7	12.2
Pass No.40	18.9	18.8	18.9	15.2	14.9	15.1	19.1	19.4	19.3	17.9	17.9	17.9	10.5	11.0	10.8	4.4	4.4	4.4	5.3	5.0	5.2
Applied 2,500 p.s.i., then 50 gyr. @ constant 150 p.s.i.																					
Pass 1/4"	85.7	83.9	84.8	92.1	92.8	92.5	76.6	76.7	76.7	76.4	74.0	75.2	69.0	72.1	70.6	36.9	35.1	36.0	48.9	49.4	49.2
Pass No.10	46.9	46.2	46.6	49.0	49.7	49.4	42.5	42.3	42.4	32.6	34.9	33.8	28.2	30.8	29.5	13.4	13.4	13.4	18.8	19.3	19.1
Pass No.40	23.8	23.5	23.7	21.0	21.4	21.2	27.3	26.5	26.9	18.8	20.3	19.6	14.0	15.7	14.9	6.6	6.7	6.7	8.6	9.1	8.9
Sandblast Test (% by Wt.) Standard Procedure																					
1/2"-No. 4 Sample	8.4	6.9	7.7	1.8	1.6	1.7	Insufficient			Size not available.				-			-			-	
3/8"-1/4" Sample	4.0	4.3	4.2	1.5	1.6	1.6	material			1.5	1.4	1.5	0.8	0.9	0.9	0.4	0.4	0.4	0.2	0.1	0.2
2,400 gms. sand 3/8"-1/4" Sample	7.8	7.5	7.7	2.2	2.3	2.3	of proper size.			2.7	2.4	2.6	2.0	2.1	2.1	0.9	1.3	1.1	0.5	0.5	0.5
3,600 gms. sand 3/8"-1/4" Sample	9.7	9.5	9.6	3.9	3.9	3.9		"		4.1	4.3	4.2	3.4	3.2	3.3	0.9	1.1	1.0	0.6	0.6	0.6
British Aggregate Crushing Value Test - 3/8"-1/4" (% by Wt.)																					
Pass 1/4"	83.5	83.3	83.4	85.6	85.2	85.4	75.4	74.7	75.1	78.2	78.9	78.6	74.2	73.2	73.7	42.3	43.4	42.9	52.7	52.1	52.4
Pass No.10	39.9	41.0	40.5	36.1	35.7	35.9	35.8	36.5	36.2	33.0	32.3	32.7	26.1	26.4	26.3	11.0	11.6	11.3	14.6	14.6	14.6
Pass No.40	14.3	14.9	14.6	8.8	8.9	8.9	16.2	15.8	16.0	12.8	12.5	12.7	8.0	8.1	8.1	2.9	3.2	3.1	3.6	3.6	3.6
British Aggregate Impact Value																					
1/2"-3/8" Sample, Aggr, Impact Value	34	34	34	31	31	31	Size not														
Pass 1/4"	66.0	63.8	64.9	66.5	67.3	66.9	available.														
Pass No.10	29.7	31.8	30.8	29.6	29.4	29.5		"			-			-			-			-	
Pass No.40	10.8	12.9	11.9	7.8	8.4	8.1															
3/8"-1/4" Sample, Aggr. Impact Value	36	37	37	32	33	33	33	34	34	30	30	30	23	22	23	7	6	7	15	16	16
Pass 1/4"	73.7	73.7	73.7	78.0	78.8	78.4	68.0	68.6	68.3	67.5	68.1	67.8	55.5	54.7	55.1	22.4	22.9	22.7	43.5	46.3	44.9
Pass No.10	33.3	33.6	33.5	27.9	28.1	28.0	29.2	31.0	30.1	26.6	25.7	26.2	18.6	18.8	18.7	5.9	5.9	5.9	13.1	14.7	13.9
Pass No.40	13.0	13.7	13.4	6.5	5.9	6.2	13.9	15.2	14.6	10.6	10.3	10.5	5.4	5.8	5.6	1.8	1.9	1.9	4.1	4.8	4.5

R3-72-107 Fordyce Gravel, Victoria			R3-72-142 Rock Asphalt, White's Mines, Inc.		
A	B	Avg.	A	B	Avg.
