

# **Permanent Deformation of Subgrade Soils**

## **Phase II: Repeated Load Testing of Four Soils**

**(MBTC FR-1089)**

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## **1. Introduction**

Permanent deformation of subgrade soils was investigated through repeated load testing. Four subgrade soils of Arkansas subgrades were tested in this phase of research. The emphasis in the selection of subgrade soils was primarily based upon the coverage of predominant pedologic occurrence. Research report TRC-94 (Elliott et al. 1988) served as the main source in the selection of subgrades.

The major goal of this phase of research was to develop data that can be used in Phase III. Phase III will seek to verify the effect of factors such as deviator stress, moisture content, first cycle freeze-thaw, density, load history induced by sequential loading, and soils type on the permanent deformation of highway subgrades. Additional objectives are to verify the general deformation trend of subgrade soils that was found in the first phase of this research and to explore additional possible factors that affect testing results.

All the repeated load tests were conducted using the test protocol established during the first phase of this research. The main features of the test protocol are summarized here (Elliott et al. 1998). The confining pressure of repeated load testing was set to a fixed value of 21 kPa (3 psi). Load frequency should be set to 1 Hz (a load duration of 0.1 second followed by a rest period of 0.9 second). Deviator stresses were varied in the investigation to determine their effect on the deformation accumulation. Moisture contents were set to three levels to simulate the service range of highway subgrades in Arkansas, namely, 105%, 110%, and 120% of the optimum moisture content (OMC). Some specimens were subjected to one cycle of freeze-thaw to gain data on the effect of this parameter.

## 2. Properties of Soils Tested

Four representative Arkansas subgrade soils were selected for repeated load testing. The Planning and Research Section of Arkansas Highway and Transportation Department (AHTD) conducted all sampling work. Engineering properties for these four soils are listed in Table 1.

Table 1 Summary of Soil Properties

| Soil   | Enders          | Gallion         | Houston        | Sacul         |
|--|-----------------|-----------------|----------------|---------------|
| Coverage                                       | 10.8            | N. A.           | 1.0            | 6.1           |
| Sampling                                       | Highway 162     | Highway 365     | Highway 19     | Highway 71    |
| Location                                       | Crawford County | Faulkner County | Nevada Country | Miller County |
| $M_R(\text{MPa})@ 28 \text{ kPa of } \sigma_d$ | 33              | 129             | 103            | 77            |
| R-value  | @ 240 psi: 20   | @ 240 psi: 3    | @ 240 psi: 6   | @ 240 psi: 14 |
|  | @ 300 psi: 25   | @ 300 psi: 4    | @ 300 psi: 7   | @ 300 psi: 18 |
| LL   | 21              | 27              | 51             | 34            |
| PL   | 17              | 17              | 26             | 16            |
| PI   | 4               | 10              | 25             | 18            |
| Specific Gravity                               | 2.7154          | 2.6740          | 2.7056         | 2.6745        |
| OMC  | 13.82           | 15              | 20.05          | 14            |

|                         |       |       |       |       |
|-------------------------|-------|-------|-------|-------|
| MDD (t/m <sup>3</sup> ) | 1.880 | 1.822 | 1.637 | 1.824 |
| % of Fines*             | 61    | 78    | 79    | 66    |
| AASHTO Classification   | A-4   | A-4   | A-7-5 | A-6   |
| Unified Classification  | CL    | CL    | MH    | CL    |

\*particles with a diameter less than 0.075 mm (passing # 200 sieve)

Gradation curves for the soils tested are plotted in Figure 1 through Figure 4. Classification properties are included in Table 1. Compaction curves are presented in Figure 5 through Figure 8. All conventional soil tests were carried out in accordance with the corresponding specifications of AASHTO or ASTM as listed in Table 2.

Table 2. Specification Used for Conventional Soil Testing

|                              |               |
|------------------------------|---------------|
| Property                     | Specification |
| Liquid Limit                 | AASHTO T-265  |
| Plastic Limit                | AASHTO T-265  |
| Optimum Moisture Content (%) | AASHTO T-99   |

|   |                 |
|---|-----------------|
| Maximum Dry Density ( $\text{kN/m}^3$ ) | AASHTO T-99     |
| Specific Gravity                        | AASHTO T-100    |
| % of Fines                              | AASHTO T-87, 88 |
| % of Clay Particles                     | AASHTO T-87, 88 |
| AASHTO Classification                   | AASHTO M-145    |
| Unified Classification                  | ASTM D-2487     |

Static strength of soils were determined by triaxial testing with the confining pressure set at 21 kPa (3 psi). This is the same confining pressure as used in the repeated load testing. The triaxial strength test results are presented in Table 3.

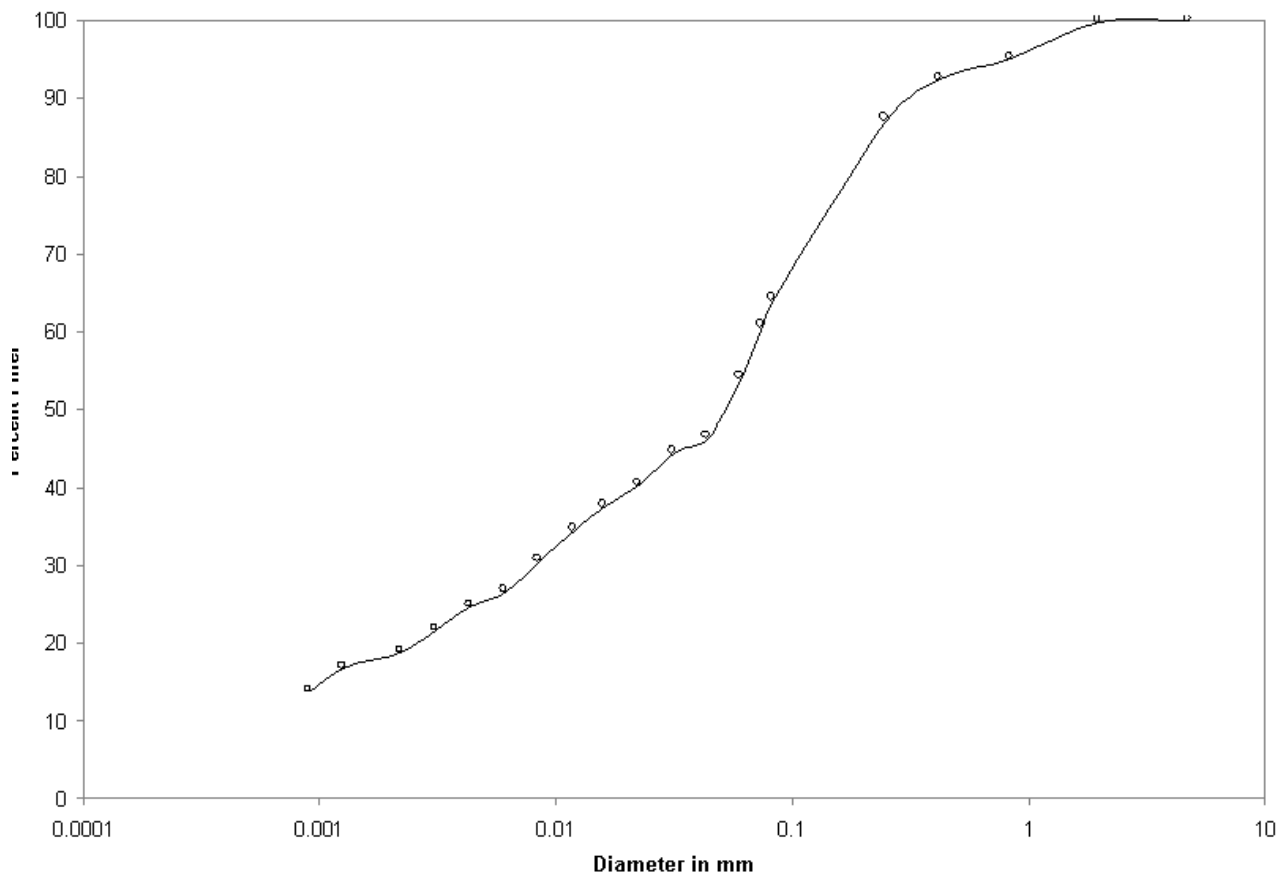


Figure 1 Gradation Curve of Enders Soil

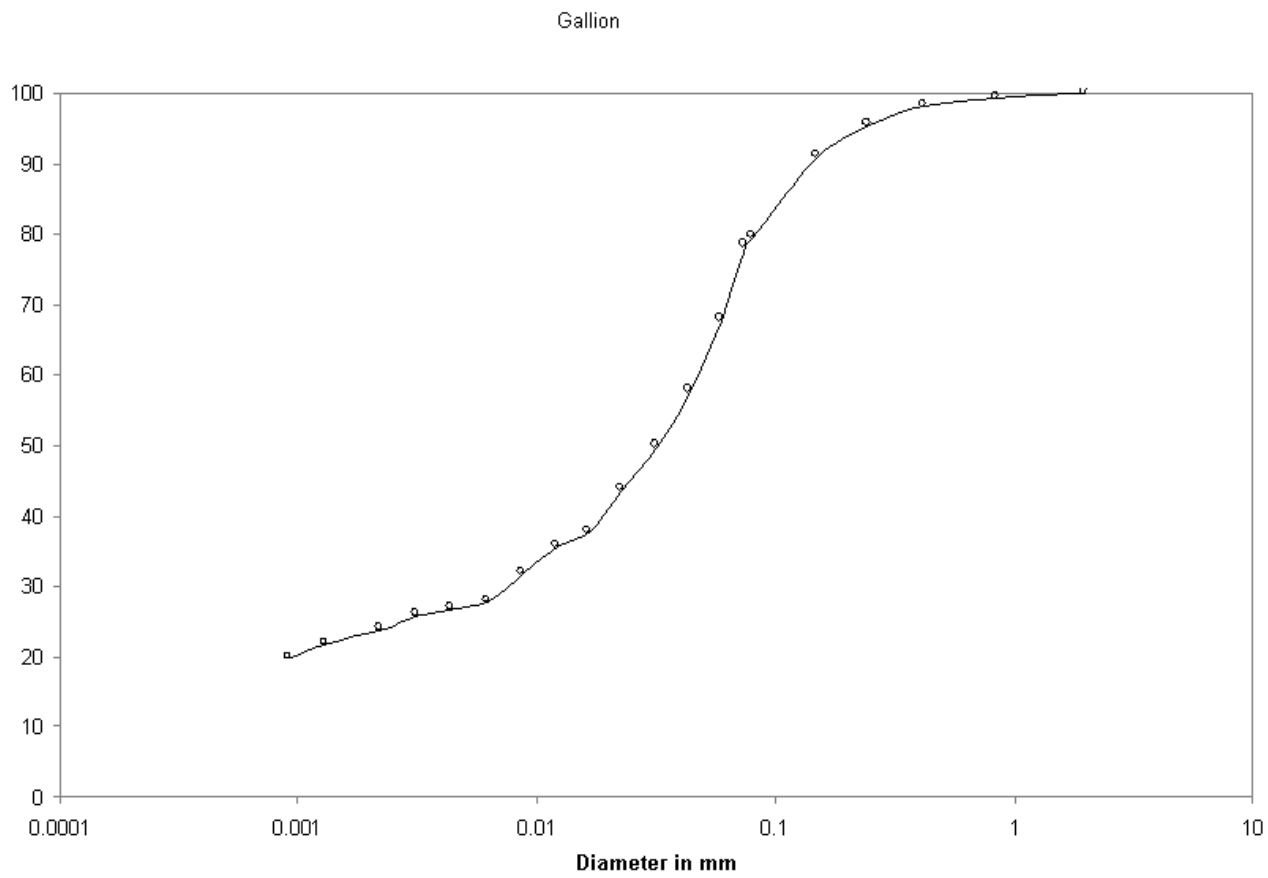


Figure 2 Gradation Curve of Gallion Soil

9  
Percent Finer

### Houston

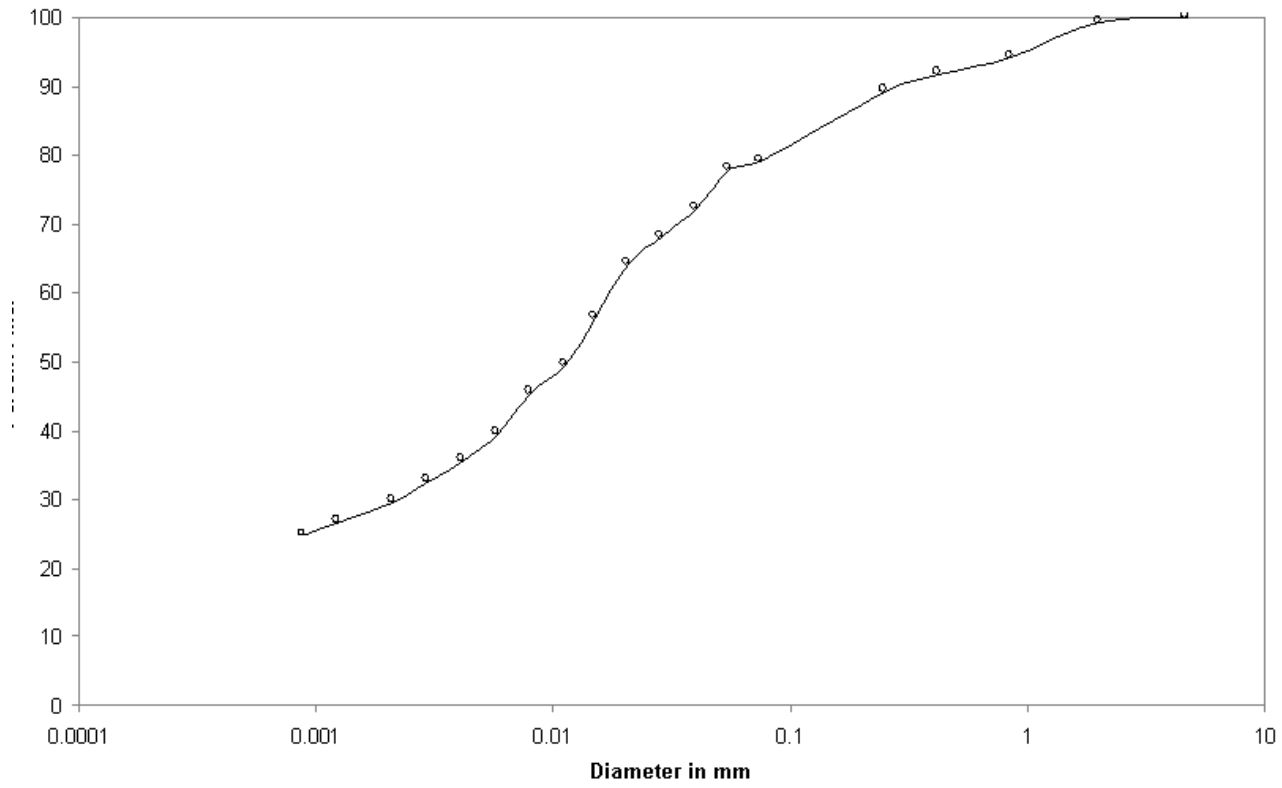


Figure 3 Gradation Curve of Houston Soil

g  
Percent Finer

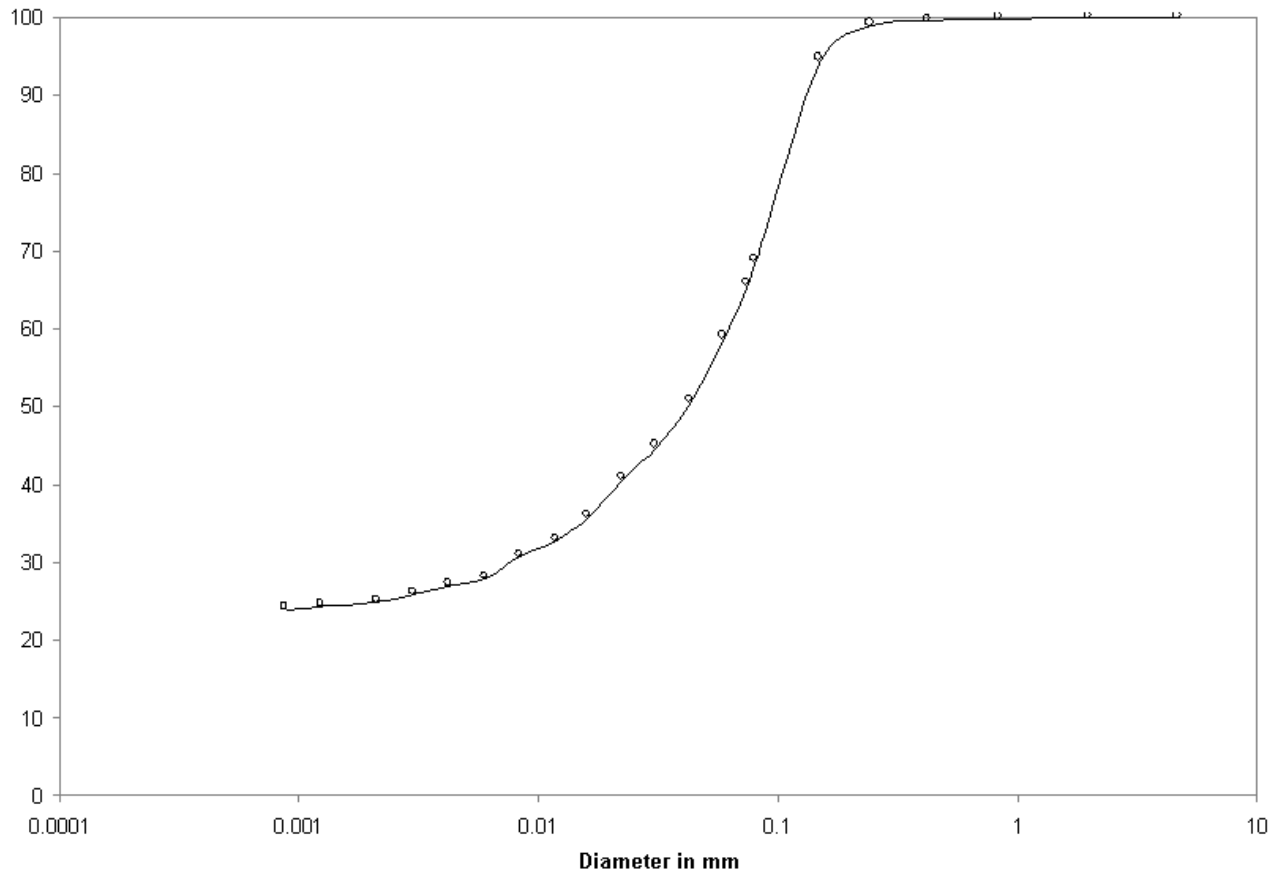


Figure 4 Gradation Curve of Sacul Soil

7  
Percent Finer

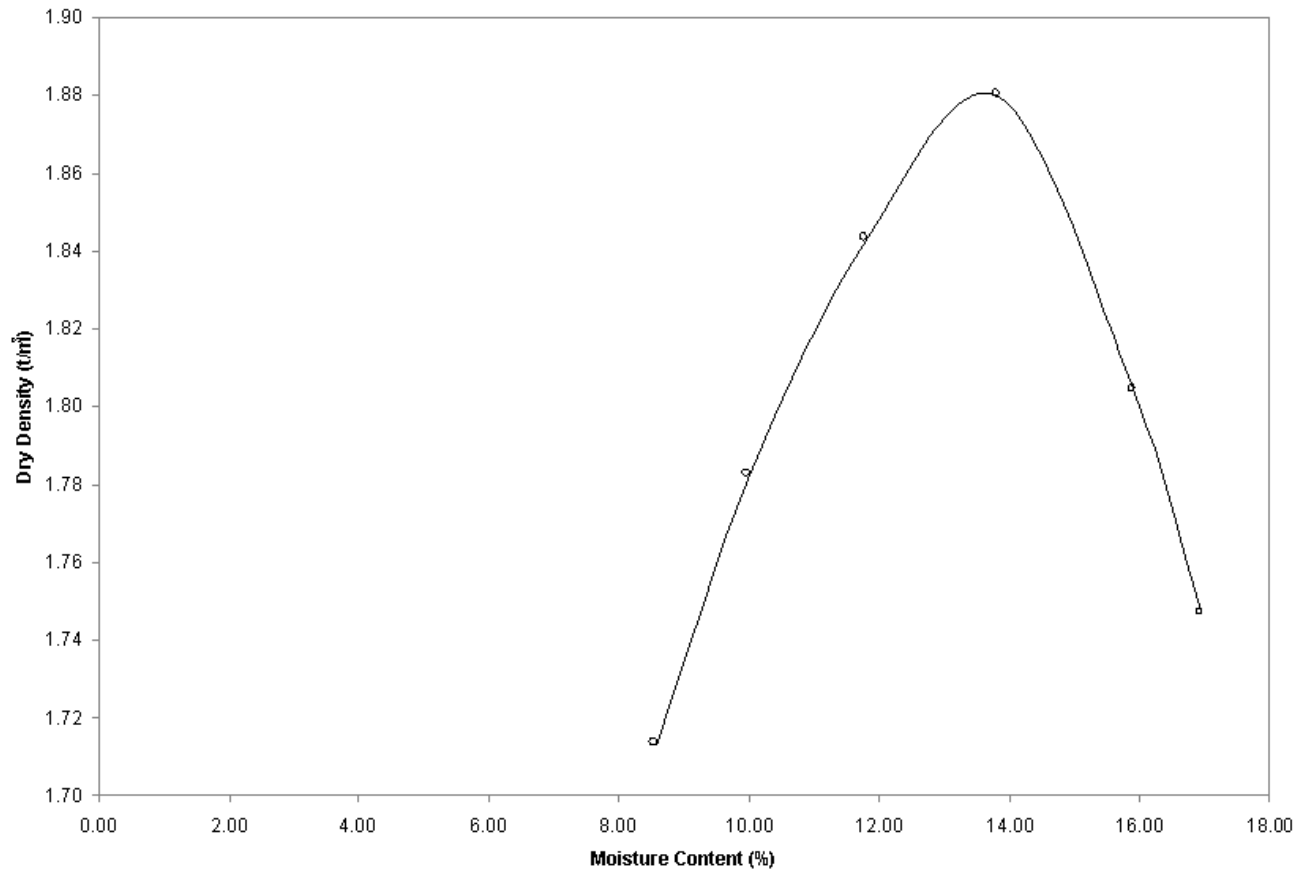


Figure 5 Compaction Curve for Enders Soil(AASHTO T-99)

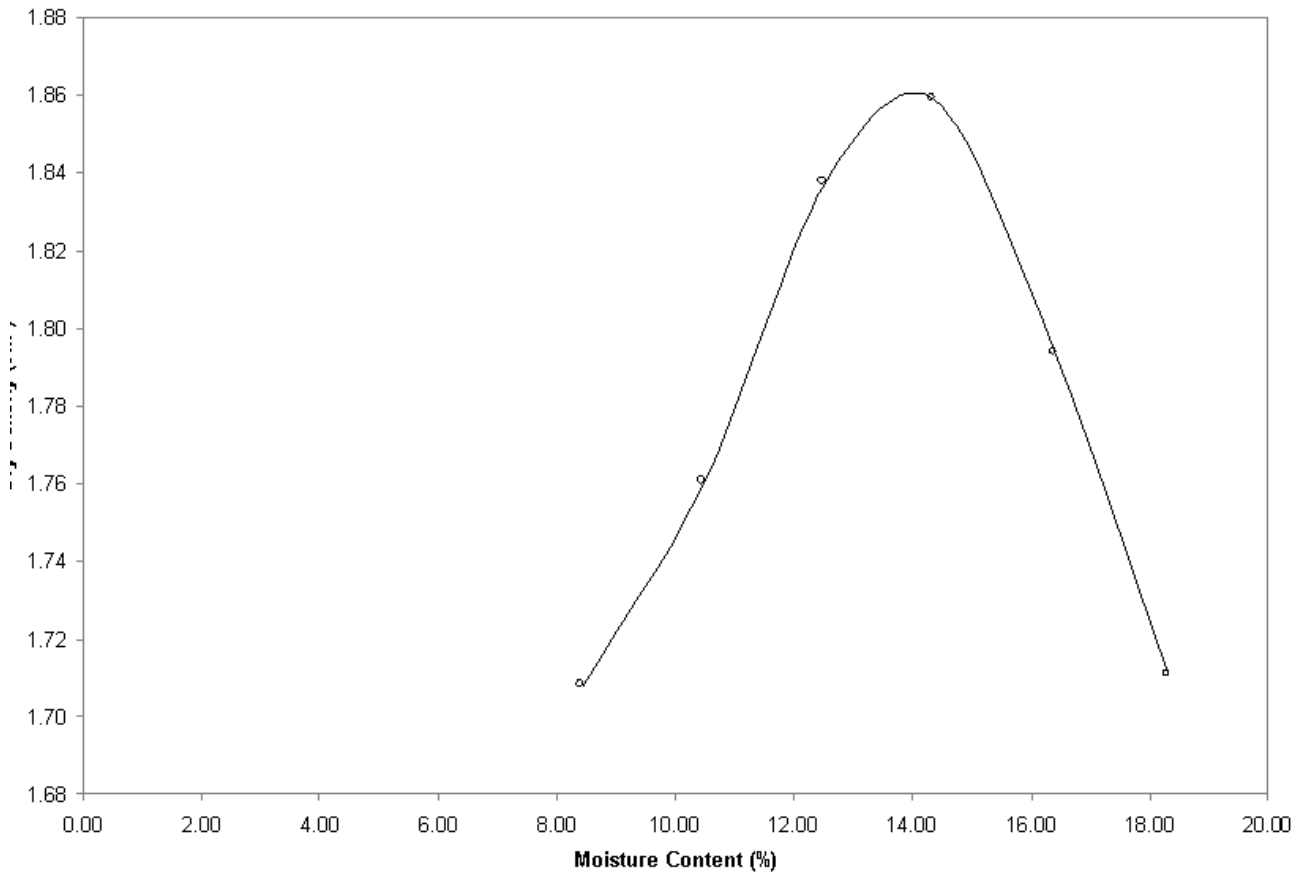


Figure 6 Compaction Curve for Gallion Soil (AASHTO T-99)

6  
Dry Density (t/m³)

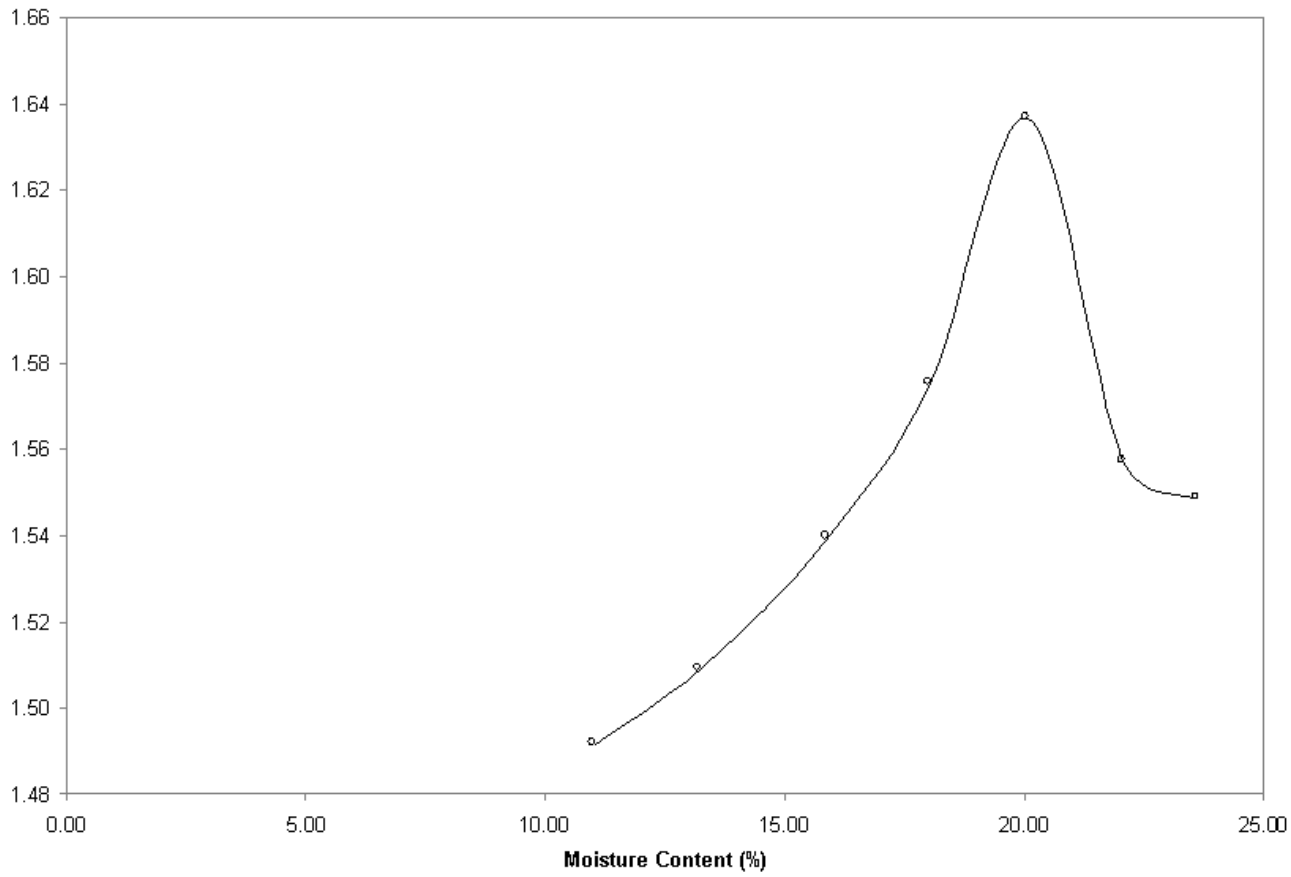


Figure 7 Compaction Curve for Gallion Soil (AASHTO T-99)

10  
Dry Density (t/m<sup>3</sup>)

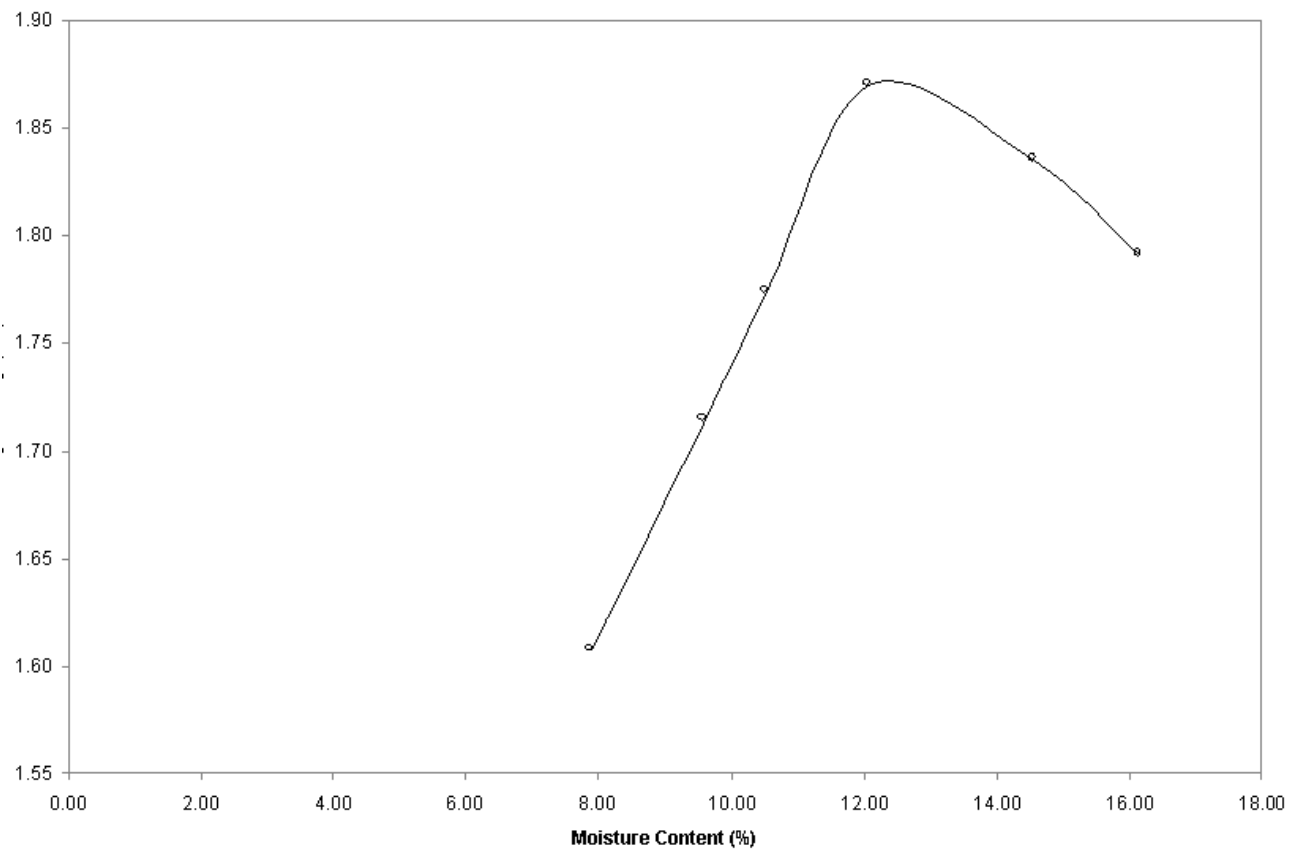


Figure 8 Compaction Curve for Sacul Soil (AASHTO T-99)

11  
Dry Density (t/m³)

Table 3. Static Strength (in kPa) of Subgrade Soils

|         | 105<br>(% of OMC) | 110<br>(% of OMC) | 120<br>(% of OMC) |
|---------|-------------------|-------------------|-------------------|
| Enders  | 151 kPa           | 111 kPa           | 83 kPa            |
| Gallion | 242 kPa           | 174 kPa           | 111 kPa           |
| Houston | 345 kPa           | 276 kPa           | 138 kPa           |
| Sacul   | 283 kPa           | 241 kPa           | 152 kPa           |

### **3. Test Program and Test Results**

In order to investigate the effects of moisture content on the accumulation of permanent deformation, specimens were fabricated at three different moisture contents corresponding to 105%, 110%, 120% of optimum to simulate service conditions of pavement subgrades. Specimens with the same moisture content and density were subjected to various levels of deviator stress to explore the role of deviator stress in the development of subgrade deformation. The effect of limited variation in density on deformation behavior was also investigated. The first-cycle freeze-thaw was studied to estimate the impact of seasonal effects. Stress history induced from staged loading was studied to evaluate its effects on different soils.

The test protocol developed in the first phase of this research project (Elliott et al. 1998) was observed throughout all the tests. The confining pressure is set to a constant magnitude of 21 kPa (3 psi). The rest period was 0.9 second and the load duration was 0.1 second resulting in a load frequency of 1 Hz. Repeated load testing was concluded around 10,000 repetitions. Fresh specimens were used for each level of applied deviator stresses except for those specimens used to study the effects of staged loading.

All the test results of repeated load testing on the four selected soils are summarized in this section. Detailed presentation of the results in graphical and digital formats is included in Appendix A. Test results of specimens with the same moisture content are grouped together to better demonstrate the influence of deviator stress. Laboratory test results are summarized in Table 4 followed detailed description of every figure for all the four soils.

### 3-1 Test Results for Enders

Repeated load testing results for Enders are presented in Figure A-1 to A-7. Figure A-1 illustrates test results for specimens with moisture contents corresponding to 105% of optimum and dry densities corresponding to 95% of maximum. Deviator stress ranges from 28 kPa (4 psi) to 103 kPa (15 psi). Figure A-2 presents test results with moisture contents corresponding to 110% of optimum and dry densities corresponding to 95% of maximum. Deviator stress ranges from 28 kPa (4 psi) to 83 kPa (12 psi). Figure A-3 illustrates test results with moisture contents corresponding to 120% of optimum and dry densities corresponding to 95% of maximum. Deviator stress ranges from 28 kPa (4 psi) to 41 kPa (6 psi).

Figure A-4 demonstrates the effect of dry density on the accumulation of permanent strain. Specimens are fabricated to a moisture content at 110% of optimum. Dry density ranges from 91.7% to 97.9% of maximum. The effect of the first cycle of freeze-thaw is presented in Figure A-5. The moisture contents of the specimens in these tests are 105% of optimum and the dry densities are 95%.

The effect of stress history induced from staged loading is shown in Figure A-6 and Figure A-7. In Figure A-6, one specimen was subjected to a deviator stress of 28 kPa (4 psi) for about 10,000 load repetitions and subsequently the deviator stress was increased to 62 kPa (9 psi) for repeated loading. The effect of staged load was compared to a virgin specimen subjected to 62 kPa (9 psi). In Figure A-7, one specimen was subjected to a deviator stress of 62 kPa (9 psi) for about 10,000 load repetitions and subsequently the deviator stress was increased to 103 kPa (15 psi) for repeated loading. The effect of staged load was compared to a virgin specimen subjected to 103 kPa (15 psi).

Table 4. Summary of Data in Figures A-1 through A-28

| No. of Figures | Soil    | Effect Tested                                  |
|----------------|---------|--|
| A-1            | Enders  | deviator stress @ 105% of OMC & 95% of MDD     |
| A-2            | Enders  | deviator stress @ 110% of OMC & 95% of MDD     |
| A-3            | Enders  | deviator stress @ 120% of OMC & 95% of MDD     |
| A-4            | Enders  | density @ 110% of OMC                          |
| A-5            | Enders  | freeze-thaw at 105% of OMC & 95% of MDD        |
| A-6            | Enders  | stress history @ ultimate $\sigma_d = 62$ kPa  |
| A-7            | Enders  | stress history @ ultimate $\sigma_d = 103$ kPa |
| A-8            | Gallion | deviator stress @ 105% of OMC & 95% of MDD     |
| A-9            | Gallion | deviator stress @ 110% of OMC & 95% of MDD     |
| A-10           | Gallion | deviator stress @ 120% of OMC & 95% of MDD     |
| A-11           | Gallion | density @ 110% of OMC                          |
| A-12           | Gallion | freeze-thaw at 105% of OMC & 95% of MDD        |
| A-13           | Gallion | stress history @ ultimate $\sigma_d = 83$ kPa  |

|      |         |   |
|------|---------|---|
| A-14 | Gallion | stress history @ ultimate $\sigma_d = 62$ kPa               |
| A-15 | Houston | deviator stress @ 105% of OMC & 95% of MDD                  |
| A-16 | Houston | deviator stress @ 110% of OMC & 95% of MDD                  |
| A-17 | Houston | deviator stress @ 120% of OMC & 95% of MDD                  |
| A-18 | Houston | density @ 110% of OMC                                       |
| A-19 | Houston | freeze-thaw at 105% of OMC & 95% of MDD                     |
| A-20 | Houston | stress history @ ultimate $\sigma_d = 83$ kPa & 110% of OMC |
| A-21 | Houston | stress history @ ultimate $\sigma_d = 83$ kPa & 120% of OMC |
| A-22 | Sacul   | deviator stress @ 105% of OMC & 95% of MDD                  |
| A-23 | Sacul   | deviator stress @ 110% of OMC & 95% of MDD                  |
| A-24 | Sacul   | deviator stress @ 120% of OMC & 95% of MDD                  |
| A-25 | Sacul   | density @ 110% of OMC                                       |
| A-26 | Sacul   | freeze-thaw at 105% of OMC & 95% of MDD                     |
| A-27 | Sacul   | stress history @ ultimate $\sigma_d = 124$ kPa              |
| A-28 | Sacul   | stress history @ ultimate $\sigma_d = 83$ kPa               |

### 3-2 Test Results for Gallion

Repeated load testing results for Gallion are presented in Figure A-8 to A-14. Figure A-8 illustrates test results for specimens with moisture contents corresponding to 105% of optimum and dry densities corresponding to 95% of maximum. Deviator stress ranges from 28 kPa (4 psi) to 103 kPa (15 psi). Figure A-9 presents test results with moisture contents corresponding to 110% of optimum and dry densities corresponding to 95% of maximum. Deviator stress ranges from 28 kPa (4 psi) to 83 kPa (12 psi). Figure A-10 illustrates test results with moisture contents corresponding to 120% of optimum and dry densities corresponding to 95% of maximum. Deviator stress ranges from 28 kPa (4 psi) to 62 kPa (9 psi).

Figure A-11 demonstrates the effect of dry density on the accumulation of permanent strain. Specimens are fabricated to a moisture content at 110% of optimum. Dry density ranges from 93.5% to 98.1% of maximum. The effect of the first cycle of freeze-thaw is presented in Figure A-12. The moisture contents of the specimens in these tests are 105% of optimum and the dry densities are 95% of maximum. The applied deviator stress is 28 kPa (4 psi).

The effect of stress history induced from staged load is shown in Figure A-13 and Figure A-14. In Figure A-13, one specimen was subjected to a deviator stress of 28 kPa (4 psi) for about 10,000 load repetitions and subsequently the deviator stress was increased to 83 kPa (12 psi) for repeated loading. The effect of staged load was compared to a virgin specimen subjected to 83 kPa (12 psi). In Figure A-14, one specimen was subjected to a deviator stress of 21 kPa (3 psi) for about 10,000 load repetitions and the deviator stress was subsequently increased to 41 kPa (6 psi) for another 10,000 load applications. After the specimen had been subjected to around 20,000 repetitions of these

two levels of deviator stress, an even higher deviator stress, 62 kPa (9 psi) was applied and the result was compared to a virgin specimen subjected to 62 kPa (9 psi).

### 3-3 Test Results for Houston

Repeated load testing results for Houston are presented in Figure A-15 to A-21. Figure A-15 illustrates test results for specimens with moisture contents corresponding to 105% of optimum and dry densities corresponding to 95% of maximum. Deviator stress ranges from 41 kPa (4 psi) to 207 kPa (30 psi). Figure A-16 presents test results with moisture contents corresponding to 110% of optimum and dry densities corresponding to 95% of maximum. Deviator stress ranges from 41 kPa (6 psi) to 165 kPa (24 psi). Figure A-17 illustrates test results with moisture contents corresponding to 120% of optimum and dry densities corresponding to 95% of maximum. Deviator stress ranges from 41 kPa (6 psi) to 124 kPa (18 psi).

Figure A-18 demonstrates the effect of dry density on the accumulation of permanent strain. Specimens are fabricated to a moisture content at 110% of optimum. Dry density ranges from 91.8% to 97.8% of maximum. The effect of the first cycle of freeze-thaw is presented in Figure A-19. The moisture contents of the specimens in these tests are 105% of optimum and the dry densities are 95%.

The effect of stress history induced from staged load is shown in Figure A-20 and Figure A-21. In Figure A-20, one specimen was subjected to a deviator stress of 28 kPa (4 psi) for about 10,000 load repetitions and subsequently the deviator stress was increased to 83 kPa (12 psi) for repeated loading. The effect of staged load was compared to a virgin specimen subjected to 83 kPa (12 psi). Moisture contents for these specimens are 110 % of optimum. Figure A-21 illustrates the similar stress scenario as Figure A-20 except that the specimens in these

figures have a higher moisture content corresponding to 120% of OMC.

### 3-4 Test Results for Sacul

Repeated load testing results for Enders are presented in Figure A-22 to A-28. Figure A-22 illustrates test results for specimens with moisture contents corresponding to 105% of optimum and dry densities corresponding to 95% of maximum. Deviator stress ranges from 41 kPa (6 psi) to 207 kPa (30 psi). Figure A-23 presents test results with moisture contents corresponding to 110% of optimum and dry densities corresponding to 95% of maximum. Deviator stress ranges from 41 kPa (6 psi) to 165 kPa (24 psi). Figure A-24 illustrates test results with moisture contents corresponding to 120% of optimum and dry densities corresponding to 95% of maximum. Deviator stress ranges from 41 kPa (6 psi) to 124 kPa (18 psi).

Figure A-25 demonstrates the effect of dry density on the accumulation of permanent strain. Specimens are fabricated to a moisture content at 110% of optimum. Dry density ranges from 93.8% to 96.3% of maximum. The effect of the first cycle of freeze-thaw is presented in Figure A-26. The moisture contents of the specimens in these tests are 105% of optimum and the dry densities are 95%.

The effect of stress history induced from staged load is shown in Figure A-27 and Figure A-28. In Figure A-27, one specimen was subjected to a deviator stress of 83 kPa (12 psi) for about 10,000 load repetitions and subsequently the deviator stress was increased to 124 kPa (18 psi) for repeated loading. The effect of staged load was compared to a virgin specimen subjected to 124 kPa (18 psi). In Figure A-28, one specimen was subjected to a deviator stress of 41 kPa (6 psi) for about 10,000 load repetitions and subsequently the deviator stress was increased to 83 kPa (12 psi) for repeated loading. The effect of staged load was compared to a virgin specimen subjected to 83 kPa (12 psi).

#### **4. Reference**

Elliott, R. P., and Dennis, N. D., and Qiu, Y. (1998). *Permanent deformation of Subgrade Soils, Phase I: A Test Protocol*, MBTC FR-1069, Department of Civil Engineering, University of Arkansas.

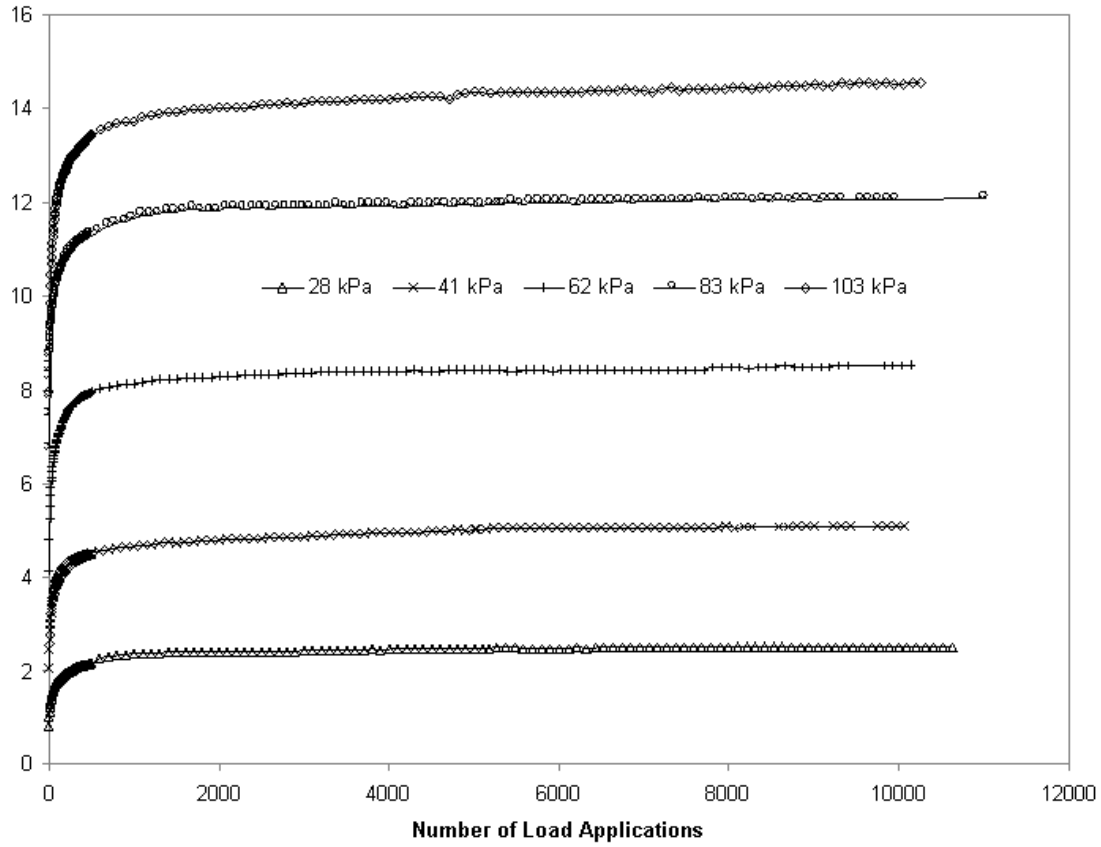
Elliott, R. P., Thornton, S. I., Foo, K. Y., Siew, K. W., and Woodbridge, R. (1988). *Final Report TRC-94, Resilient Properties of Arkansas Subgrades*, FHWA/AR-89/004.