10.1	9.0	9.6	20.0	20.6	20.3
1.0	0.9	1.0	4.1	3.7	3.9
0.7	0.7	0.7	4.0	3.6	3.8
30.4	30.9	30.7	56.4	55.8	56.1
11.0	10.3	10.7	24.7	25.5	24.1
4.8	4.6	4.7	13.7	14.1	13.9
38.9	38.0	38.5	This test not performed.		
12.7	11.7	12.2			
5.3	5.0	5.2			
48.9	49.4	49.2	75.7	72.7	74.2
18.8	19.3	19.1	37.7	36.4	37.1
8.6	9.1	8.9	20.8	20.2	20.5
	-			-	
0.2	0.1	0.2	2.0	2.1	2.1
0.5	0.5	0.5	3.8	3.9	3.9
0.6	0.6	0.6	5.0	5.7	5.4
52.7	52.1	52.4	57.7	51.4	54.6
14.6	14.6	14.6	20.9	18.3	19.6
3.6	3.6	3.6	8.7	7.6	8.2
	-			-	
15	16	16	19	21	20
43.5	46.3	44.9	53.9	59.0	56.5
13.1	14.7	13.9	17.8	18.9	18.4
4.1	4.8	4.5	6.6	7.2	6.9

STATISTICAL ANALYSIS FOR TRENDS

Test Method & Size	Featherlite-Ranger				Texas Industries-Eastland				Texas Industries-Clodine				Texas Industries-Dallas				Superock, I	
	X̄	σ	CV(%)	R	X̄	σ	CV(%)	R	X̄	σ	CV(%)	R	X̄	σ	CV(%)	R	X̄	σ
Tex-404-A, Unit Weight																		
Standard- As received.	48.91	2.44	4.99	8.77	52.83	2.28	4.31	7.73	49.51	3.85	7.77	14.84	42.36	4.18	9.87	13.85	41.33	2.12
Tex-431-A, Pressure Slaking																		
3/4"-No. 10 (Loss, % by Wt.)	2.00	0.62	30.81	3.1	1.32	0.29	22.19	1.2	2.69	0.64	23.83	2.1	3.01	0.64	21.35	2.1	2.68	0.45
Tex-432-A, Freeze & Thaw Test																		
1/2"-3/8" Sample Pass No. 10	0.46	0.36	78.40	1.2	1.14	0.58	50.97	2.2	5.31	6.69	126.07	28.0	10.52	2.83	28.86	8.7	0.37	0.26
3/8"-No. 4 Sample Pass No. 10	0.53	0.54	103.00	2.5	1.45	1.09	75.02	4.6	6.52	7.73	118.63	30.1	14.10	3.88	27.51	13.5	0.61	0.52
Total Weighted Loss	3.92	2.25	57.51	8.2	8.97	7.14	79.61	28.9	15.79	11.97	75.82	54.5	41.63	10.26	24.64	34.8	3.78	3.24
3/8"-1/4" Sample Pass No. 10	1.23	1.37	111.58	4.8	1.33	0.83	62.99	3.0	9.82	11.04	112.37	33.7	11.97	2.36	19.73	6.2	-	-
Tex-410-A, Los Angeles Abrasion Test																		
3/8"- No. 4, L. A. Abrasion Value	19.95	1.25	6.27	4.4	20.92	1.05	5.03	4.5	25.20	1.90	7.56	6.4	21.58	1.14	5.29	3.5	19.11	3.23
Pass No. 10	22.85	1.35	5.91	5.2	24.24	0.80	3.28	2.8	29.91	1.69	5.64	5.7	25.71	1.37	5.32	4.4	22.32	9.01
3/8"-1/4", L. A. Abrasion Value	19.98	0.83	4.17	2.5	20.68	0.96	4.66	3.4	25.94	1.48	5.72	5.4	21.86	2.80	12.81	8.6	-	-
Pass No. 10	23.15	1.20	5.19	3.7	24.05	0.95	3.94	2.8	29.47	2.04	6.91	5.9	25.85	2.78	10.74	8.4	-	-
3,000 gms. - 500 rev.																		