## **APPENDIX**

### **RESULTS OF REPEATED LOAD TESTING**



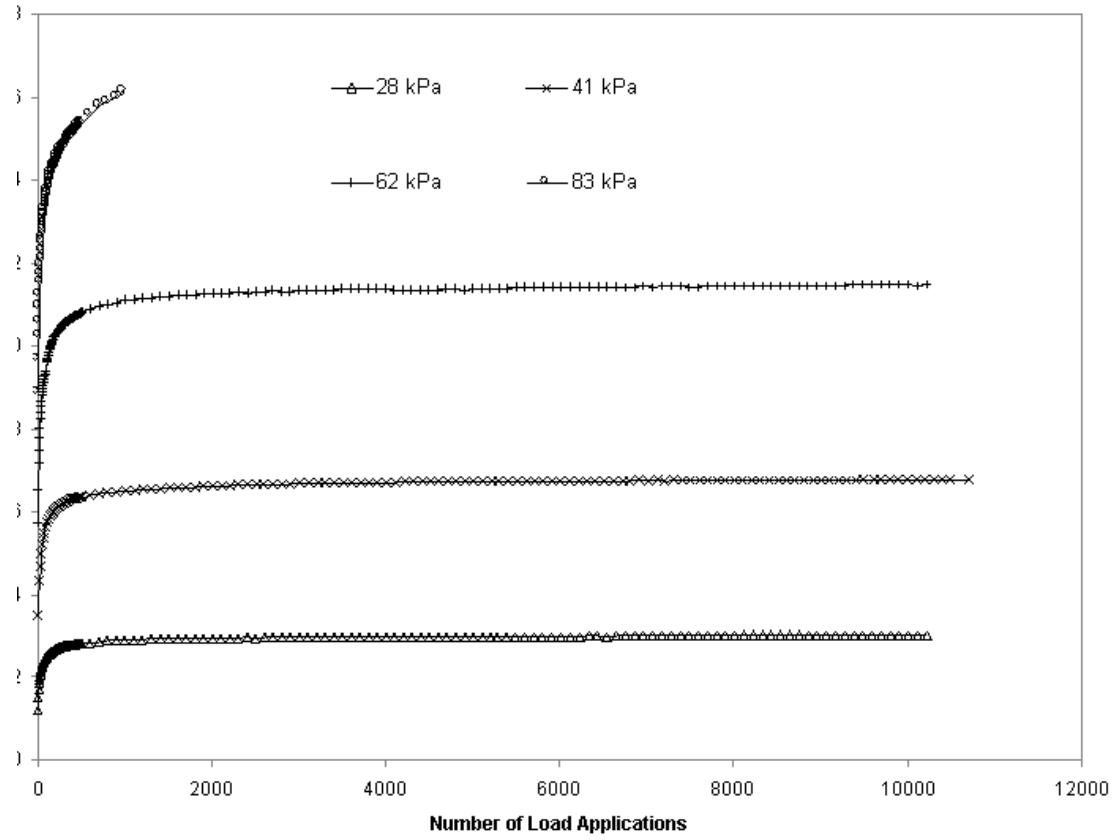
Figure A-1 Repeated Load Test Results for Enders  
(Moisture Content at 105% of OMC)



A-1

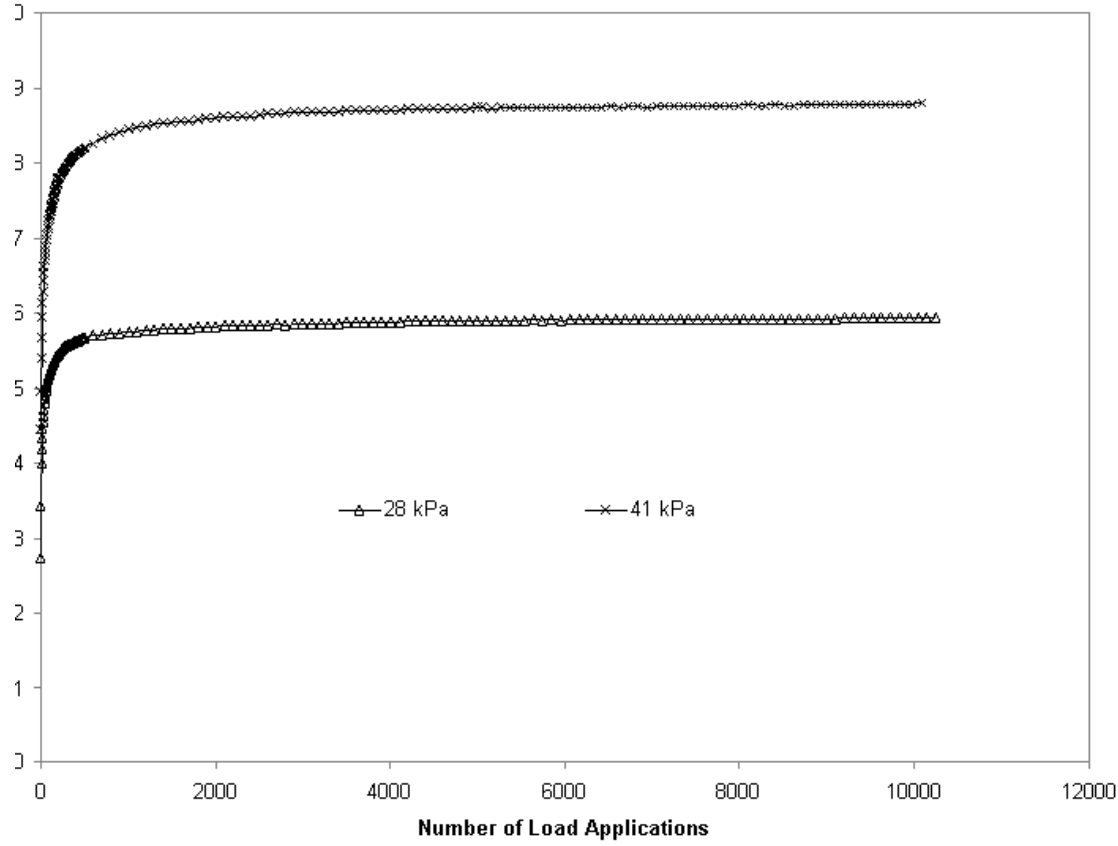
Axial Strain in %

Figure A-2 Repeated Load Test Results for Enders  
(Moisture Content at 110% of OMC)



A-2  
Axial Strain (%)

Figure A-3 Repeated Load Test Results for Enders  
(Moisture Content at 120% of OMC)

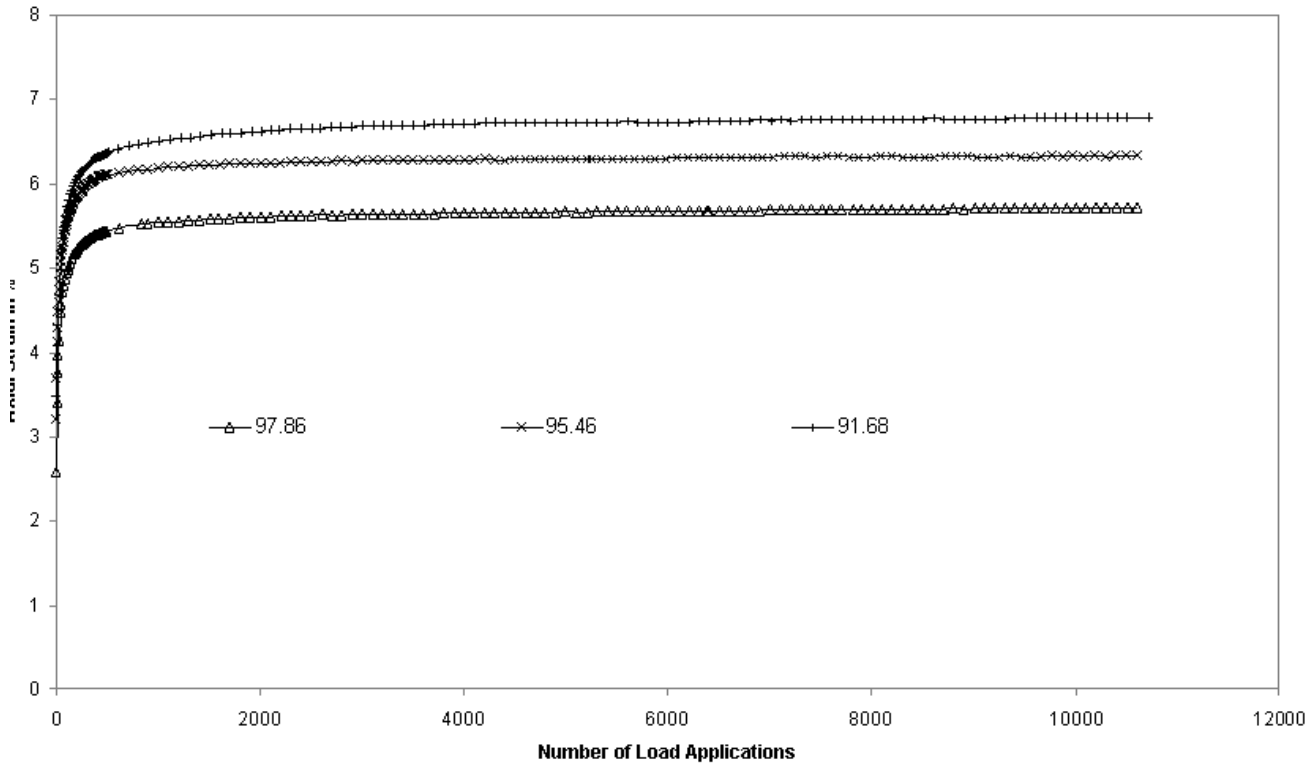


A-3

Axial Strain in %

1

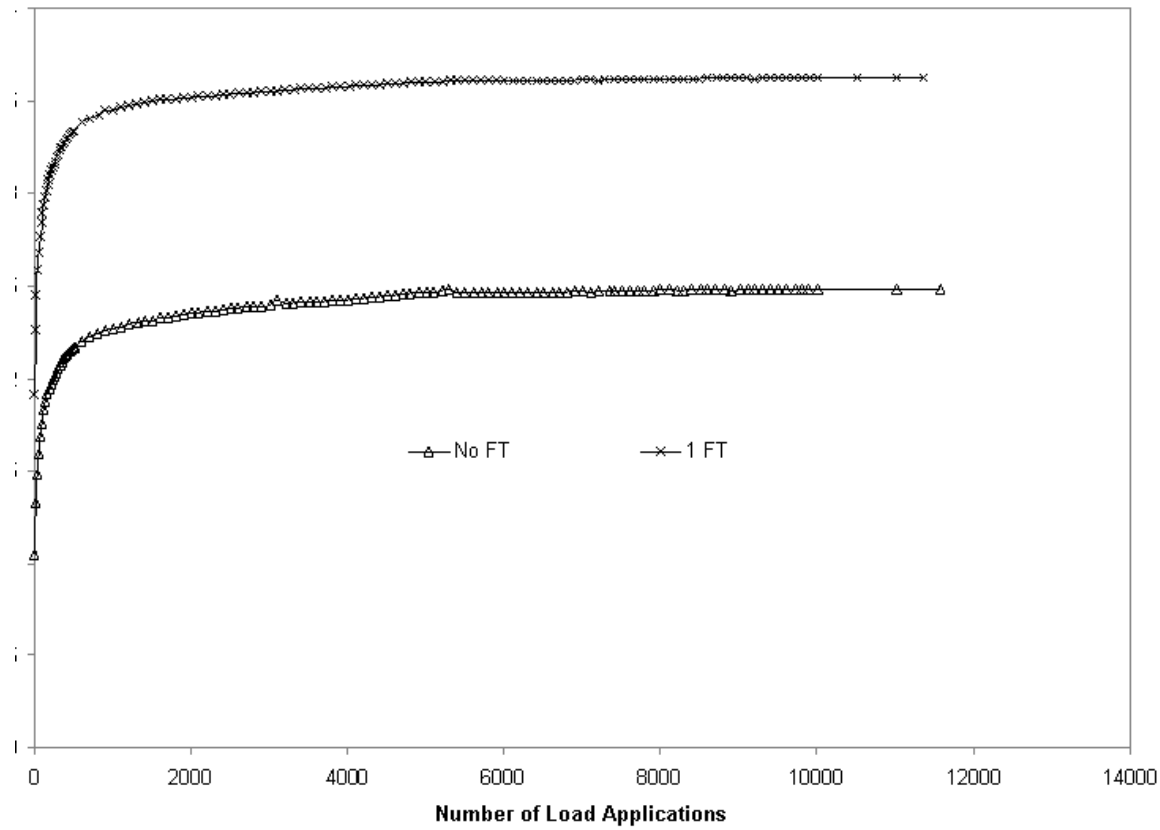
Figure A-4 Effect of Density on Permanent Strain for Enders



A-4

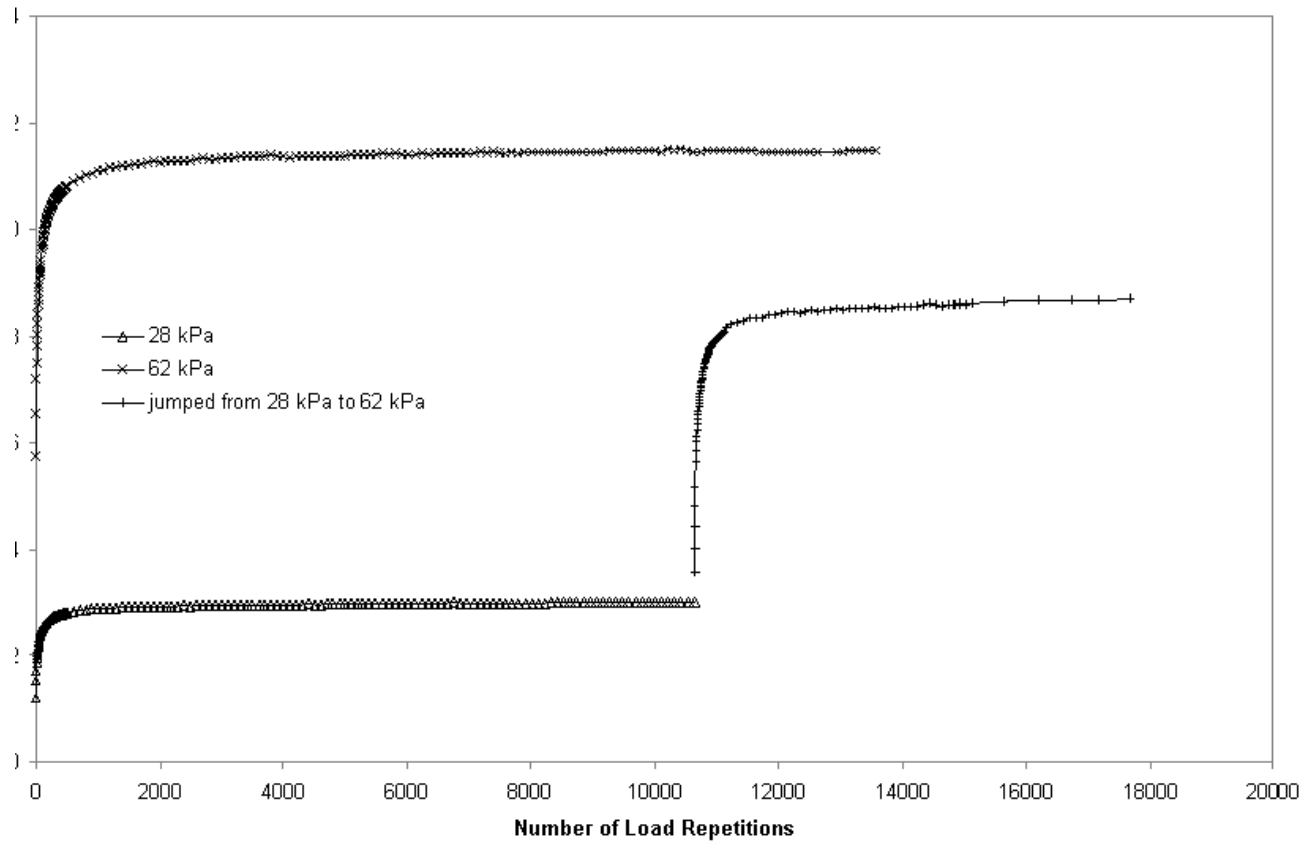
Final Strain in Bl

Figure A-5 Effect of Freeze on Permanent Strain for Enders



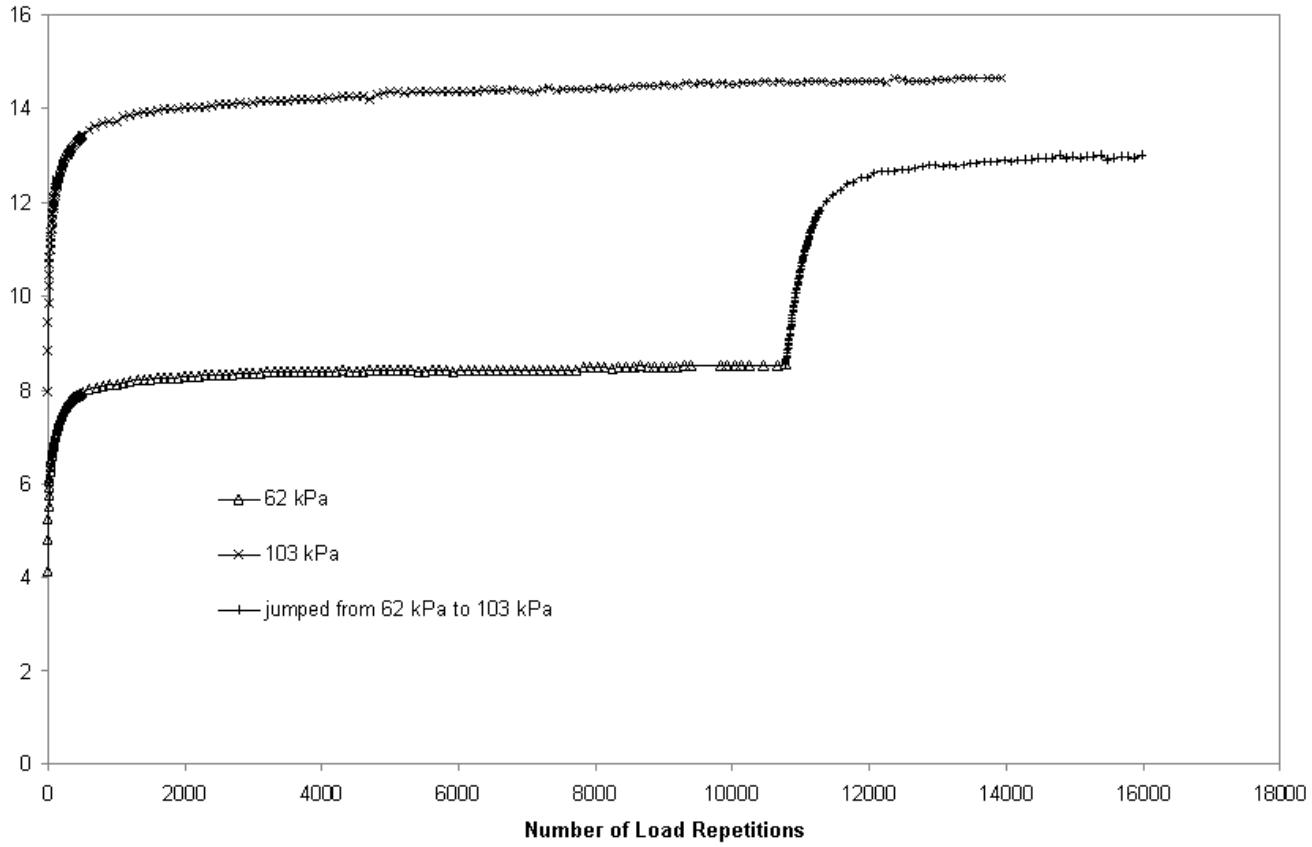
A-5  
Axial Strain (%)

Figure A-6 Effect of Stress History on Permanent Strain for Enders  
(Ultimate Deviator Stress at 62 kPa)



A-6  
Axial Strain in %

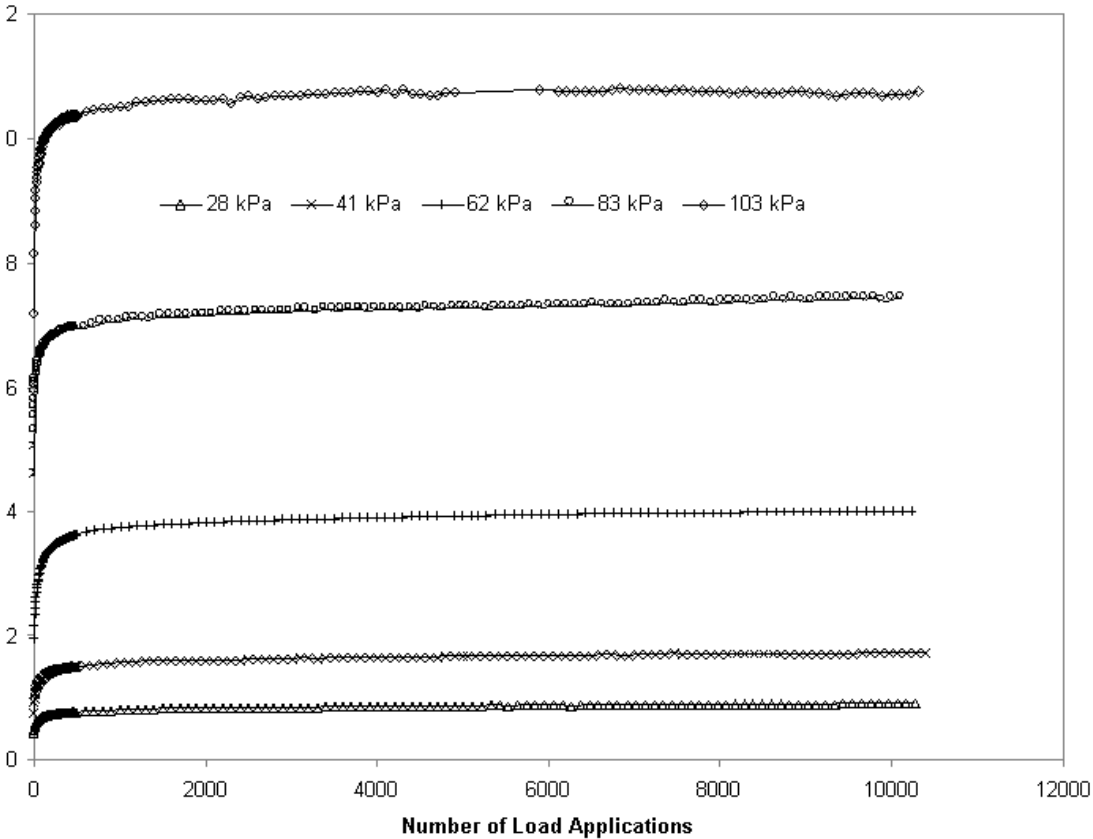
Figure A-7 Effect of Stress History on Permanent Strain for Enders  
(Ultimate Deviator Stress at 103 kPa)



A-7

Axial Strain in %

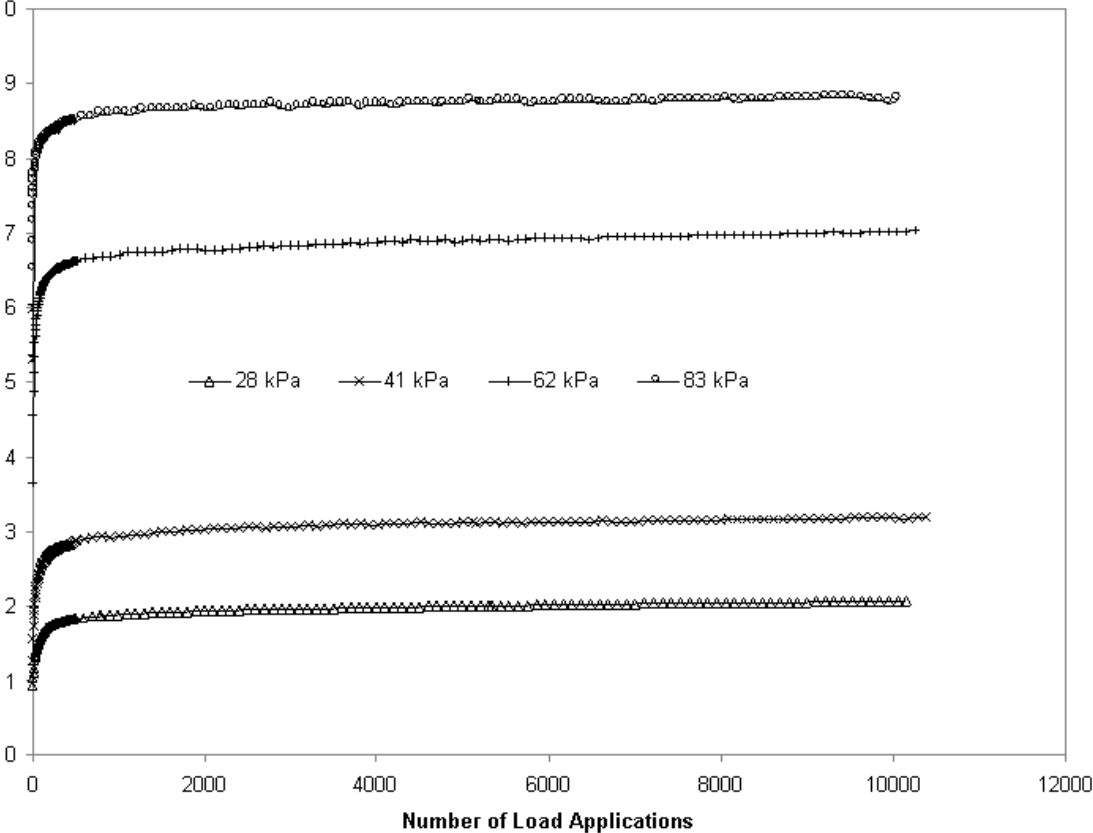
Figure A-8 Repeated Load Test Results for Gallion  
(Moisture Content at 105% of OMC)



A-8

Axial Strain in %

Figure A-9 Repeated Load Test Results for Gallion  
(Moisture Content at 110% of OMC)

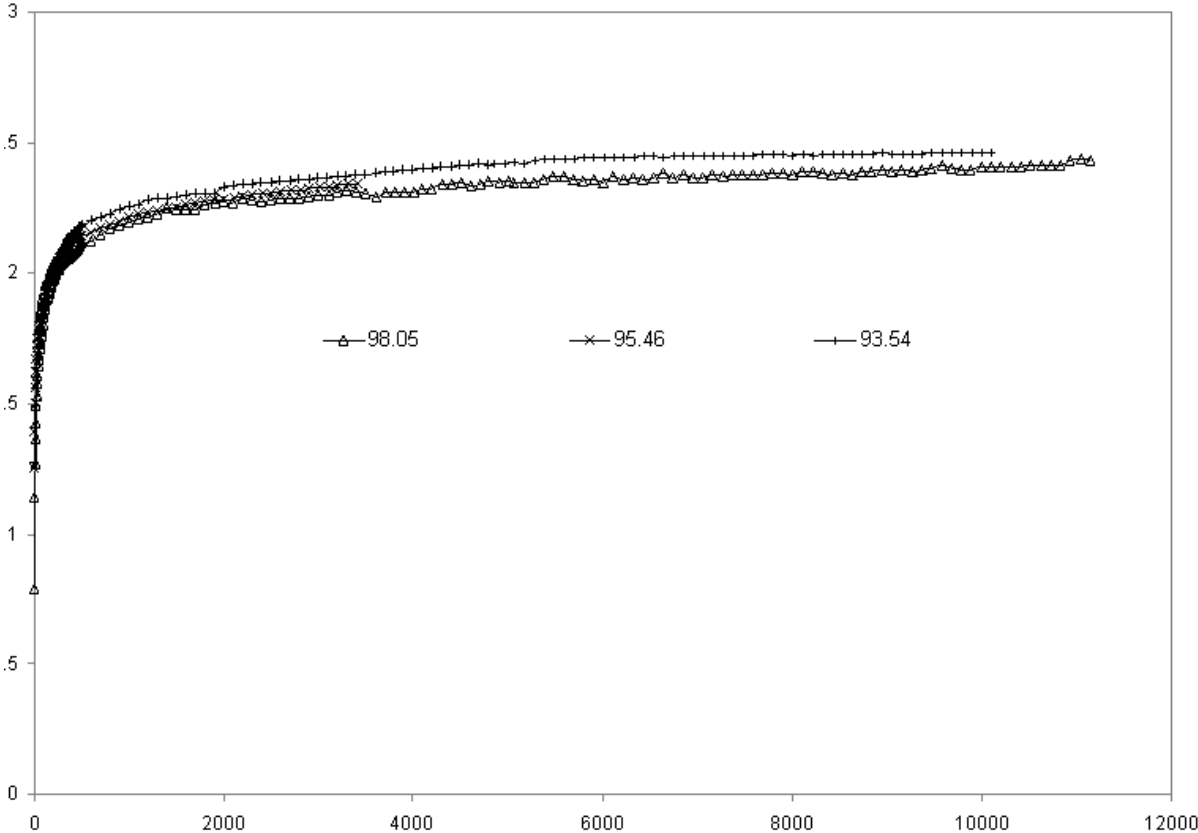


A-9

Axial Strain in %

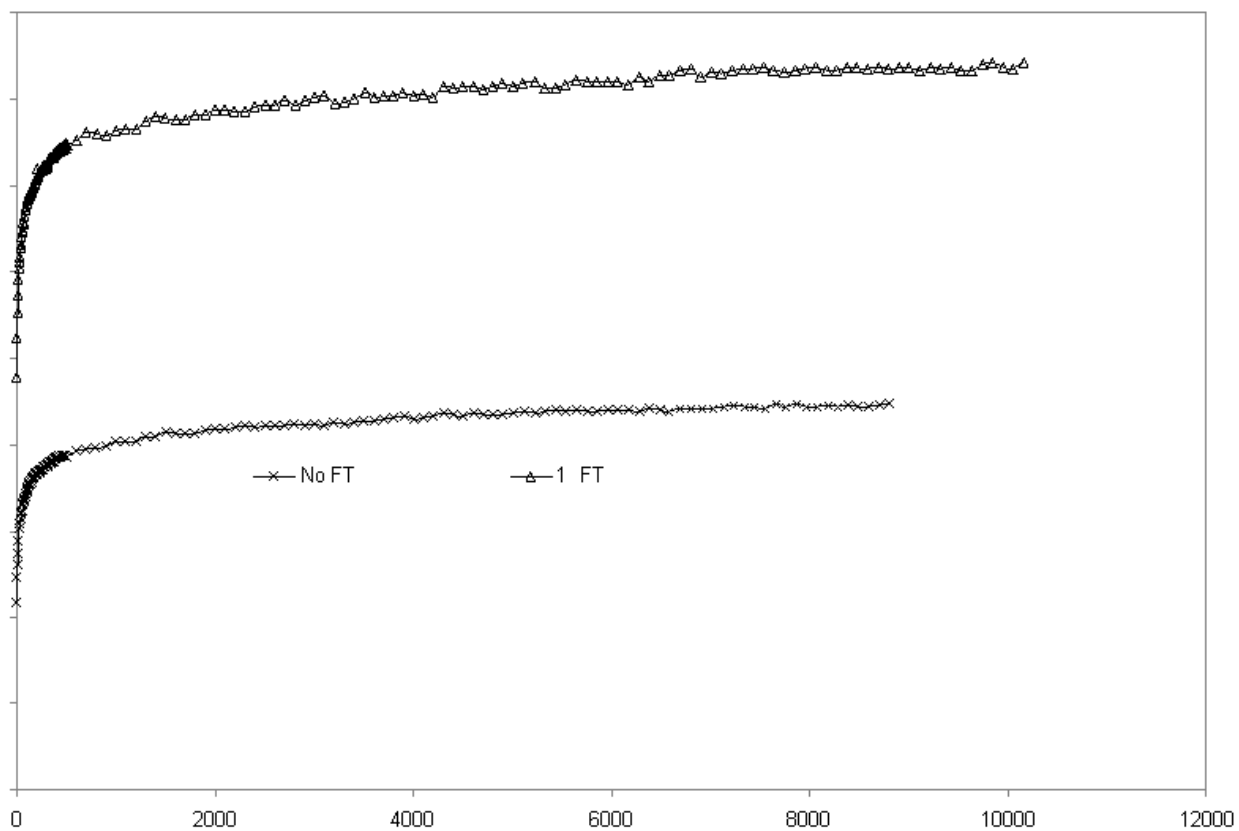


Figure A-11 Effect of Density on Permanent Strain for Gallion



A-11  
0  
1  
2

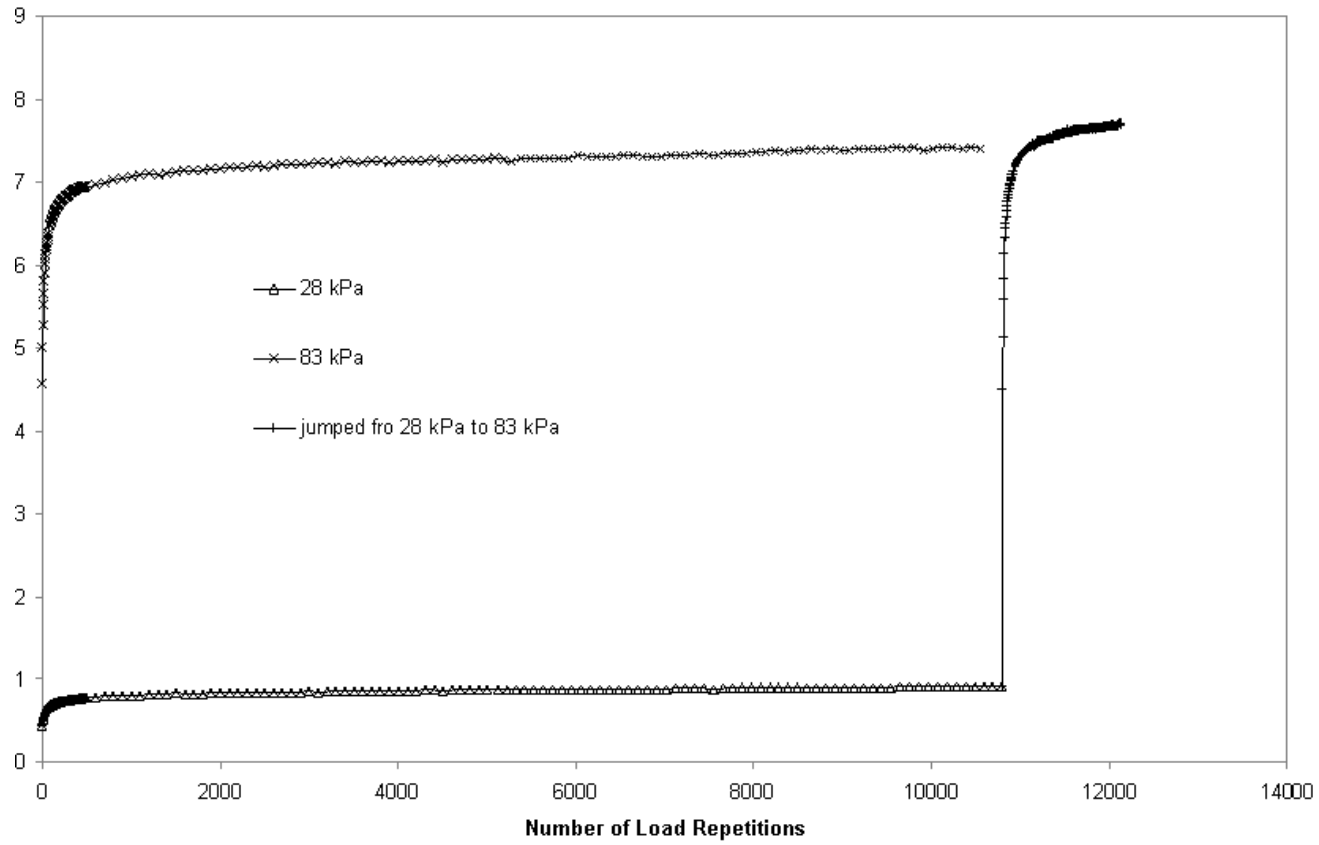
Figure A-12 Effect of Freeze-Thaw on Permanent Strain for Gallion



A-12

1.8  
1.6  
1.4  
1.2  
1  
0.8  
0.6  
0.4  
0.2  
0

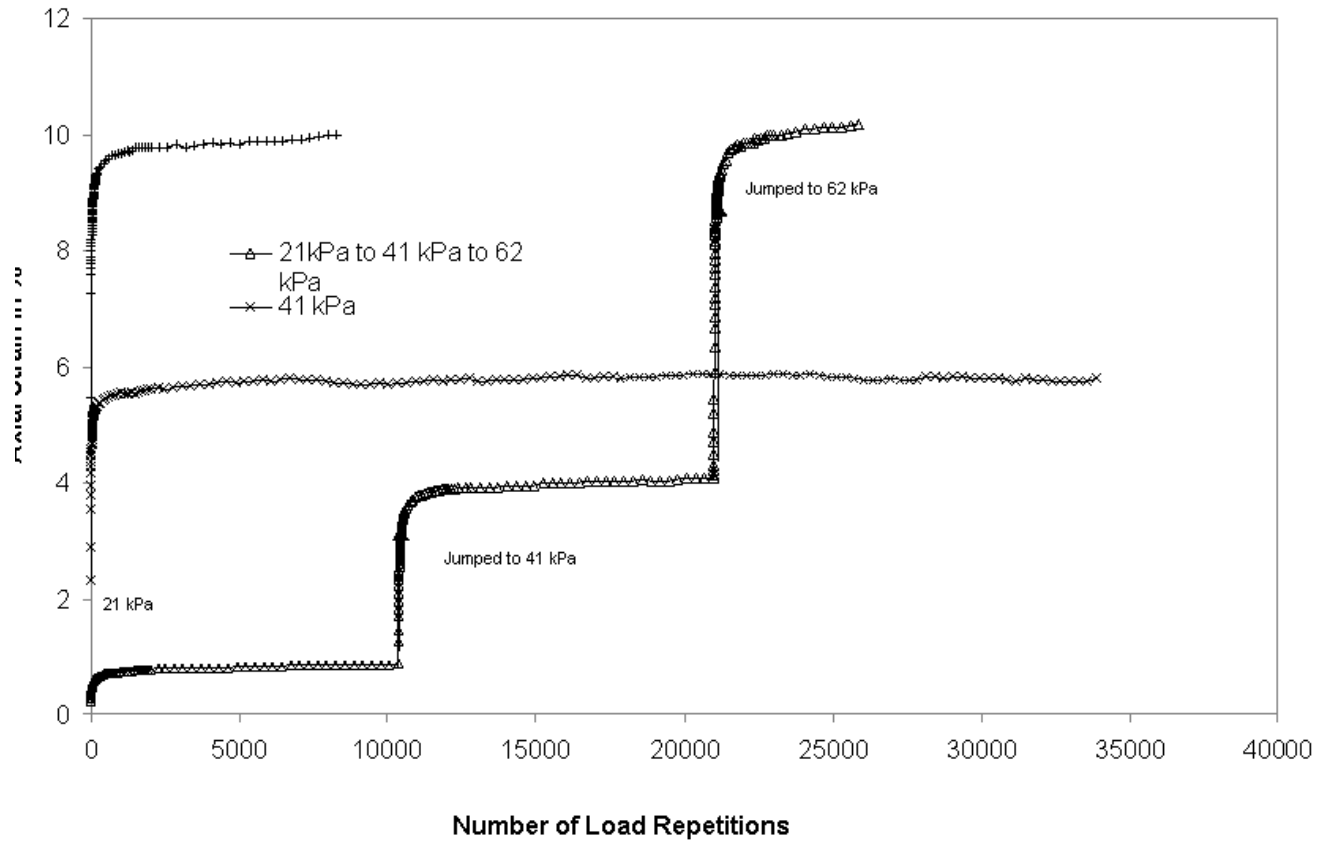
Figure A-13 Effect of Stress History on Permanent Strain for Gallion  
(Ultimate Deviator Stress at 83 kPa)



A-13

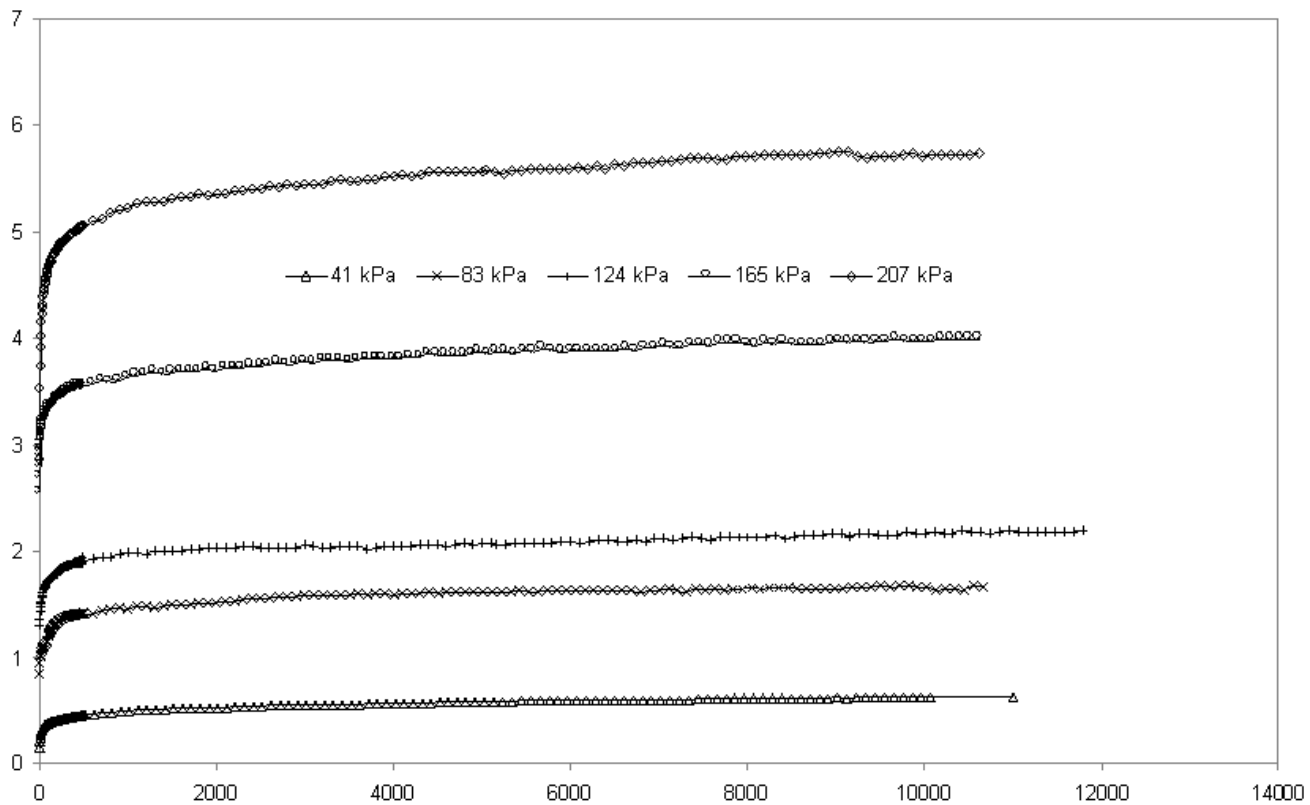
Axial Strain in %

Figure A-14 Effect of Stress History on Permanent Strain for Gallion  
(Ultimated deciator Stress at 62 kPa)



A-14  
A vial Strain in 0/

Figure A-15 Repeated Load Test Result for Houston  
(Moisture Content at 105% of OMC)



A-15

Figure A-16 Repeated Load Test Results for Houston  
(Moisture Content at 110%)

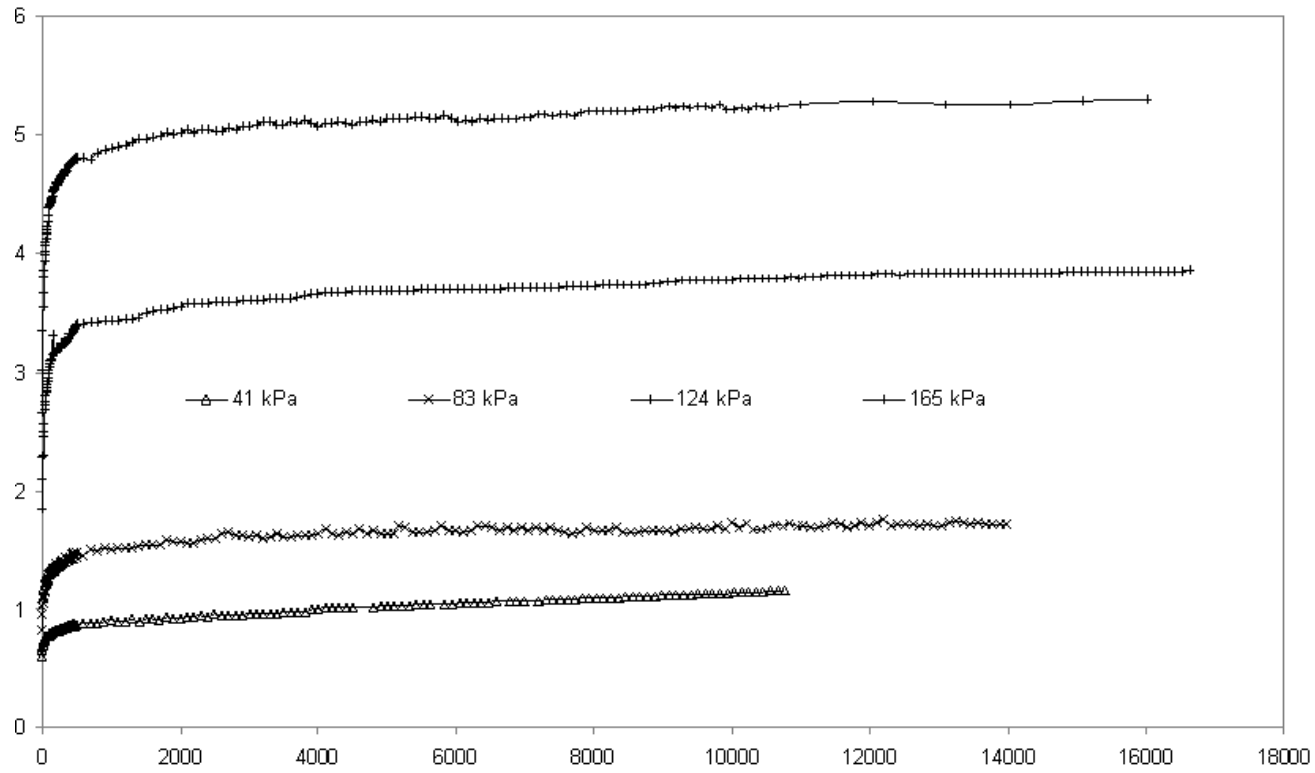
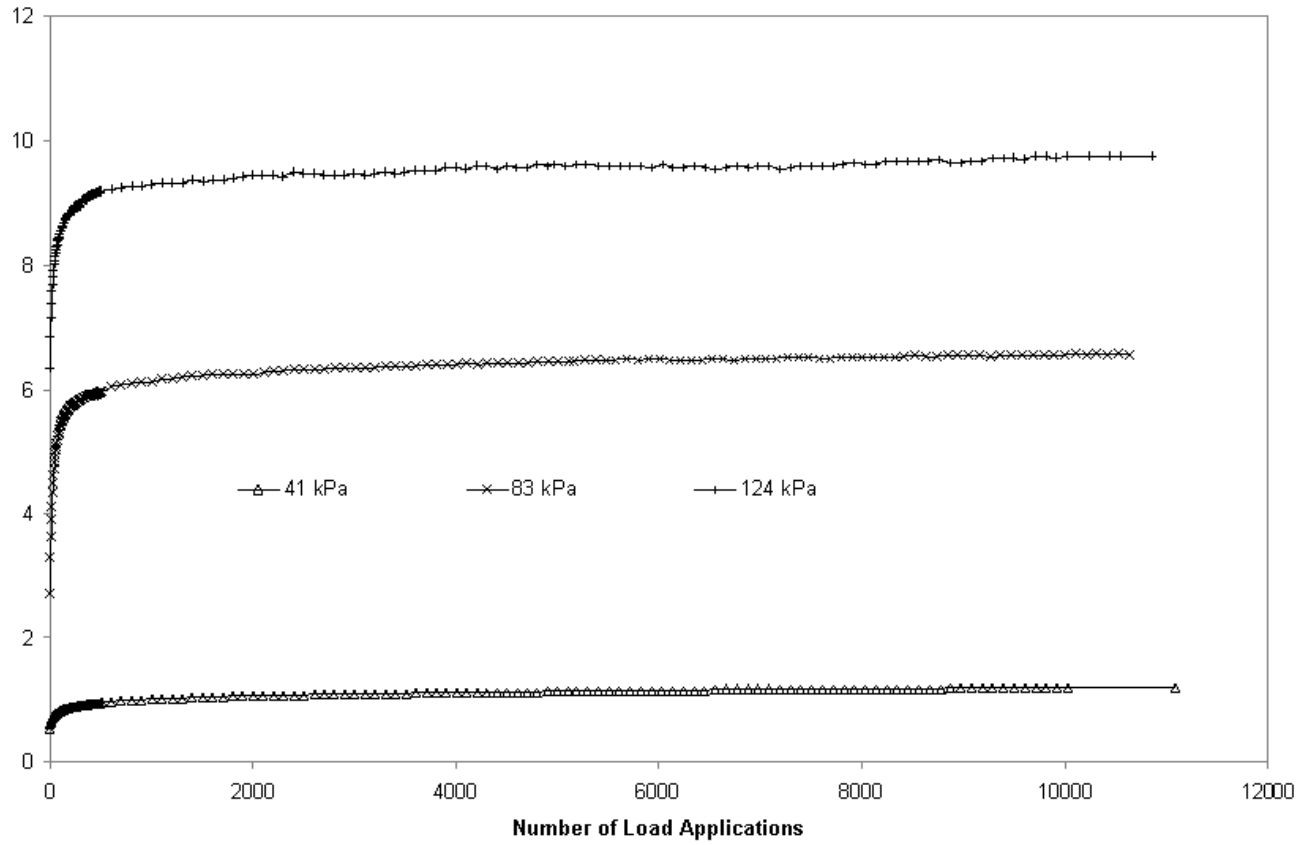