3/8"-No. 4, L. A. Abrasion Value	30.29	2.70	8.92	10.8	29.59	1.09	3.68	3.3	34.97	6.44	18.40	21.1	33.19	2.06	6.20	5.4	-	-
Pass No. 10	35.14	2.82	8.02	10.9	34.67	1.19	3.43	6.6	41.30	5.96	14.43	20.0	40.25	3.35	8.31	7.3	-	-
3/8"-1/4", L. A. Abrasion Value	28.45	1.15	4.04	3.6	28.68	2.35	8.19	7.7	37.19	2.81	7.55	9.4	33.09	2.46	7.44	8.3	-	-
Pass No. 10	32.86	1.41	4.31	4.0	34.53	6.26	18.12	23.4	42.92	2.66	6.20	7.8	38.95	2.65	6.79	9.2	-	-
Bituminous Section Mill																		
Pass No. 10	6.14	0.89	14.54	2.9	5.22	1.34	25.63	3.8	7.72	0.34	4.40	1.0	3.72	0.60	16.18	1.4	-	-
Bituminous Section Motorized Press																		
50 gyr. @ constant 150 p.s.i.																		
Pass No. 10	27.58	1.97	7.13	9.5	28.70	1.92	6.70	9.2	34.17	2.01	5.88	8.8	36.55	2.65	7.26	10.4	30.40	2.45
2,500 p.s.i., then 50 gyr. @ 150 p.s.i.																		
Pass No. 10	41.14	1.42	3.45	6.4	40.70	2.19	5.38	13.0	50.36	1.97	3.90	9.2	57.52	2.18	3.79	7.8	45.20	3.66
British Aggregate Crushing Value Test Pass No. 10	34.46	1.76	5.09	6.0	34.03	2.62	7.70	9.5	39.91	2.15	5.38	6.9	49.62	1.42	2.85	4.6	-	-
British Aggregate Impact Value																		
1/2"-3/8" Sample, Aggr. Impact Value	30.14	4.24	14.07	13	31.17	3.79	12.15	14	38.00	1.96	5.16	6	41.25	3.82	9.25	12	-	-
Pass No. 10	27.12	4.29	15.82	13.2	27.93	3.32	11.89	12.1	34.04	1.63	4.78	5.2	36.84	2.53	6.86	7.4		
3/8"-1/4" Sample, Aggr. Impact Value	32.04	3.28	10.24	15	31.76	3.24	10.21	18	38.97	1.80	4.62	7	43.20	2.46	5.70	9	32.68	2.83
Pass No. 10	29.21	2.73	9.35	13.9	28.44	3.37	11.84	17.5	35.73	1.63	4.57	6.5	39.62	2.98	7.52	11.3	30.62	2.62

Texas Industries-Dallas				Superock, Inc.			
$\bar{X}$	σ	CV(%)	R	$\bar{X}$	σ	CV(%)	R
42.36	4.18	9.87	13.85	41.33	2.12	5.13	5.50
3.01	0.64	21.35	2.1	2.68	0.45	16.68	1.3
10.52	2.83	28.86	8.7	0.37	0.26	70.99	0.8
14.10	3.88	27.51	13.5	0.61	0.52	84.81	1.7
41.63	10.26	24.64	34.8	3.78	3.24	85.62	8.8
11.97	2.36	19.73	6.2	-	-	-	-
21.58	1.14	5.29	3.5	19.11	3.23	16.88	8.4
25.71	1.37	5.32	4.4	22.32	9.01	40.36	28.0
21.86	2.80	12.81	8.6	-	-	-	-
25.85	2.78	10.74	8.4	-	-	-	-
33.19	2.06	6.20	5.4	-	-	-	-
40.25	3.35	8.31	7.3	-	-	-	-
33.09	2.46	7.44	8.3	-	-	-	-
38.95	2.65	6.79	9.2	-	-	-	-
3.72	0.60	16.18	1.4	-	-	-	-
36.55	2.65	7.26	10.4	30.40	2.45	8.06	9.6
57.52	2.18	3.79	7.8	45.20	3.66	8.09	12.0
49.62	1.42	2.85	4.6	-	-	-	-
41.25	3.82	9.25	12	-	-	-	-
36.84	2.53	6.86	7.4				
43.20	2.46	5.70	9	32.68	2.83	8.67	10
39.62	2.98	7.52	11.3	30.62	2.62	8.56	10.3