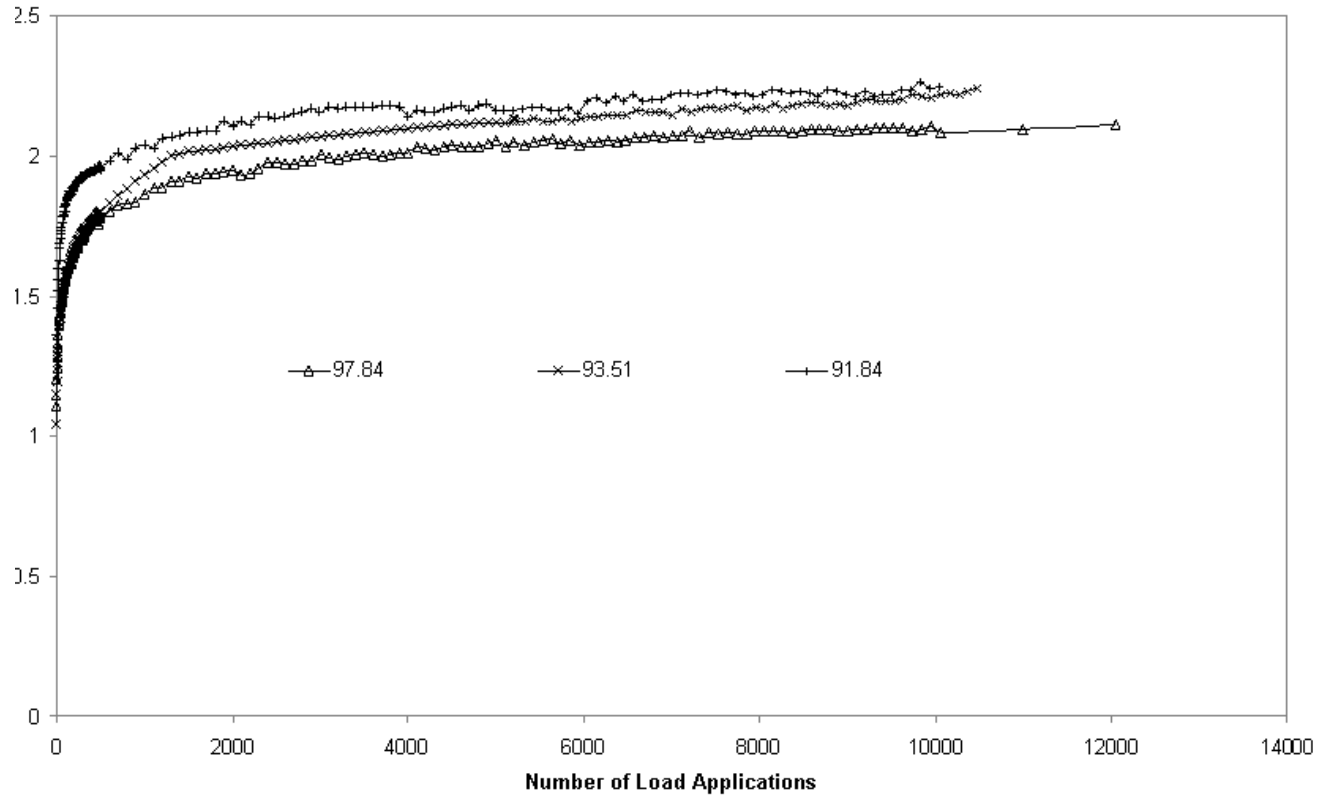
Figure A-17 Repeated Load Test Results for Houston  
(Moisture Content at 120%)



A-17

Axial Strain in %

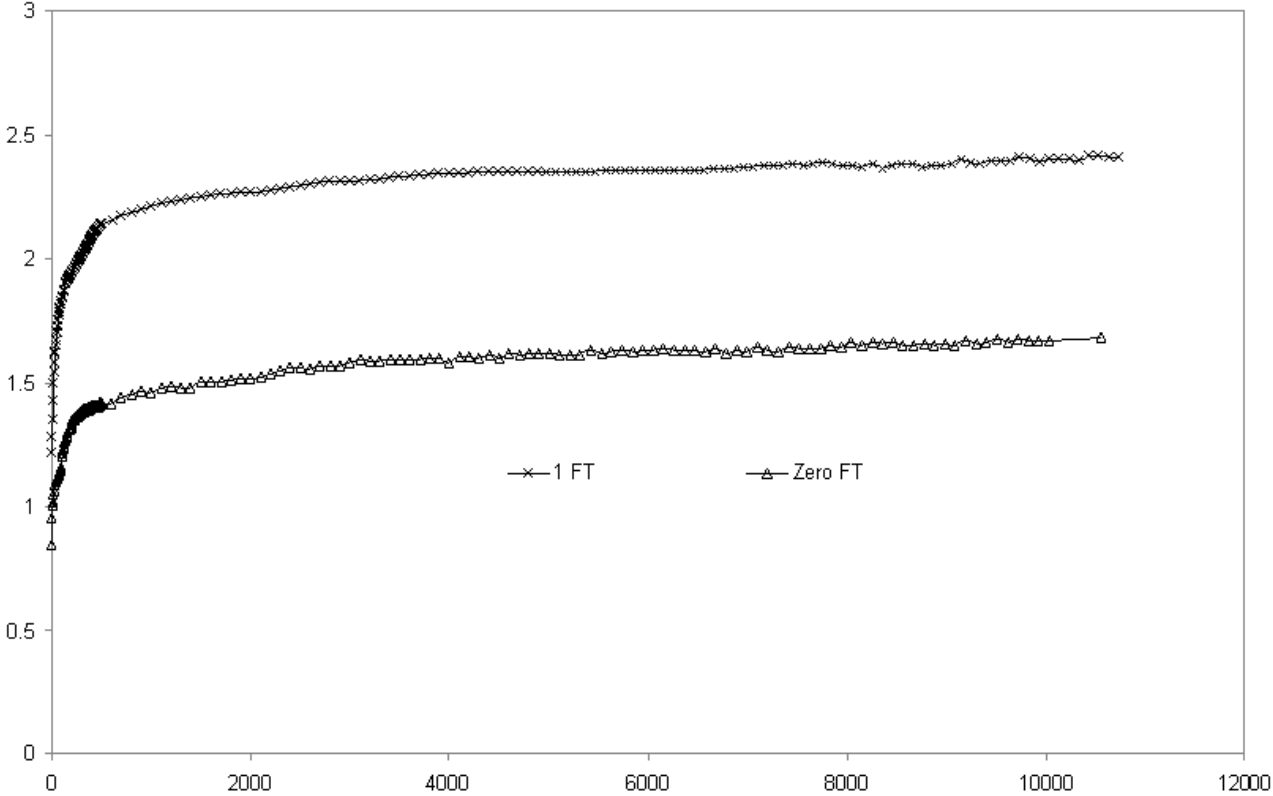
Figure A-18 Effect of Density on Permanent Strain for Houston



A-18

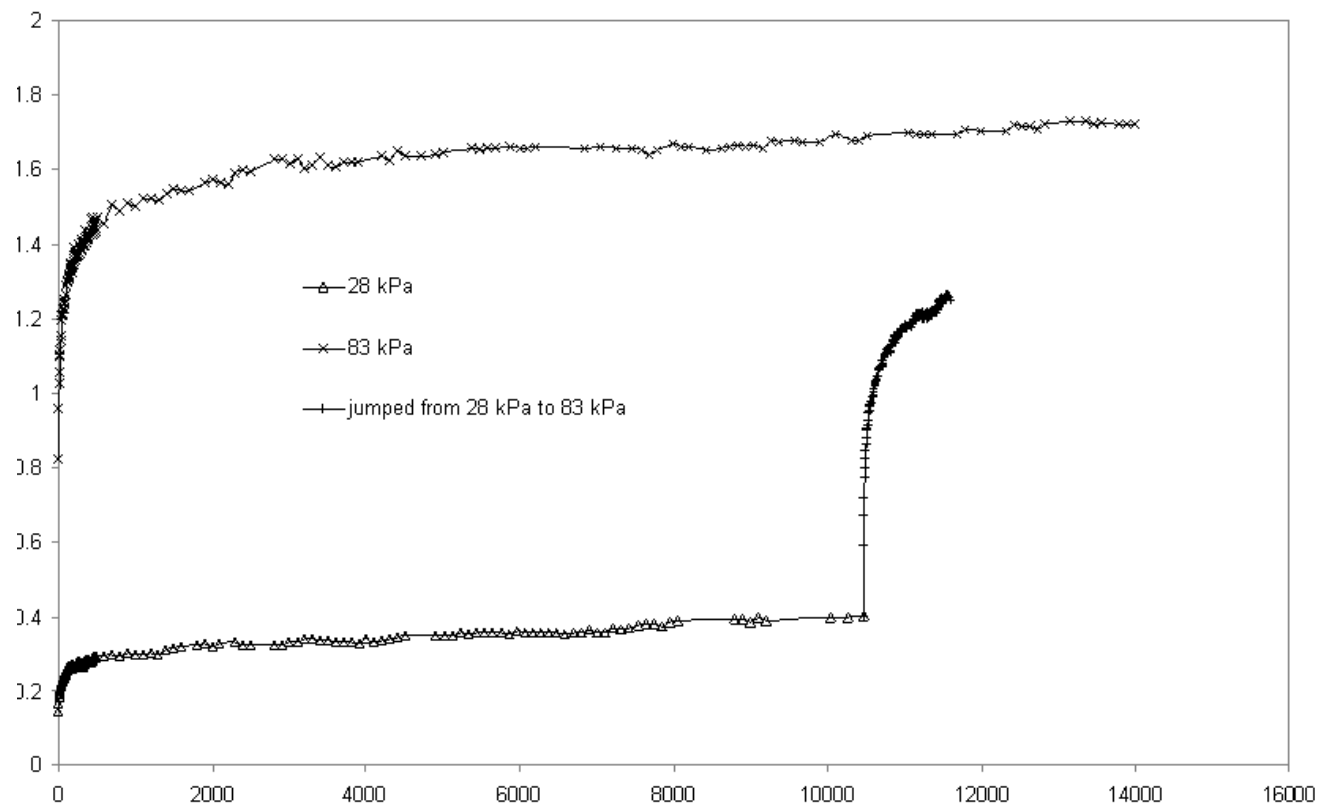
Axial Strain in %

Figure A-19 Effect of Freeze-Thaw on Permanent Strain for Houston



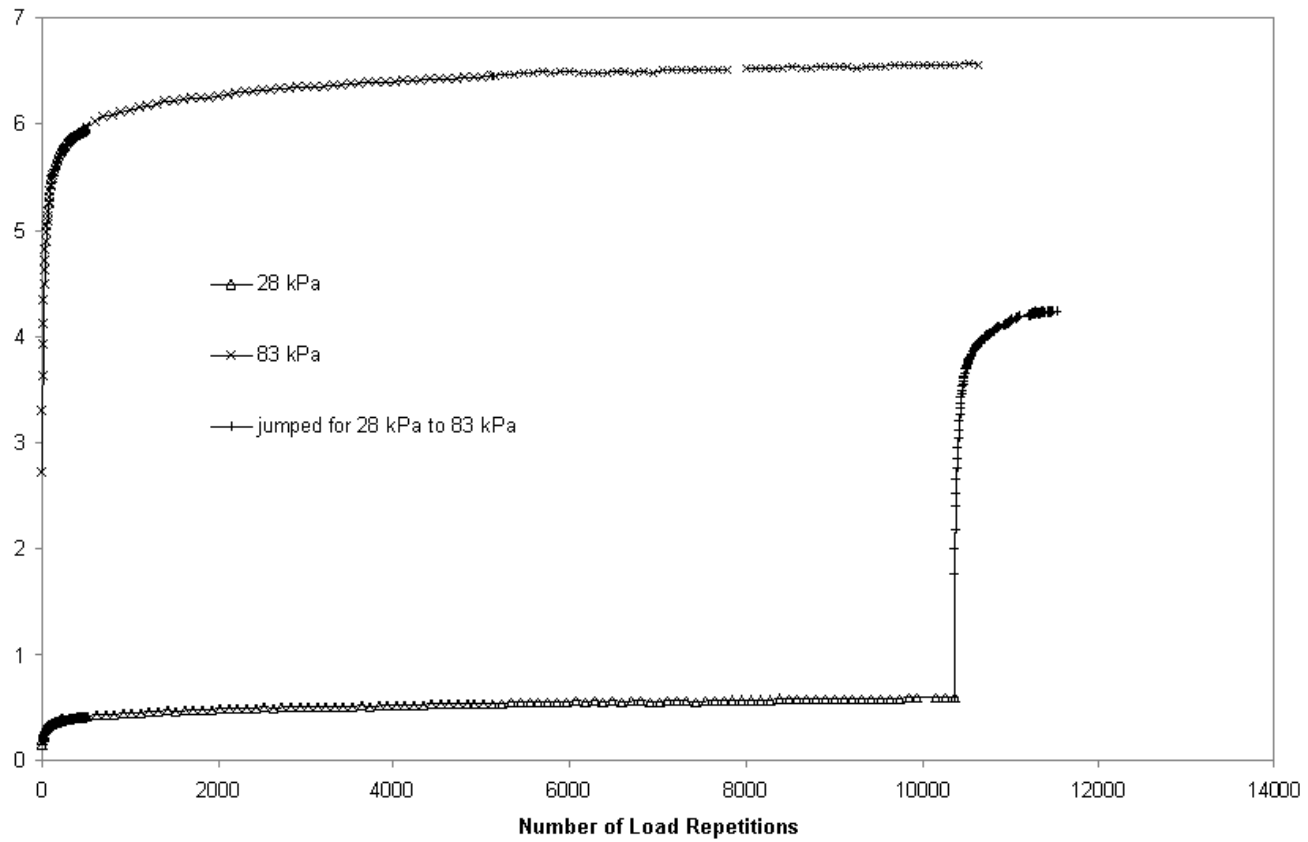
A-19

Figure A-20 Effect of Stress History on Permanent Strain for Houston  
(Moisture content at 110% of OMC)



A-20

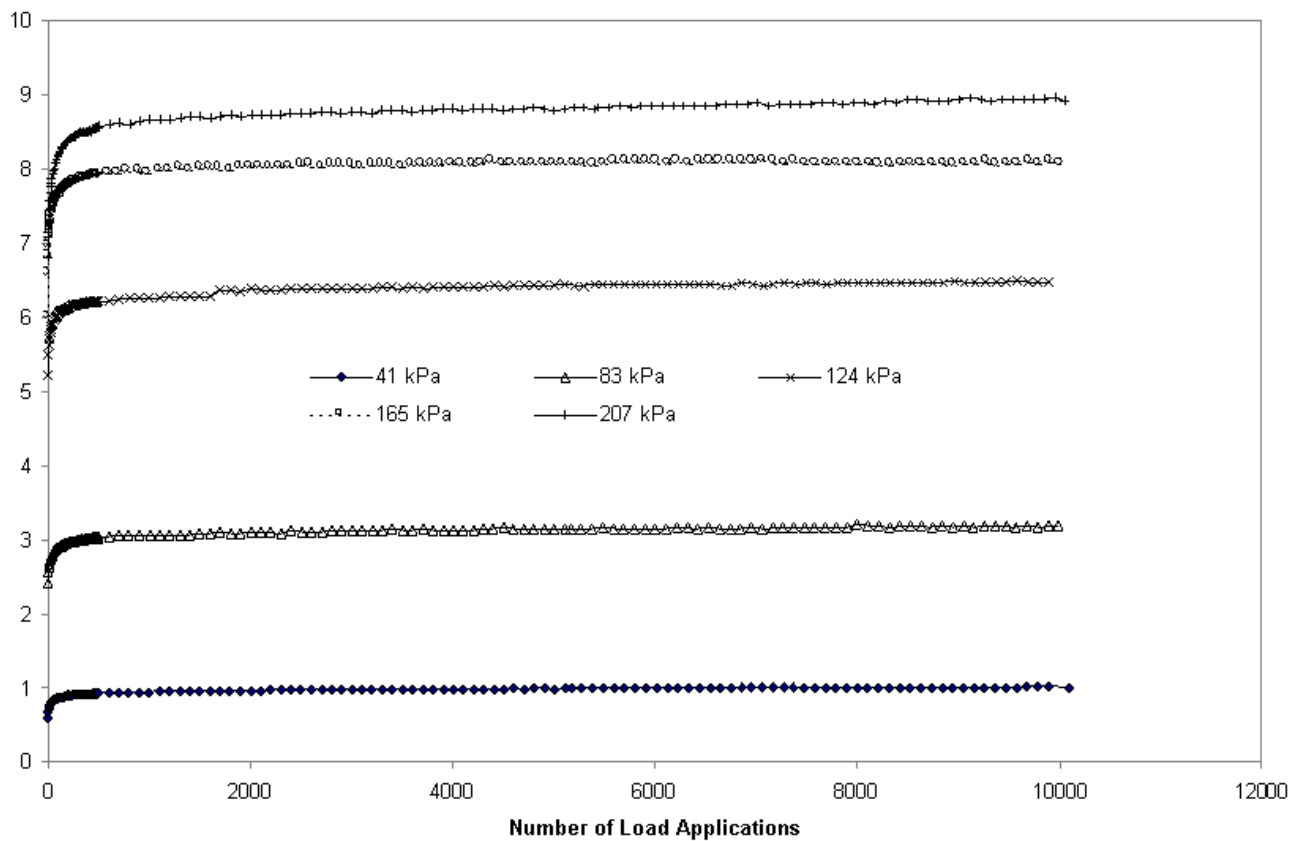
Figure A-21 Effect of Stress History on Permanent Strain for houston  
(Moisture Content at 120% of OMC)



A-21

Axial Strain in %

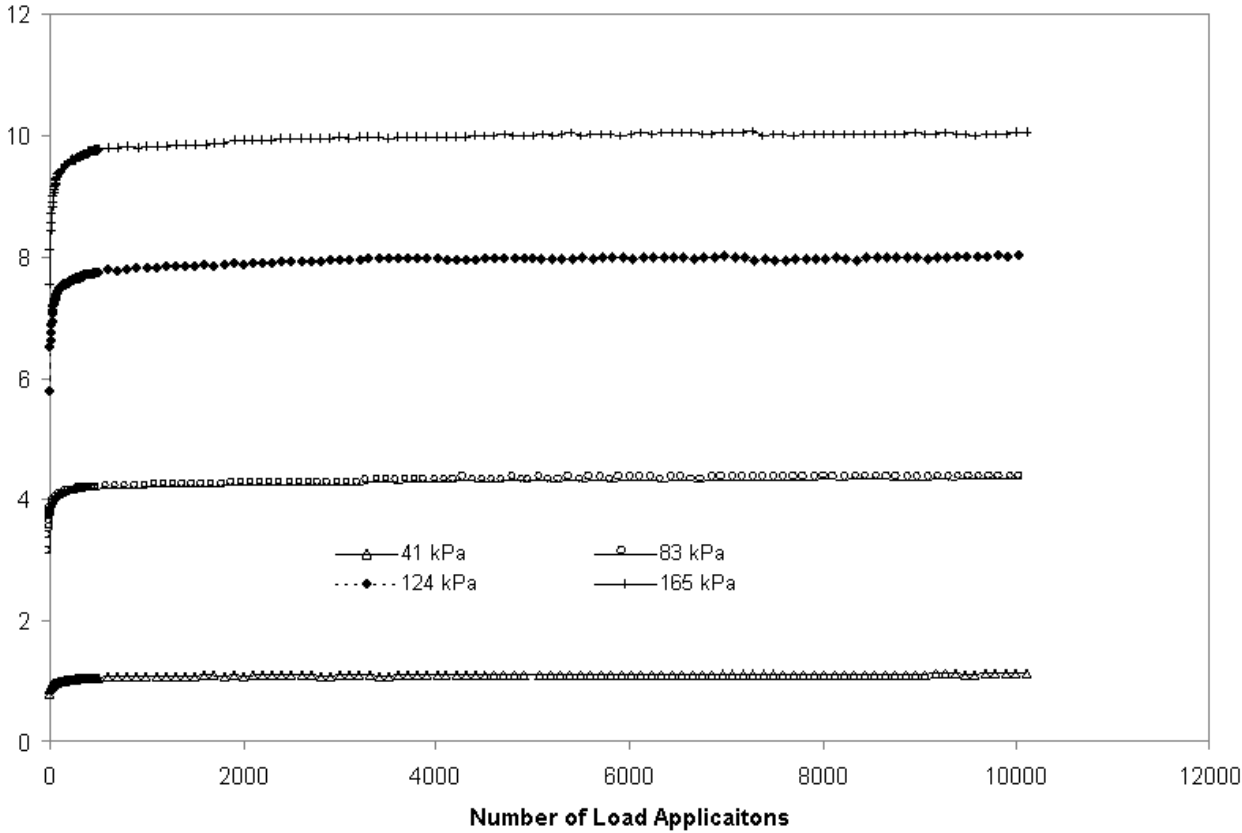
Figure A-22 Repeated Load Test Results for Sacul  
(Moisture Content at 105% of OMC)



A-22

Axial Strain in %

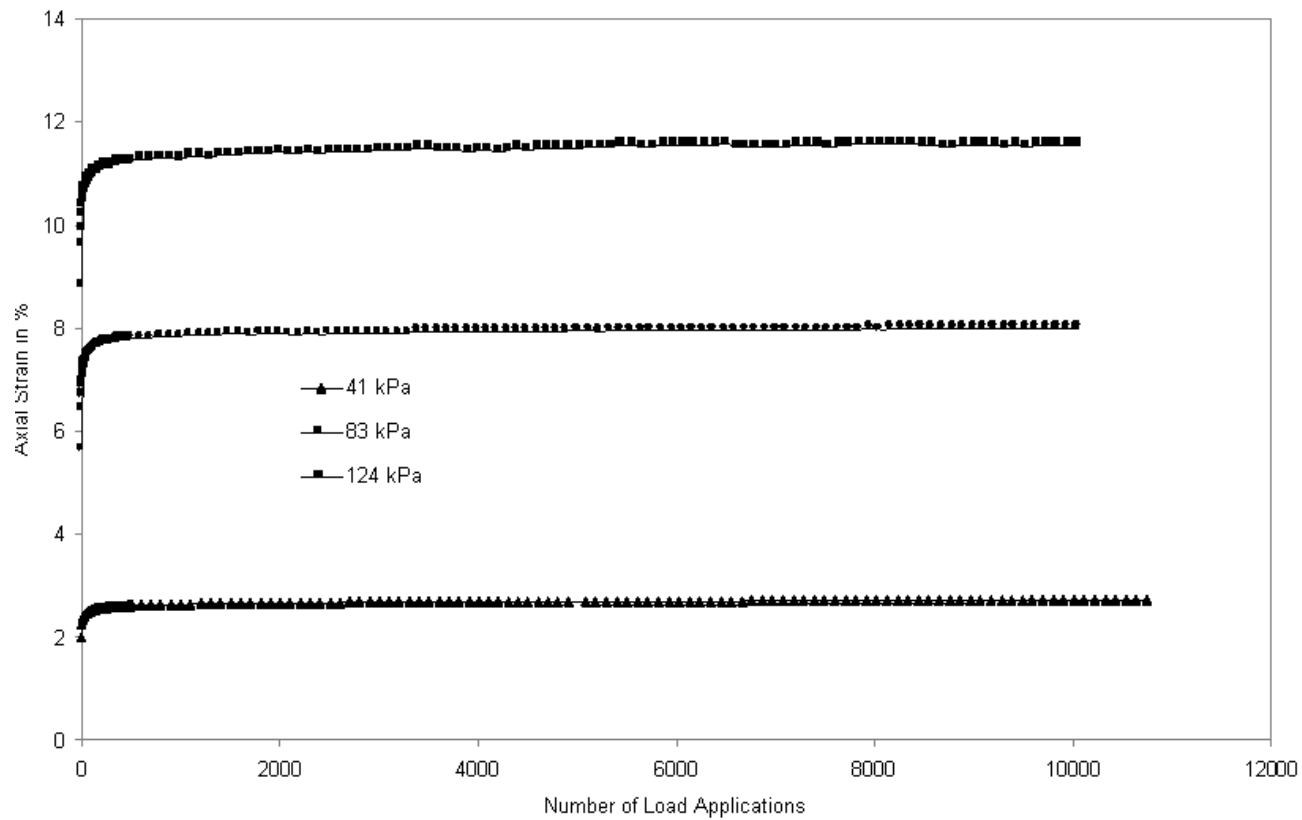
Figure A-23 Repeated Load Test Results for Sacul  
(Moisture Content at 110% of OMC)



A-23

Axial Strain in %

Figure A-24 Repeated Load Test Results for Sacul  
(Moisture Content at 120% of OMC)



A-24

Figure A-25 Effect of Density on Permanent Strain for Sacul

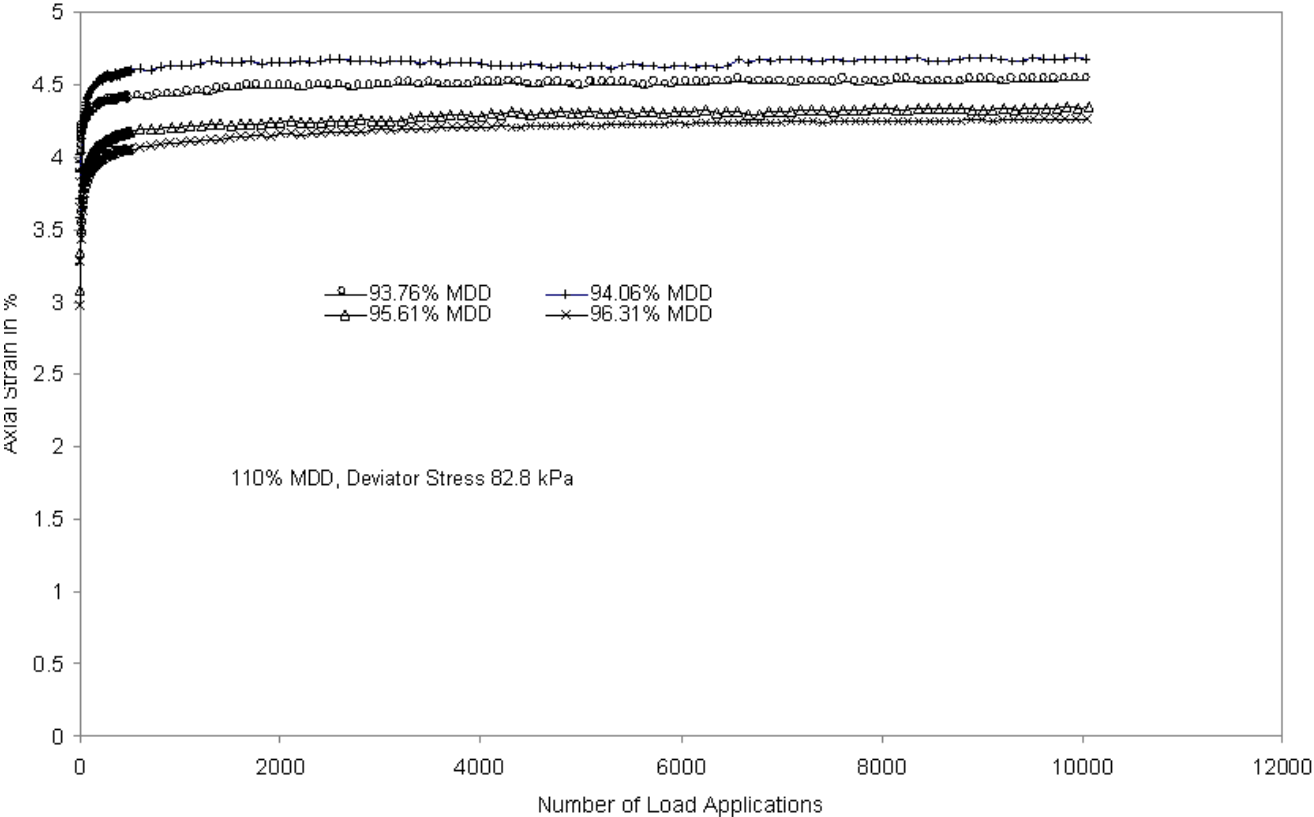
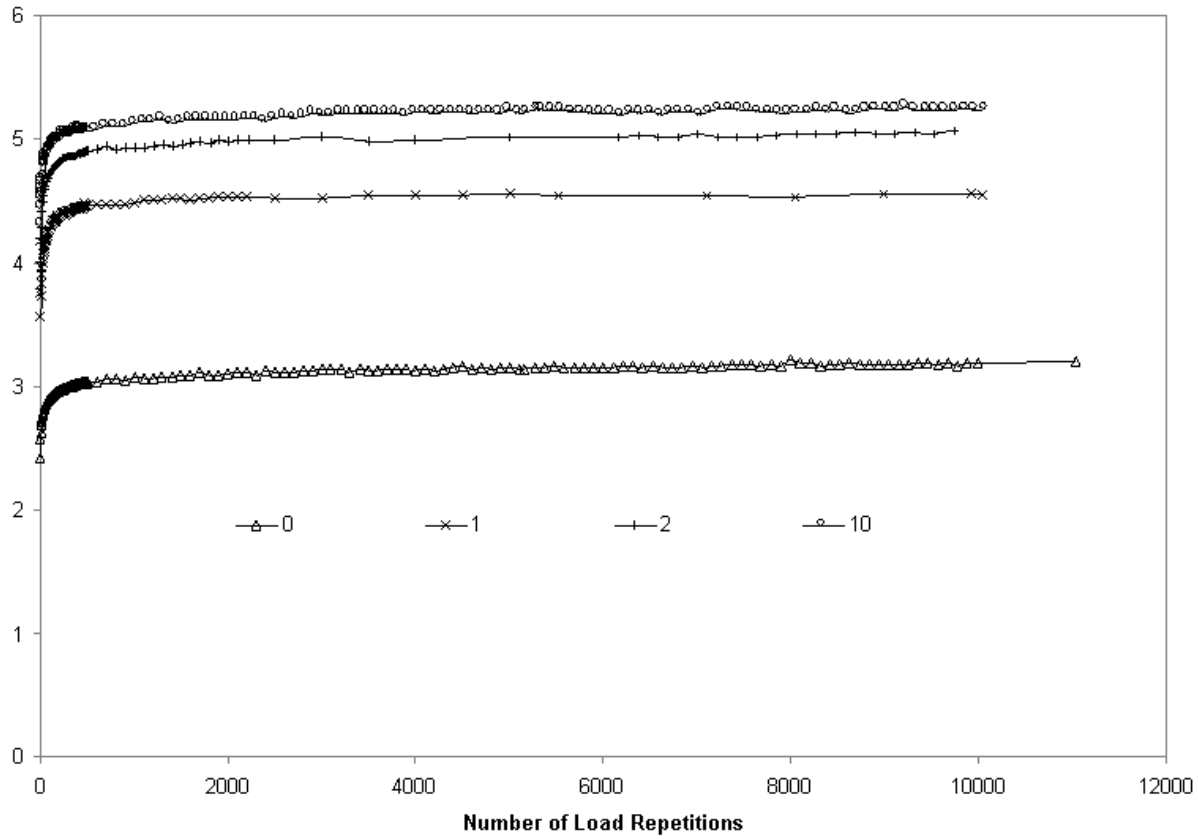


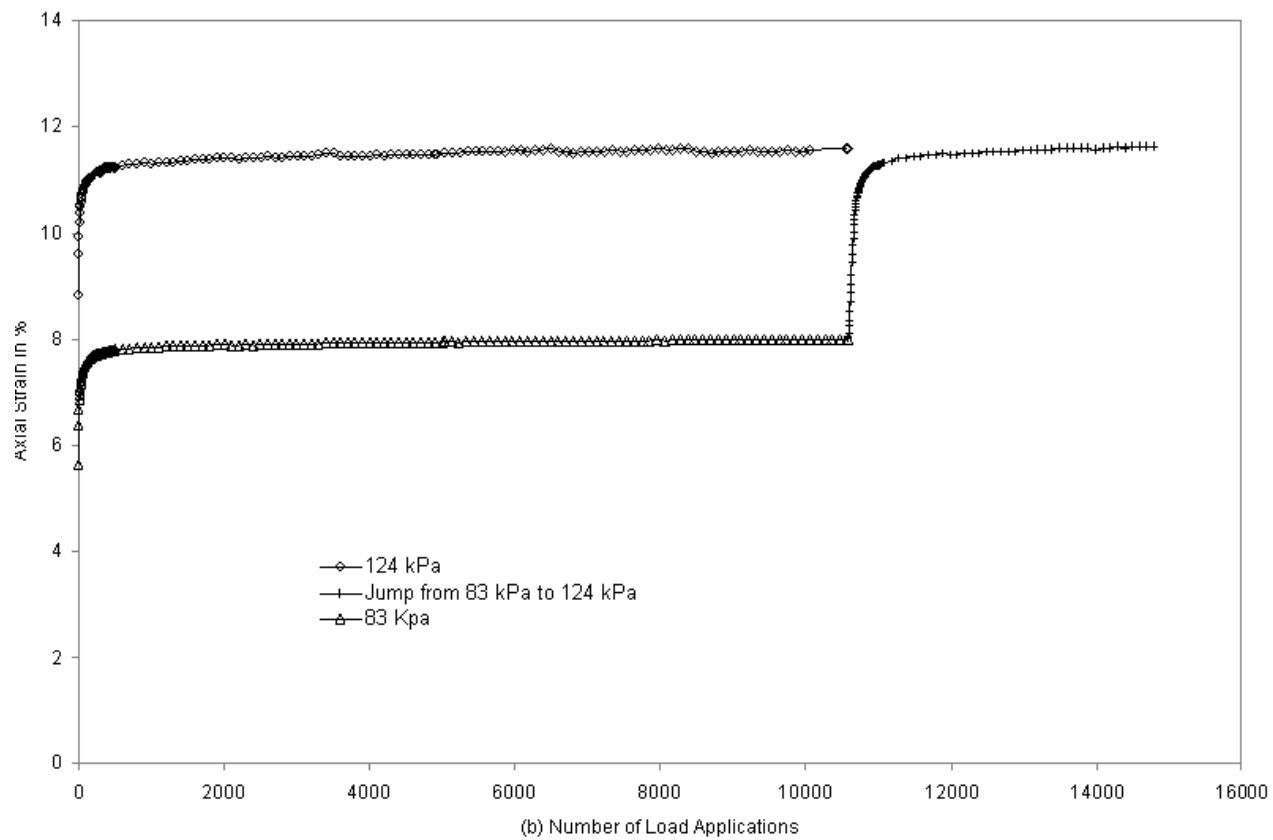
Figure A-26 Effect of Freeze-Thaw on Permanent Strain for Sacul



A-26

% Axial Strain In

Figure A-27 Effect of Stress History on Permanent Strain for Sacul  
(Ultimate Deviator Stress at 124 kPa)



A-27

Figure A-28 Effect of Stress History on Permanent Strain for Sacul  
(Ultimate Deviator Stress at 83 kPa)

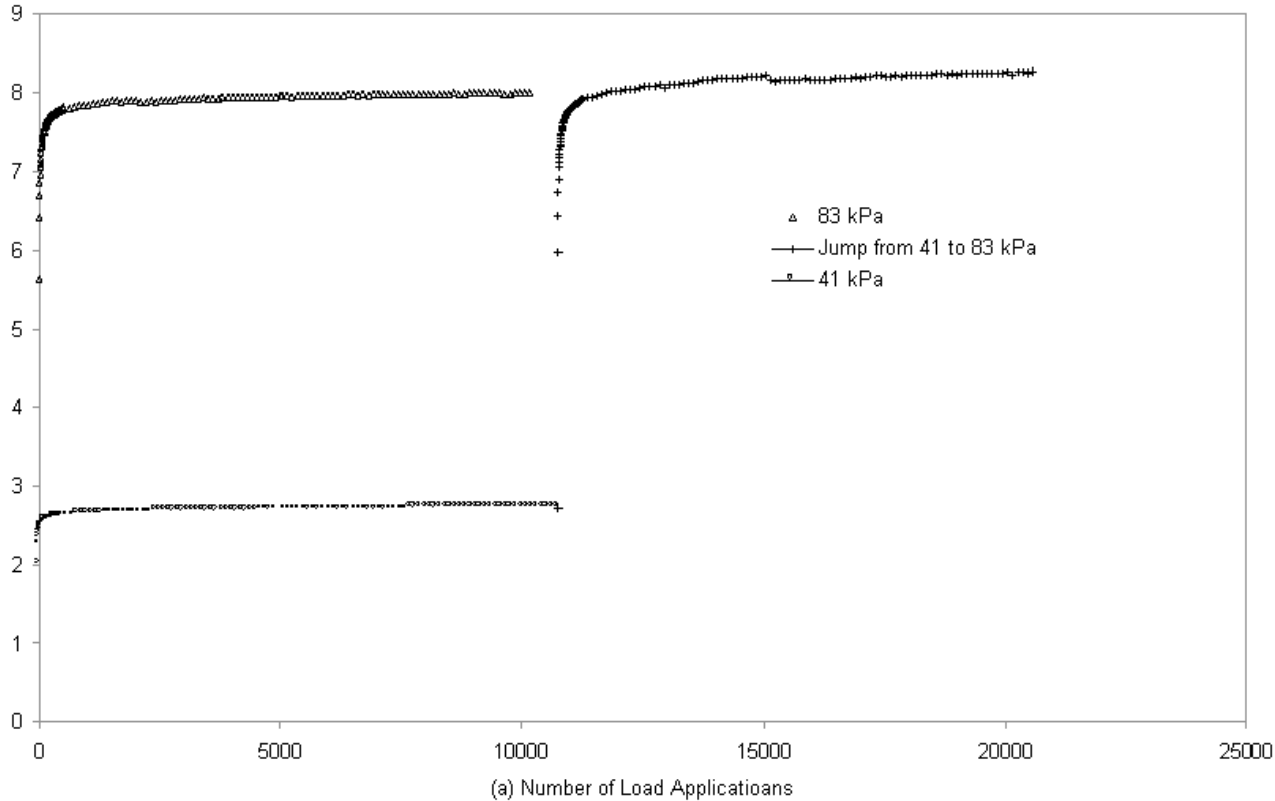


TABLE A-  
1 DATA  
FOR  
FIGURE  
A-1

| Deviator=<br>28Kpa |      | Deviator=<br>41kPa |      | Deviator=<br>62kPa |      | Deviator=<br>83kPa |       | Deviator=<br>103kPa |       |
|--------------------|------|--------------------|------|--------------------|------|--------------------|-------|---------------------|-------|
| N                  | %    | N                  | %    | N                  | %    | N                  | %     | N                   | %     |
| 1                  | 0.80 | 1                  | 2.04 | 1                  | 4.15 | 1                  | 6.72  | 1                   | 7.93  |
| 6                  | 1.00 | 6                  | 2.45 | 6                  | 4.81 | 6                  | 7.46  | 6                   | 8.84  |
| 11                 | 1.11 | 11                 | 2.66 | 11                 | 5.27 | 11                 | 7.86  | 11                  | 9.44  |
| 49                 | 1.55 | 50                 | 3.56 | 51                 | 6.46 | 49                 | 9.38  | 49                  | 11.24 |
| 102                | 1.75 | 103                | 3.90 | 100                | 6.93 | 101                | 10.13 | 101                 | 12.09 |
| 109                | 1.77 | 108                | 3.93 | 106                | 7.00 | 106                | 10.19 | 106                 | 12.13 |
| 151                | 1.85 | 152                | 4.08 | 151                | 7.24 | 152                | 10.50 | 152                 | 12.50 |
| 201                | 1.93 | 204                | 4.21 | 202                | 7.48 | 203                | 10.71 | 204                 | 12.77 |
| 250                | 1.98 | 255                | 4.30 | 254                | 7.63 | 249                | 10.86 | 253                 | 12.95 |
| 302                | 2.05 | 302                | 4.35 | 304                | 7.71 | 303                | 11.00 | 301                 | 13.05 |
| 309                | 2.05 | 307                | 4.36 | 311                | 7.73 | 308                | 11.01 | 307                 | 13.06 |
| 354                | 2.09 | 350                | 4.40 | 356                | 7.81 | 351                | 11.08 | 354                 | 13.17 |
| 401                | 2.10 | 404                | 4.44 | 409                | 7.87 | 397                | 11.16 | 406                 | 13.26 |
| 453                | 2.13 | 449                | 4.48 | 455                | 7.90 | 454                | 11.23 | 454                 | 13.34 |
| 505                | 2.15 | 502                | 4.50 | 502                | 7.95 | 505                | 11.29 | 503                 | 13.42 |
| 601                | 2.26 | 602                | 4.56 | 602                | 8.01 | 603                | 11.37 | 605                 | 13.53 |
| 705                | 2.30 | 705                | 4.59 | 704                | 8.05 | 705                | 11.47 | 702                 | 13.61 |
| 804                | 2.32 | 803                | 4.61 | 801                | 8.08 | 803                | 11.54 | 804                 | 13.66 |
| 904                | 2.34 | 902                | 4.64 | 904                | 8.12 | 905                | 11.59 | 904                 | 13.71 |
| 1002               | 2.35 | 1006               | 4.66 | 1001               | 8.13 | 1003               | 11.66 | 1005                | 13.71 |
| 1201               | 2.36 | 1202               | 4.69 | 1201               | 8.17 | 1205               | 11.73 | 1205                | 13.84 |
| 1403               | 2.38 | 1403               | 4.73 | 1401               | 8.21 | 1401               | 11.78 | 1401                | 13.90 |
| 1606               | 2.39 | 1604               | 4.74 | 1605               | 8.25 | 1604               | 11.81 | 1602                | 13.95 |
| 1801               | 2.39 | 1805               | 4.79 | 1805               | 8.27 | 1804               | 11.81 | 1803                | 13.98 |
| 2008               | 2.40 | 2001               | 4.79 | 2006               | 8.29 | 2002               | 11.81 | 2005                | 14.01 |
| 2204               | 2.40 | 2202               | 4.81 | 2202               | 8.29 | 2205               | 11.89 | 2203                | 14.03 |
| 2401               | 2.40 | 2404               | 4.83 | 2405               | 8.31 | 2403               | 11.87 | 2404                | 14.04 |
| 2604               | 2.40 | 2605               | 4.85 | 2604               | 8.33 | 2602               | 11.87 | 2605                | 14.07 |
| 2802               | 2.41 | 2801               | 4.86 | 2803               | 8.35 | 2807               | 11.88 | 2801                | 14.12 |
| 3005               | 2.41 | 3002               | 4.87 | 3002               | 8.35 | 3004               | 11.89 | 3003                | 14.11 |
| 3203               | 2.42 | 3204               | 4.89 | 3201               | 8.37 | 3205               | 11.91 | 3205                | 14.14 |
| 3401               | 2.43 | 3405               | 4.92 | 3401               | 8.38 | 3404               | 11.92 | 3401                | 14.14 |
| 3604               | 2.44 | 3601               | 4.93 | 3601               | 8.38 | 3603               | 11.90 | 3603                | 14.18 |
| 3802               | 2.44 | 3803               | 4.94 | 3805               | 8.39 | 3804               | 11.94 | 3805                | 14.20 |
| 4005               | 2.44 | 4004               | 4.94 | 4004               | 8.39 | 4005               | 11.92 | 4002                | 14.18 |
| 4204               | 2.45 | 4201               | 4.97 | 4203               | 8.40 | 4202               | 11.91 | 4205                | 14.23 |
| 4402               | 2.45 | 4403               | 4.97 | 4403               | 8.40 | 4403               | 11.92 | 4402                | 14.24 |
| 4605               | 2.46 | 4604               | 4.98 | 4603               | 8.40 | 4603               | 11.94 | 4604                | 14.24 |
| 4804               | 2.47 | 4801               | 5.00 | 4803               | 8.42 | 4807               | 11.94 | 4802                | 14.29 |
| 5003               | 2.47 | 5003               | 5.02 | 5003               | 8.42 | 5001               | 11.93 | 5004                | 14.33 |
| 6010               | 2.47 | 5973               | 5.06 | 6032               | 8.41 | 5996               | 11.98 | 6059                | 14.35 |
| 7058               | 2.48 | 7021               | 5.04 | 7080               | 8.43 | 7051               | 12.03 | 7111                | 14.36 |
| 8001               | 2.49 | 7965               | 5.08 | 8026               | 8.47 | 7994               | 12.05 | 8058                | 14.46 |
| 9049               | 2.50 | 9019               | 5.08 | 9083               | 8.50 | 9042               | 12.03 | 9007                | 14.50 |

10096 2.50 10077 5.10 10032 8.52 11033 12.08 10055 14.52

TABLE A-  
2 DATA  
FOR  
FIGURE  
A-2

| Deviator =<br>28 kPa |      | Deviator=<br>41 kPa |      | Deviator=<br>62 kPa |       | Deviator =<br>83 kPa |       |
|----------------------|------|---------------------|------|---------------------|-------|----------------------|-------|
| N                    | %    | N                   | %    | N                   | %     | N                    | %     |
| 1                    | 1.21 | 1                   | 3.49 | 1                   | 5.75  | 1                    | 8.87  |
| 6                    | 1.53 | 14                  | 4.32 | 6                   | 6.55  | 6                    | 9.65  |
| 11                   | 1.70 | 27                  | 4.69 | 11                  | 7.18  | 11                   | 10.25 |
| 50                   | 2.25 | 41                  | 4.99 | 49                  | 8.81  | 51                   | 12.30 |
| 104                  | 2.49 | 55                  | 5.23 | 53                  | 8.89  | 56                   | 12.46 |
| 113                  | 2.51 | 109                 | 5.73 | 107                 | 9.61  | 96                   | 13.28 |
| 155                  | 2.59 | 157                 | 5.93 | 150                 | 10.01 | 153                  | 13.94 |
| 203                  | 2.66 | 203                 | 6.06 | 200                 | 10.26 | 205                  | 14.33 |
| 253                  | 2.72 | 248                 | 6.14 | 250                 | 10.39 | 251                  | 14.58 |
| 305                  | 2.75 | 309                 | 6.21 | 303                 | 10.53 | 301                  | 14.79 |
| 355                  | 2.77 | 355                 | 6.27 | 351                 | 10.61 | 353                  | 14.95 |
| 407                  | 2.79 | 400                 | 6.31 | 403                 | 10.68 | 405                  | 15.11 |
| 453                  | 2.80 | 446                 | 6.33 | 453                 | 10.75 | 457                  | 15.25 |
| 499                  | 2.81 | 508                 | 6.36 | 494                 | 10.78 | 503                  | 15.36 |
| 601                  | 2.83 | 600                 | 6.41 | 605                 | 10.90 | 606                  | 15.55 |
| 702                  | 2.86 | 710                 | 6.45 | 702                 | 10.95 | 708                  | 15.75 |
| 804                  | 2.88 | 803                 | 6.47 | 806                 | 11.02 | 803                  | 15.86 |
| 903                  | 2.89 | 903                 | 6.48 | 905                 | 11.04 | 901                  | 15.98 |
| 1003                 | 2.89 | 1009                | 6.50 | 1005                | 11.10 | 1004                 | 16.09 |
| 1201                 | 2.91 | 1219                | 6.54 | 1203                | 11.15 |                      |       |
| 1405                 | 2.92 | 1413                | 6.56 | 1404                | 11.19 |                      |       |
| 1606                 | 2.94 | 1620                | 6.59 | 1606                | 11.22 |                      |       |
| 1805                 | 2.93 | 1805                | 6.59 | 1806                | 11.24 |                      |       |
| 2005                 | 2.93 | 2014                | 6.62 | 2005                | 11.25 |                      |       |
| 2204                 | 2.94 | 2203                | 6.63 | 2201                | 11.28 |                      |       |
| 2403                 | 2.95 | 2413                | 6.66 | 2404                | 11.28 |                      |       |
| 2601                 | 2.95 | 2601                | 6.66 | 2604                | 11.31 |                      |       |
| 2804                 | 2.95 | 2804                | 6.67 | 2805                | 11.32 |                      |       |
| 3002                 | 2.96 | 3014                | 6.68 | 3008                | 11.34 |                      |       |
| 3204                 | 2.96 | 3220                | 6.68 | 3202                | 11.34 |                      |       |
| 3402                 | 2.95 | 3406                | 6.69 | 3405                | 11.36 |                      |       |
| 3605                 | 2.96 | 3614                | 6.70 | 3607                | 11.37 |                      |       |
| 3803                 | 2.97 | 3800                | 6.71 | 3805                | 11.39 |                      |       |
| 4001                 | 2.96 | 4007                | 6.72 | 4004                | 11.38 |                      |       |
| 4204                 | 2.97 | 4222                | 6.72 | 4206                | 11.36 |                      |       |
| 4402                 | 2.98 | 4414                | 6.72 | 4405                | 11.35 |                      |       |
| 4601                 | 2.97 | 4603                | 6.72 | 4604                | 11.36 |                      |       |
| 4801                 | 2.99 | 4812                | 6.72 | 4803                | 11.37 |                      |       |
| 5004                 | 2.98 | 5003                | 6.73 | 5002                | 11.37 |                      |       |
| 6018                 | 2.98 | 6000                | 6.72 | 6025                | 11.41 |                      |       |
| 6126                 | 2.99 | 6105                | 6.73 | 6129                | 11.40 |                      |       |
| 7072                 | 2.99 | 7014                | 6.75 | 7073                | 11.43 |                      |       |
| 8016                 | 3.00 | 7902                | 6.77 | 8015                | 11.45 |                      |       |

|       |      |       |      |       |       |
|-------|------|-------|------|-------|-------|
| 9066  | 3.01 | 8911  | 6.77 | 9063  | 11.47 |
| 10011 | 3.02 | 10002 | 6.78 | 10006 | 11.49 |

TABLE A-3  
DATA  
FOR  
FIGURE  
A-3

Deviator =  
28 kPa

| N    | %    |
|------|------|
| 1    | 2.73 |
| 6    | 3.42 |
| 11   | 4.00 |
| 52   | 4.86 |
| 102  | 5.18 |
| 151  | 5.34 |
| 156  | 5.35 |
| 203  | 5.45 |
| 254  | 5.52 |
| 303  | 5.57 |
| 352  | 5.59 |
| 399  | 5.62 |
| 450  | 5.64 |
| 501  | 5.67 |
| 604  | 5.70 |
| 703  | 5.71 |
| 801  | 5.73 |
| 904  | 5.74 |
| 1005 | 5.75 |
| 1203 | 5.77 |
| 1401 | 5.78 |
| 1605 | 5.80 |
| 1805 | 5.80 |
| 2005 | 5.81 |
| 2205 | 5.83 |
| 2405 | 5.83 |
| 2605 | 5.84 |
| 2805 | 5.84 |
| 3002 | 5.86 |
| 3203 | 5.85 |
| 3404 | 5.86 |
| 3604 | 5.87 |
| 3805 | 5.87 |
| 4006 | 5.87 |
| 4201 | 5.89 |
| 4402 | 5.89 |
| 4603 | 5.89 |
| 4804 | 5.90 |
| 5005 | 5.89 |
| 6061 | 5.91 |
| 7006 | 5.91 |
| 8054 | 5.92 |

Deviator=  
41 kPa

| N    | %    |
|------|------|
| 1    | 4.44 |
| 6    | 4.94 |
| 11   | 5.39 |
| 49   | 6.69 |
| 102  | 7.25 |
| 150  | 7.52 |
| 155  | 7.53 |
| 201  | 7.76 |
| 253  | 7.88 |
| 300  | 7.97 |
| 352  | 8.06 |
| 407  | 8.12 |
| 453  | 8.16 |
| 503  | 8.20 |
| 602  | 8.26 |
| 705  | 8.32 |
| 801  | 8.35 |
| 907  | 8.40 |
| 1006 | 8.43 |
| 1203 | 8.48 |
| 1404 | 8.52 |
| 1602 | 8.55 |
| 1802 | 8.57 |
| 2002 | 8.59 |
| 2202 | 8.61 |
| 2402 | 8.62 |
| 2604 | 8.65 |
| 2806 | 8.66 |
| 3001 | 8.67 |
| 3203 | 8.67 |
| 3403 | 8.68 |
| 3603 | 8.69 |
| 3803 | 8.70 |
| 4003 | 8.70 |
| 4203 | 8.71 |
| 4403 | 8.71 |
| 4603 | 8.71 |
| 4804 | 8.72 |
| 5004 | 8.73 |
| 6000 | 8.73 |
| 6944 | 8.74 |
| 7994 | 8.77 |

8998 5.92  
10046 5.93

8938 8.78  
9986 8.79

TABLE A-  
4 DATA  
FOR  
FIGURE  
A-4

Density=  
95.46%

Density=  
91.68%

Density=  
97.86%

| N     | %        |
|-------|----------|
| 1     | 3.205714 |
| 6     | 3.687543 |
| 11    | 4.115457 |
| 54    | 5.1578   |
| 101   | 5.514314 |
| 151   | 5.704229 |
| 200   | 5.842171 |
| 250   | 5.900457 |
| 300   | 5.983029 |
| 350   | 6.0214   |
| 412   | 6.081143 |
| 460   | 6.094743 |
| 514   | 6.1166   |
| 619   | 6.128257 |
| 711   | 6.149143 |
| 803   | 6.159343 |
| 902   | 6.171971 |
| 1000  | 6.182657 |
| 1201  | 6.208886 |
| 1404  | 6.221029 |
| 1601  | 6.224914 |
| 1802  | 6.234143 |
| 2004  | 6.240943 |
| 2200  | 6.245314 |
| 2402  | 6.257457 |
| 2603  | 6.259886 |
| 2800  | 6.268143 |
| 3003  | 6.267657 |
| 3200  | 6.271057 |
| 3401  | 6.273486 |
| 3603  | 6.275429 |
| 3803  | 6.276886 |
| 4000  | 6.284657 |
| 4204  | 6.286114 |
| 4401  | 6.284171 |
| 4603  | 6.288057 |
| 4800  | 6.288057 |
| 5002  | 6.298257 |
| 5988  | 6.299229 |
| 7038  | 6.319629 |
| 8094  | 6.324    |
| 9142  | 6.321086 |
| 10190 | 6.3274   |

| N     | %        |
|-------|----------|
| 1     | 3.493743 |
| 14    | 4.323829 |
| 55    | 5.231629 |
| 68    | 5.363743 |
| 109   | 5.733371 |
| 157   | 5.927657 |
| 203   | 6.0554   |
| 248   | 6.1438   |
| 309   | 6.214229 |
| 355   | 6.267171 |
| 400   | 6.308457 |
| 446   | 6.330314 |
| 508   | 6.361886 |
| 600   | 6.406571 |
| 710   | 6.446886 |
| 803   | 6.470686 |
| 903   | 6.481857 |
| 1009  | 6.499829 |
| 1219  | 6.5382   |
| 1413  | 6.563457 |
| 1620  | 6.587257 |
| 1805  | 6.591629 |
| 2014  | 6.619314 |
| 2203  | 6.6334   |
| 2413  | 6.656229 |
| 2601  | 6.658657 |
| 2804  | 6.672743 |
| 3014  | 6.684886 |
| 3220  | 6.683914 |
| 3406  | 6.687314 |
| 3614  | 6.697029 |
| 3800  | 6.706257 |
| 4007  | 6.716457 |
| 4222  | 6.717914 |
| 4414  | 6.722771 |
| 4603  | 6.723257 |
| 4812  | 6.717429 |
| 5003  | 6.7252   |
| 6000  | 6.724229 |
| 7014  | 6.753371 |
| 8006  | 6.7694   |
| 9018  | 6.771829 |
| 10002 | 6.778143 |

| N     | %        |
|-------|----------|
| 1     | 2.591771 |
| 8     | 3.410686 |
| 14    | 3.771086 |
| 53    | 4.577857 |
| 106   | 4.940686 |
| 156   | 5.121371 |
| 201   | 5.211229 |
| 250   | 5.285057 |
| 303   | 5.340429 |
| 349   | 5.375886 |
| 397   | 5.399686 |
| 455   | 5.426886 |
| 502   | 5.441457 |
| 623   | 5.4774   |
| 832   | 5.519171 |
| 905   | 5.5284   |
| 1002  | 5.546371 |
| 1204  | 5.551229 |
| 1405  | 5.565314 |
| 1600  | 5.584257 |
| 1802  | 5.592514 |
| 2003  | 5.604171 |
| 2209  | 5.615343 |
| 2402  | 5.6202   |
| 2609  | 5.632829 |
| 2800  | 5.629914 |
| 3006  | 5.631857 |
| 3207  | 5.6372   |
| 3403  | 5.641571 |
| 3606  | 5.644971 |
| 3807  | 5.648857 |
| 4002  | 5.6542   |
| 4201  | 5.649343 |
| 4409  | 5.656629 |
| 4606  | 5.656143 |
| 4801  | 5.659543 |
| 5002  | 5.668286 |
| 6000  | 5.673143 |
| 6901  | 5.684314 |
| 7901  | 5.695486 |
| 8006  | 5.696457 |
| 9008  | 5.7052   |
| 10007 | 5.712486 |

TABLE A-  
5 DATA  
FOR  
FIGURE  
A-5

| No FT |          | One FT |          |
|-------|----------|--------|----------|
| N     | %        | N      | %        |
| 1     | 1.145314 | 1      | 1.908371 |
| 9     | 1.508143 | 16     | 2.259057 |
| 53    | 2.218743 | 58     | 2.674829 |
| 104   | 2.519886 | 110    | 2.888057 |
| 157   | 2.6554   | 156    | 3.013857 |
| 207   | 2.739429 | 204    | 3.093029 |
| 250   | 2.800629 | 252    | 3.157143 |
| 298   | 2.8288   | 299    | 3.210086 |
| 351   | 2.869114 | 346    | 3.252829 |
| 397   | 2.887571 | 407    | 3.292171 |
| 468   | 2.924    | 449    | 3.314029 |
| 506   | 2.935657 | 510    | 3.338314 |
| 620   | 2.975    | 613    | 3.382029 |
| 718   | 2.996371 | 701    | 3.399029 |
| 818   | 3.011429 | 817    | 3.421857 |
| 911   | 3.0226   | 901    | 3.448086 |
| 992   | 3.0328   | 1004   | 3.448086 |
| 1208  | 3.051743 | 1215   | 3.469943 |
| 1410  | 3.063886 | 1406   | 3.489371 |
| 1609  | 3.073114 | 1617   | 3.502    |
| 1810  | 3.086714 | 1806   | 3.5088   |
| 2009  | 3.092543 | 2018   | 3.514629 |
| 2209  | 3.100314 | 2208   | 3.520457 |
| 2407  | 3.103714 | 2419   | 3.528714 |
| 2627  | 3.108086 | 2609   | 3.535514 |
| 2805  | 3.110514 | 2802   | 3.541829 |
| 3013  | 3.115857 | 3017   | 3.547657 |
| 3220  | 3.120229 | 3208   | 3.554457 |
| 3428  | 3.121686 | 3402   | 3.561743 |
| 3613  | 3.126057 | 3615   | 3.565143 |
| 3803  | 3.126057 | 3807   | 3.574857 |
| 4013  | 3.131886 | 4021   | 3.576314 |
| 4211  | 3.131886 | 4213   | 3.580686 |
| 4410  | 3.136743 | 4405   | 3.585543 |
| 4604  | 3.139171 | 4620   | 3.592829 |
| 4804  | 3.141114 | 4812   | 3.595743 |
| 5006  | 3.143543 | 5004   | 3.598171 |
| 6001  | 3.157629 | 6001   | 3.608857 |
| 7014  | 3.170743 | 7012   | 3.612743 |
| 8017  | 3.176086 | 8002   | 3.616629 |
| 9021  | 3.184829 | 9011   | 3.621971 |
| 10058 | 3.1858   | 10005  | 3.624886 |

TABLE A-  
6 DATA  
FOR  
FIGURE  
A-6

| 62kPa |          | jump to<br>62kPa | 28 kPa   |      |          |
|-------|----------|------------------|----------|------|----------|
| N     | %        | N                | %        | N    | %        |
| 1     | 5.750857 | 10646            | 3.020171 | 1    | 1.212343 |
| 6     | 6.5518   | 10647            | 3.580905 | 6    | 1.525629 |
| 49    | 8.813286 | 10652            | 4.015889 | 11   | 1.701943 |
| 107   | 9.609857 | 10700            | 6.368365 | 50   | 2.245943 |
| 150   | 10.01154 | 10803            | 7.403477 | 104  | 2.490743 |
| 200   | 10.25829 | 10902            | 7.786651 | 150  | 2.5874   |
| 250   | 10.39429 | 11005            | 7.952334 | 203  | 2.659771 |
| 303   | 10.5332  | 11100            | 8.048937 | 247  | 2.708343 |
| 346   | 10.61723 | 11242            | 8.16281  | 305  | 2.754486 |
| 403   | 10.68183 | 11345            | 8.224873 | 355  | 2.773429 |
| 453   | 10.74789 | 11441            | 8.24754  | 400  | 2.793829 |
| 503   | 10.79937 | 11544            | 8.290715 | 448  | 2.804029 |
| 605   | 10.897   | 11644            | 8.335508 | 499  | 2.810829 |
| 702   | 10.9548  | 11743            | 8.360873 | 504  | 2.812771 |
| 806   | 11.01551 | 11846            | 8.361413 | 601  | 2.831714 |
| 905   | 11.03543 | 11943            | 8.413223 | 702  | 2.8594   |
| 1005  | 11.09614 | 12043            | 8.41808  | 804  | 2.881257 |
| 1203  | 11.1452  | 12142            | 8.433731 | 903  | 2.8866   |
| 1404  | 11.19183 | 12245            | 8.456397 | 1003 | 2.893886 |
| 1606  | 11.22486 | 12345            | 8.476365 | 1201 | 2.905057 |
| 1806  | 11.23943 | 12444            | 8.447762 | 1405 | 2.916229 |
| 2005  | 11.25206 | 12544            | 8.474746 | 1606 | 2.9376   |
| 2201  | 11.28023 | 12645            | 8.487159 | 1805 | 2.932743 |
| 2404  | 11.27537 | 12743            | 8.478524 | 2005 | 2.929829 |
| 2604  | 11.30791 | 12842            | 8.493096 | 2204 | 2.936143 |
| 2805  | 11.32103 | 12941            | 8.488238 | 2403 | 2.952657 |
| 3008  | 11.34143 | 13045            | 8.514683 | 2601 | 2.950229 |
| 3202  | 11.34483 | 13144            | 8.487159 | 2804 | 2.9512   |
| 3405  | 11.35746 | 13243            | 8.519    | 3002 | 2.9614   |
| 3607  | 11.3696  | 13341            | 8.527096 | 3204 | 2.960914 |
| 3805  | 11.38757 | 13445            | 8.510905 | 3402 | 2.9546   |
| 4004  | 11.37931 | 13544            | 8.534111 | 3605 | 2.962371 |
| 4206  | 11.356   | 13643            | 8.542207 | 3803 | 2.969171 |
| 4405  | 11.35406 | 13742            | 8.538969 | 4204 | 2.967714 |
| 4604  | 11.35843 | 13845            | 8.537889 | 4402 | 2.975486 |
| 4803  | 11.37446 | 14043            | 8.542207 | 4601 | 2.974514 |
| 5002  | 11.37446 | 14542            | 8.600492 | 4801 | 2.987143 |
| 6025  | 11.40797 | 14943            | 8.58808  | 5004 | 2.980829 |
| 7073  | 11.42691 | 15043            | 8.602111 | 6018 | 2.984229 |
| 8015  | 11.45363 | 16217            | 8.63827  | 6967 | 2.993943 |
| 9063  | 11.46917 | 16742            | 8.661477 | 8016 | 2.997343 |
| 13358 | 11.48083 | 17161            | 8.662556 | 9066 | 3.008029 |

|       |          |       |          |       |          |
|-------|----------|-------|----------|-------|----------|
| 13463 | 11.48617 | 17686 | 8.667413 | 10011 | 3.018714 |
| 13567 | 11.48666 | 18001 | 8.690619 |       |          |

TABLE A-  
7 DATA  
FOR  
FIGURE  
A-7

| 103 kPa |          | 62 kPa |          | jump to<br>103kPa |          |
|---------|----------|--------|----------|-------------------|----------|
| N       | %        | N      | %        | N                 | %        |
| 1       | 7.933657 | 1      | 4.145571 |                   |          |
| 6       | 8.838543 | 6      | 4.806143 | 10765             | 8.541286 |
| 11      | 9.4418   | 11     | 5.27     | 10766             | 8.566654 |
| 49      | 11.24283 | 51     | 6.457571 | 10805             | 8.847829 |
| 101     | 12.08846 | 100    | 6.933571 | 10901             | 9.86621  |
| 147     | 12.46197 | 151    | 7.242971 | 10993             | 10.58884 |
| 198     | 12.7432  | 208    | 7.487286 | 11101             | 11.1825  |
| 253     | 12.94526 | 265    | 7.643686 | 11203             | 11.61262 |
| 301     | 13.05454 | 311    | 7.726257 | 11366             | 12.02116 |
| 348     | 13.16966 | 356    | 7.807857 | 11466             | 12.16094 |
| 401     | 13.23474 | 409    | 7.8744   | 11567             | 12.27535 |
| 447     | 13.35034 | 455    | 7.902571 | 11668             | 12.38491 |
| 503     | 13.42029 | 502    | 7.947743 | 11769             | 12.4351  |
| 605     | 13.52811 | 602    | 8.006029 | 11867             | 12.52145 |
| 702     | 13.60874 | 704    | 8.053143 | 11970             | 12.54088 |
| 804     | 13.66363 | 801    | 8.079857 | 12070             | 12.61967 |
| 904     | 13.70734 | 904    | 8.116771 | 12165             | 12.65853 |
| 1005    | 13.70977 | 1001   | 8.131829 | 12270             | 12.66554 |
| 1205    | 13.84091 | 1201   | 8.1736   | 12370             | 12.6758  |
| 1401    | 13.89871 | 1401   | 8.211    | 12466             | 12.71573 |
| 1602    | 13.95166 | 1605   | 8.245    | 12567             | 12.71196 |
| 1803    | 13.98177 | 1805   | 8.266371 | 12670             | 12.71681 |
| 2005    | 14.00946 | 2006   | 8.287743 | 12765             | 12.75513 |
| 2203    | 14.02597 | 2202   | 8.293571 | 12872             | 12.80154 |
| 2404    | 14.042   | 2405   | 8.308629 | 12966             | 12.79561 |
| 2605    | 14.06531 | 2604   | 8.327571 | 13065             | 12.78157 |
| 2801    | 14.11729 | 2803   | 8.346029 | 13167             | 12.8037  |
| 3003    | 14.10806 | 3002   | 8.345543 | 13269             | 12.77186 |
| 3205    | 14.13866 | 3201   | 8.373714 | 13369             | 12.80478 |
| 3401    | 14.14303 | 3401   | 8.3776   | 13467             | 12.83338 |
| 3603    | 14.17994 | 3601   | 8.383429 | 13565             | 12.835   |
| 3805    | 14.19549 | 3805   | 8.388286 | 13668             | 12.85821 |
| 4002    | 14.17849 | 4004   | 8.393629 | 13767             | 12.8717  |
| 4205    | 14.22949 | 4203   | 8.4014   | 13865             | 12.87818 |
| 4402    | 14.23871 | 4403   | 8.395086 | 13968             | 12.88897 |
| 4604    | 14.24454 | 4603   | 8.401886 | 14067             | 12.88304 |
| 4802    | 14.28874 | 4803   | 8.417914 | 14165             | 12.90678 |
| 5004    | 14.33391 | 5003   | 8.416457 | 14268             | 12.89761 |
| 5103    | 14.33877 | 5105   | 8.417429 | 14366             | 12.89923 |
| 6059    | 14.3548  | 6032   | 8.409657 | 14465             | 12.93538 |
| 7006    | 14.36694 | 6975   | 8.420343 | 14568             | 12.937   |
| 8058    | 14.45534 | 8026   | 8.474257 | 14666             | 12.94618 |

|       |          |       |          |       |          |
|-------|----------|-------|----------|-------|----------|
| 9007  | 14.50489 | 8976  | 8.483971 | 14769 | 12.98557 |
| 10055 | 14.52043 | 10032 | 8.516029 | 14868 | 12.92189 |
| 10160 | 14.5486  | 10137 | 8.5306   | 15070 | 12.94456 |
| 11103 | 14.59086 | 10241 | 8.528171 | 15266 | 12.98288 |
| 11731 | 14.60009 | 10451 | 8.524286 | 15470 | 12.89869 |
| 13303 | 14.63846 | 10660 | 8.527686 | 15665 | 12.95427 |
| 13932 | 14.64283 | 10765 | 8.541286 | 15978 | 12.99529 |

TABLE  
A-8  
DATA  
FOR  
FIGURE  
A-8

| 28kPa |          | 41kPa |          | 62kPa |          | 83kPa |          | 103kPa <sup>a</sup> |          |
|-------|----------|-------|----------|-------|----------|-------|----------|---------------------|----------|
| N     | %        | N     | %        | N     | %        | N     | %        | N                   | %        |
| 1     | 0.435686 | 1     | 0.7684   | 1     | 1.960829 | 1     | 4.573    | 1                   | 7.186413 |
| 6     | 0.492029 | 6     | 0.9282   | 6     | 2.173571 | 6     | 5.010629 | 6                   | 8.155143 |
| 11    | 0.522143 | 11    | 0.9928   | 11    | 2.3698   | 11    | 5.267571 | 11                  | 8.600921 |
| 53    | 0.644057 | 49    | 1.2104   | 52    | 2.9172   | 49    | 6.183629 | 49                  | 9.596095 |
| 101   | 0.685343 | 103   | 1.320657 | 103   | 3.1892   | 102   | 6.500314 | 104                 | 9.957683 |
| 154   | 0.713029 | 156   | 1.388657 | 155   | 3.346571 | 153   | 6.662543 | 150                 | 10.0899  |
| 198   | 0.732943 | 202   | 1.416829 | 208   | 3.421857 | 198   | 6.735886 | 195                 | 10.16816 |
| 250   | 0.740714 | 252   | 1.444029 | 252   | 3.480629 | 250   | 6.788829 | 242                 | 10.22321 |
| 304   | 0.753343 | 310   | 1.468314 | 302   | 3.518029 | 307   | 6.845171 | 296                 | 10.27124 |
| 351   | 0.759657 | 359   | 1.477057 | 351   | 3.5598   | 353   | 6.888886 | 348                 | 10.30308 |
| 403   | 0.766943 | 407   | 1.484829 | 396   | 3.590886 | 407   | 6.925314 | 394                 | 10.3306  |
| 453   | 0.7718   | 450   | 1.501829 | 450   | 3.611771 | 452   | 6.932114 | 451                 | 10.38349 |
| 505   | 0.7718   | 500   | 1.511543 | 500   | 3.638971 | 501   | 6.9394   | 503                 | 10.38781 |
| 602   | 0.7854   | 505   | 1.507171 | 505   | 3.639943 | 601   | 6.960771 | 604                 | 10.43746 |
| 702   | 0.790257 | 603   | 1.527571 | 604   | 3.676371 | 701   | 6.986514 | 702                 | 10.45581 |
| 802   | 0.790743 | 701   | 1.534857 | 701   | 3.703086 | 805   | 7.015657 | 805                 | 10.48765 |
| 901   | 0.796571 | 804   | 1.542629 | 803   | 3.722514 | 902   | 7.0448   | 901                 | 10.48549 |
| 1002  | 0.8058   | 902   | 1.552343 | 906   | 3.74     | 1006  | 7.064714 | 1002                | 10.49305 |
| 1205  | 0.808714 | 1104  | 1.572257 | 1103  | 3.764771 | 1202  | 7.092886 | 1202                | 10.56698 |
| 1405  | 0.818429 | 1305  | 1.593143 | 1304  | 3.7808   | 1401  | 7.105029 | 1402                | 10.60314 |
| 1605  | 0.825229 | 1501  | 1.598    | 1502  | 3.7944   | 1602  | 7.126886 | 1604                | 10.62257 |
| 1801  | 0.826686 | 1703  | 1.596057 | 1702  | 3.805086 | 1802  | 7.139514 | 1802                | 10.62311 |
| 2001  | 0.8364   | 1899  | 1.607229 | 1903  | 3.822571 | 2003  | 7.157    | 2001                | 10.60098 |
| 2202  | 0.838343 | 2103  | 1.606743 | 2104  | 3.830829 | 2203  | 7.179829 | 2201                | 10.61825 |
| 2405  | 0.840771 | 2301  | 1.6082   | 2304  | 3.846371 | 2401  | 7.185171 | 2400                | 10.64794 |
| 2603  | 0.844171 | 2504  | 1.6184   | 2505  | 3.851714 | 2604  | 7.193914 | 2605                | 10.62473 |
| 2801  | 0.8466   | 2703  | 1.617429 | 2701  | 3.863857 | 2805  | 7.206543 | 2804                | 10.68517 |
| 3004  | 0.847086 | 2906  | 1.632    | 2902  | 3.870657 | 3002  | 7.212371 | 3004                | 10.67222 |
| 3202  | 0.849029 | 3104  | 1.636857 | 3103  | 3.878914 | 3203  | 7.2352   | 3203                | 10.70568 |
| 3405  | 0.851457 | 3302  | 1.631514 | 3304  | 3.889114 | 3403  | 7.245886 | 3403                | 10.71594 |
| 3603  | 0.853886 | 3501  | 1.648029 | 3506  | 3.8896   | 3604  | 7.233743 | 3602                | 10.72781 |
| 3801  | 0.860686 | 3704  | 1.644143 | 3701  | 3.897371 | 3805  | 7.251714 | 3800                | 10.74778 |
| 4004  | 0.859229 | 3905  | 1.648514 | 3903  | 3.907571 | 4002  | 7.243457 | 4000                | 10.73159 |
| 4203  | 0.865543 | 4103  | 1.650457 | 4105  | 3.911943 | 4204  | 7.257543 | 4204                | 10.71648 |
| 4406  | 0.867971 | 4303  | 1.6592   | 4301  | 3.918743 | 4405  | 7.259    | 4403                | 10.71432 |
| 4604  | 0.870886 | 4503  | 1.660657 | 4503  | 3.9236   | 4602  | 7.269686 | 4604                | 10.6733  |
| 4803  | 0.869914 | 4704  | 1.658714 | 4705  | 3.931857 | 4804  | 7.264829 | 4800                | 10.72403 |

|       |          |      |          |       |          |       |          |       |          |
|-------|----------|------|----------|-------|----------|-------|----------|-------|----------|
| 5002  | 0.8738   | 4903 | 1.663086 | 5005  | 3.940114 | 5006  | 7.274543 | 5900  | 10.77692 |
| 6061  | 0.880114 | 5884 | 1.675714 | 6017  | 3.961971 | 6024  | 7.316314 | 6215  | 10.75749 |
| 6166  | 0.879143 | 6094 | 1.677171 | 6123  | 3.964886 | 6129  | 7.305143 | 7054  | 10.77314 |
| 7025  | 0.882057 | 6933 | 1.686886 | 6964  | 3.977514 | 6970  | 7.305629 | 8102  | 10.74346 |
| 8074  | 0.888371 | 7982 | 1.702429 | 8017  | 3.993543 | 8027  | 7.362457 | 8207  | 10.73806 |
| 9017  | 0.895171 | 8926 | 1.709714 | 8963  | 4.004714 | 8970  | 7.385771 | 9045  | 10.72241 |
| 10065 | 0.908286 | 9975 | 1.716514 | 10017 | 4.016857 | 10018 | 7.409086 | 10093 | 10.69705 |

TABLE A-9  
DATA  
FOR  
FIGURE  
A-9

| 28kPa |          | 41kPa |          | 62kPa |          | 83kPa |          |
|-------|----------|-------|----------|-------|----------|-------|----------|
| N     | %        | N     | %        | N     | %        | N     | %        |
| 1     | 0.920914 | 1     | 1.258479 | 1     | 3.663743 | 1     | 5.254949 |
| 6     | 1.033114 | 6     | 1.554279 | 6     | 4.5628   | 6     | 5.938349 |
| 11    | 1.095771 | 11    | 1.736422 | 11    | 4.873171 | 11    | 6.518778 |
| 55    | 1.442086 | 51    | 2.298879 | 49    | 5.891714 | 49    | 7.813206 |
| 103   | 1.5878   | 104   | 2.533479 | 98    | 6.217629 | 98    | 8.123578 |
| 150   | 1.674257 | 159   | 2.626737 | 148   | 6.342943 | 148   | 8.246463 |
| 204   | 1.735943 | 218   | 2.719994 | 203   | 6.440086 | 203   | 8.300863 |
| 252   | 1.761686 | 273   | 2.741851 | 303   | 6.515371 | 297   | 8.350406 |
| 349   | 1.792771 | 357   | 2.797708 | 362   | 6.578514 | 354   | 8.409663 |
| 399   | 1.809286 | 412   | 2.813737 | 415   | 6.579486 | 403   | 8.451435 |
| 444   | 1.821429 | 469   | 2.856965 | 475   | 6.607171 | 457   | 8.482521 |
| 592   | 1.848143 | 504   | 2.872022 | 507   | 6.614943 | 504   | 8.496121 |
| 696   | 1.860286 | 604   | 2.887079 | 602   | 6.652343 | 602   | 8.549063 |
| 795   | 1.868057 | 705   | 2.923994 | 703   | 6.652343 | 705   | 8.542263 |
| 794   | 1.873886 | 803   | 2.934679 | 803   | 6.686829 | 808   | 8.591806 |
| 896   | 1.880686 | 902   | 2.915251 | 902   | 6.688771 | 903   | 8.589378 |
| 994   | 1.887971 | 1002  | 2.936622 | 1004  | 6.703343 | 1001  | 8.604435 |
| 1191  | 1.903029 | 1203  | 2.960422 | 1204  | 6.751914 | 1203  | 8.604435 |
| 1391  | 1.9142   | 1405  | 2.988108 | 1404  | 6.743657 | 1404  | 8.644263 |
| 1594  | 1.923429 | 1601  | 3.006565 | 1604  | 6.762114 | 1600  | 8.645721 |
| 1796  | 1.934114 | 1803  | 3.014337 | 1804  | 6.786886 | 1804  | 8.650092 |
| 1993  | 1.937514 | 2004  | 3.025994 | 2004  | 6.764057 | 2004  | 8.655921 |
| 2194  | 1.945771 | 2201  | 3.046879 | 2204  | 6.773771 | 2202  | 8.662721 |
| 2394  | 1.952571 | 2403  | 3.048337 | 2404  | 6.792229 | 2406  | 8.677292 |
| 2591  | 1.955971 | 2604  | 3.064851 | 2604  | 6.814086 | 2605  | 8.691863 |
| 2798  | 1.961314 | 2801  | 3.060479 | 2805  | 6.8      | 2803  | 8.711292 |
| 2995  | 1.964714 | 3002  | 3.070194 | 3005  | 6.818457 | 3003  | 8.651063 |
| 3195  | 1.969571 | 3204  | 3.079908 | 3201  | 6.822829 | 3201  | 8.681178 |
| 3394  | 1.974429 | 3405  | 3.090594 | 3401  | 6.859257 | 3406  | 8.684578 |
| 3592  | 1.977343 | 3601  | 3.099822 | 3602  | 6.851    | 3601  | 8.715663 |
| 3795  | 1.986086 | 3802  | 3.098365 | 3803  | 6.857314 | 3805  | 8.675349 |
| 3993  | 1.987057 | 4003  | 3.094965 | 4004  | 6.8748   | 4005  | 8.715178 |
| 4094  | 1.988029 | 4106  | 3.102737 | 4103  | 6.884514 | 4105  | 8.705949 |
| 4196  | 1.990943 | 4205  | 3.116822 | 4206  | 6.886457 | 4204  | 8.687006 |
| 4393  | 1.9958   | 4406  | 3.105165 | 4403  | 6.909286 | 4405  | 8.723921 |
| 4592  | 1.9992   | 4603  | 3.104679 | 4605  | 6.882571 | 4604  | 8.728778 |
| 4794  | 2.002114 | 4800  | 3.111965 | 4805  | 6.9054   | 4804  | 8.740435 |

|       |          |       |          |       |          |       |          |
|-------|----------|-------|----------|-------|----------|-------|----------|
| 4992  | 2.006    | 5000  | 3.120708 | 5004  | 6.892286 | 5001  | 8.729749 |
| 5959  | 2.021057 | 5991  | 3.120708 | 6056  | 6.9428   | 5971  | 8.734606 |
| 7007  | 2.037086 | 7039  | 3.132365 | 7105  | 6.957371 | 7028  | 8.752578 |
| 8056  | 2.052143 | 8088  | 3.174137 | 8154  | 6.979714 | 8084  | 8.792892 |
| 8999  | 2.059914 | 9032  | 3.180451 | 9097  | 6.991857 | 9029  | 8.791435 |
| 10050 | 2.066229 | 10080 | 3.174622 | 10151 | 7.025857 | 10078 | 8.796292 |

TABLE A-  
10 DATA  
FOR  
FIGURE  
A-10

| 28kPa |          | 41kPa |          | 62kPa |          |
|-------|----------|-------|----------|-------|----------|
| N     | %        | N     | %        | N     | %        |
| 1     | 1.239057 | 1     | 3.798286 | 1     | 8.537363 |
| 6     | 1.562057 | 6     | 4.823629 | 6     | 9.463621 |
| 11    | 1.758286 | 11    | 5.243771 | 11    | 10.08971 |
| 49    | 2.480057 | 50    | 6.358    | 49    | 11.55122 |
| 97    | 2.845314 | 100   | 6.741714 | 103   | 12.12728 |
| 151   | 2.976943 | 150   | 6.889371 | 152   | 12.28028 |
| 201   | 3.0124   | 200   | 7.012257 | 204   | 12.43425 |
| 250   | 3.037657 | 248   | 7.081229 | 255   | 12.51682 |
| 299   | 3.065343 | 302   | 7.132714 | 309   | 12.57268 |
| 351   | 3.123143 | 360   | 7.160886 | 359   | 12.63631 |
| 403   | 3.139171 | 400   | 7.1842   | 402   | 12.64505 |
| 451   | 3.154714 | 453   | 7.2114   | 455   | 12.70528 |
| 503   | 3.166857 | 514   | 7.246857 | 502   | 12.73005 |
| 601   | 3.186286 | 613   | 7.274543 | 602   | 12.75288 |
| 705   | 3.215914 | 714   | 7.284743 | 705   | 12.79076 |
| 805   | 3.2504   | 813   | 7.31     | 804   | 12.82428 |
| 904   | 3.260114 | 912   | 7.326514 | 904   | 12.86119 |
| 1005  | 3.281486 | 1013  | 7.361971 | 1003  | 12.87819 |
| 1205  | 3.300429 | 1215  | 7.359057 | 1202  | 12.93065 |
| 1406  | 3.354829 | 1411  | 7.389171 | 1404  | 12.93842 |
| 1603  | 3.372314 | 1612  | 7.407629 | 1603  | 12.98651 |
| 1803  | 3.372314 | 1814  | 7.4392   | 1803  | 13.01662 |
| 2006  | 3.3796   | 2015  | 7.407143 | 2002  | 13.04771 |
| 2301  | 3.3932   | 2212  | 7.423657 | 2201  | 13.05208 |
| 2401  | 3.399029 | 2413  | 7.446    | 2401  | 13.08802 |
| 2600  | 3.403886 | 2614  | 7.461543 | 2605  | 13.12833 |
| 2800  | 3.419914 | 2811  | 7.471743 | 2805  | 13.13465 |
| 3003  | 3.419914 | 3012  | 7.412    | 3005  | 13.13999 |
| 3203  | 3.422829 | 3214  | 7.417829 | 3201  | 13.16913 |
| 3405  | 3.428657 | 3411  | 7.429971 | 3401  | 13.15068 |
| 3504  | 3.431086 | 3514  | 7.423171 | 3504  | 13.16573 |
| 3804  | 3.422829 | 3814  | 7.438714 | 3801  | 13.21236 |
| 4006  | 3.425257 | 4015  | 7.454257 | 4001  | 13.21673 |
| 4202  | 3.426229 | 4212  | 7.479029 | 4202  | 13.24831 |
| 4401  | 3.425743 | 4414  | 7.487286 | 4402  | 13.23859 |
| 4598  | 3.428657 | 4616  | 7.455714 | 4603  | 13.22839 |

|       |          |       |          |       |          |
|-------|----------|-------|----------|-------|----------|
| 4800  | 3.433514 | 4813  | 7.461057 | 4803  | 13.27793 |
| 5002  | 3.436429 | 5015  | 7.491657 | 5004  | 13.29736 |
| 6007  | 3.443229 | 6044  | 7.510114 | 6073  | 13.30562 |
| 6981  | 3.457314 | 7103  | 7.479514 | 7121  | 13.34156 |
| 7925  | 3.466057 | 8057  | 7.495543 | 8064  | 13.34253 |
| 8974  | 3.481114 | 9000  | 7.511571 | 9007  | 13.32116 |
| 10128 | 3.493743 | 10152 | 7.516914 | 10159 | 13.38625 |

TABLE A-11  
DATA  
FOR  
FIGURE  
A-11

| Density<br>98.05% |          | Density<br>95.46% |          | Density<br>93.54% |          |
|-------------------|----------|-------------------|----------|-------------------|----------|
| N                 | %        | N                 | %        | N                 | %        |
| 1                 | 0.794413 | 1                 | 1.249905 | 1                 | 1.277429 |
| 6                 | 1.144667 | 6                 | 1.390222 | 6                 | 1.41073  |
| 11                | 1.269333 | 11                | 1.500317 | 11                | 1.496    |
| 51                | 1.667079 | 49                | 1.783111 | 49                | 1.763143 |
| 107               | 1.845175 | 102               | 1.894825 | 101               | 1.90346  |
| 152               | 1.907778 | 155               | 1.95581  | 149               | 1.970381 |
| 204               | 1.969841 | 202               | 1.990133 | 201               | 2.027587 |
| 253               | 2.015175 | 250               | 2.025105 | 244               | 2.048635 |
| 303               | 2.045397 | 303               | 2.063962 | 301               | 2.084794 |
| 353               | 2.055651 | 351               | 2.098933 | 346               | 2.101524 |
| 410               | 2.076698 | 408               | 2.134488 | 400               | 2.145238 |
| 451               | 2.084254 | 449               | 2.136625 | 450               | 2.161429 |
| 504               | 2.119873 | 502               | 2.139053 | 503               | 2.181397 |
| 606               | 2.123651 | 604               | 2.153843 | 606               | 2.203524 |
| 704               | 2.148476 | 703               | 2.168633 | 705               | 2.212698 |
| 805               | 2.169524 | 803               | 2.183423 | 804               | 2.224571 |
| 906               | 2.182476 | 906               | 2.198213 | 904               | 2.245079 |
| 1003              | 2.194889 | 998               | 2.213003 | 1003              | 2.255333 |
| 1204              | 2.213778 | 1204              | 2.234083 | 1202              | 2.27746  |
| 1405              | 2.248857 | 1405              | 2.246663 | 1406              | 2.285556 |
| 1606              | 2.241302 | 1606              | 2.259243 | 1603              | 2.299048 |
| 1803              | 2.26181  | 1802              | 2.271823 | 1806              | 2.304444 |
| 2004              | 2.272603 | 2003              | 2.283189 | 2003              | 2.331429 |
| 2205              | 2.287714 | 2205              | 2.29334  | 2205              | 2.337905 |
| 2402              | 2.276921 | 2406              | 2.303492 | 2402              | 2.344381 |
| 2603              | 2.286635 | 2603              | 2.311215 | 2604              | 2.350857 |
| 2803              | 2.287175 | 2804              | 2.318938 | 2801              | 2.357333 |
| 3001              | 2.297429 | 3006              | 2.32666  | 3003              | 2.36381  |
| 3201              | 2.308222 | 3203              | 2.334383 | 3205              | 2.370286 |
| 3402              | 2.312    | 3405              | 2.342106 | 3402              | 2.376762 |
| 3603              | 2.29527  |                   |          | 3605              | 2.383238 |
| 3804              | 2.307683 |                   |          | 3802              | 2.389714 |
| 4006              | 2.310381 |                   |          | 4001              | 2.39619  |
| 4202              | 2.322794 |                   |          | 4205              | 2.402667 |

|      |          |
|------|----------|
| 4403 | 2.339524 |
| 4605 | 2.336825 |
| 4801 | 2.351937 |
| 5003 | 2.354635 |
| 6009 | 2.349778 |
| 7059 | 2.365429 |
| 8005 | 2.377302 |
| 9056 | 2.391333 |
| 9999 | 2.410222 |

|       |          |
|-------|----------|
| 4403  | 2.409143 |
| 4602  | 2.41454  |
| 4801  | 2.416159 |
| 4973  | 2.421556 |
| 6020  | 2.443143 |
| 7068  | 2.44908  |
| 8011  | 2.451778 |
| 9059  | 2.456095 |
| 10002 | 2.460413 |

TABLE A-  
12 DATA  
FOR  
FIGURE  
A-12

| No FT |          | One FT |          |
|-------|----------|--------|----------|
| N     | %        | N      | %        |
| 1     | 0.435686 | 1      | 0.958317 |
| 6     | 0.492029 | 6      | 1.049632 |
| 11    | 0.522143 | 11     | 1.107432 |
| 53    | 0.644057 | 46     | 1.262375 |
| 101   | 0.685343 | 99     | 1.352717 |
| 154   | 0.713029 | 152    | 1.384775 |
| 198   | 0.732943 | 201    | 1.412946 |
| 250   | 0.740714 | 255    | 1.437717 |
| 298   | 0.750429 | 308    | 1.44986  |
| 351   | 0.759657 | 351    | 1.463946 |
| 398   | 0.769371 | 401    | 1.476575 |
| 447   | 0.770343 | 451    | 1.484346 |
| 505   | 0.7718   | 502    | 1.491632 |
| 602   | 0.7854   | 600    | 1.503775 |
| 702   | 0.790257 | 703    | 1.524175 |
| 802   | 0.790743 | 803    | 1.519803 |
| 901   | 0.796571 | 907    | 1.51446  |
| 1002  | 0.8058   | 1003   | 1.526603 |
| 1205  | 0.808714 | 1202   | 1.529517 |
| 1405  | 0.818429 | 1402   | 1.560117 |
| 1605  | 0.825229 | 1602   | 1.553317 |
| 1801  | 0.826686 | 1801   | 1.561089 |
| 2001  | 0.8364   | 2001   | 1.574203 |
| 2202  | 0.838343 | 2201   | 1.569832 |
| 2405  | 0.840771 | 2405   | 1.58246  |
| 2603  | 0.844171 | 2605   | 1.584403 |
| 2801  | 0.8466   | 2805   | 1.584889 |
| 3004  | 0.847086 | 3005   | 1.601889 |
| 3202  | 0.849029 | 3205   | 1.58926  |
| 3405  | 0.851457 | 3405   | 1.597517 |
| 3603  | 0.853886 | 3600   | 1.603346 |
| 3801  | 0.860686 | 3801   | 1.606746 |
| 4004  | 0.859229 | 4001   | 1.606746 |
| 4203  | 0.865543 | 4201   | 1.60286  |

|       |          |       |          |
|-------|----------|-------|----------|
| 4406  | 0.867971 | 4402  | 1.624717 |
| 4604  | 0.870886 | 4605  | 1.628603 |
| 4803  | 0.869914 | 4801  | 1.62666  |
| 5002  | 0.8738   | 5001  | 1.629089 |
| 5956  | 0.879143 | 5957  | 1.639775 |
| 7025  | 0.882057 | 7007  | 1.662117 |
| 8074  | 0.888371 | 8057  | 1.671832 |
| 9017  | 0.895171 | 9002  | 1.673289 |
| 10065 | 0.908286 | 10050 | 1.667946 |

TABLE A-  
13 DATA  
FOR  
FIGURE  
A-13

| jump to 83<br>kPa |          | 28 kPa |          | 83 kPa |          |
|-------------------|----------|--------|----------|--------|----------|
| N                 | %        | N      | %        | N      | %        |
| 10799             | 0.909257 | 1      | 0.435686 | 1      | 4.573    |
| 10800             | 4.504622 | 6      | 0.492029 | 6      | 5.010629 |
| 10897             | 7.045448 | 11     | 0.522143 | 11     | 5.267571 |
| 10999             | 7.329321 | 53     | 0.644057 | 44     | 6.1268   |
| 11102             | 7.438876 | 101    | 0.685343 | 102    | 6.500314 |
| 11204             | 7.484749 | 149    | 0.714486 | 153    | 6.662543 |
| 11301             | 7.507416 | 198    | 0.732943 | 203    | 6.739771 |
| 11404             | 7.565702 | 244    | 0.741686 | 250    | 6.788829 |
| 11501             | 7.601321 | 294    | 0.748971 | 301    | 6.829629 |
| 11604             | 7.622908 | 345    | 0.755771 | 353    | 6.888886 |
| 11709             | 7.631543 | 392    | 0.770343 | 400    | 6.928229 |
| 11803             | 7.646654 | 447    | 0.770343 | 452    | 6.932114 |
| 11904             | 7.655289 | 505    | 0.7718   | 501    | 6.9394   |
| 11998             | 7.675257 | 602    | 0.7854   | 601    | 6.960771 |
| 12003             | 7.674717 | 702    | 0.790257 | 701    | 6.986514 |
| 12011             | 7.674178 | 802    | 0.790743 | 805    | 7.015657 |
| 12016             | 7.681194 | 901    | 0.796571 | 902    | 7.0448   |
| 12021             | 7.686051 | 1002   | 0.8058   | 1006   | 7.064714 |
| 12027             | 7.689829 | 1205   | 0.808714 | 1202   | 7.092886 |
| 12032             | 7.68659  | 1405   | 0.818429 | 1401   | 7.105029 |
| 12038             | 7.6704   | 1605   | 0.825229 | 1602   | 7.126886 |
| 12047             | 7.660146 | 1801   | 0.826686 | 1802   | 7.139514 |
| 12052             | 7.6704   | 2001   | 0.8364   | 2003   | 7.157    |
| 12058             | 7.663924 | 2202   | 0.838343 | 2203   | 7.179829 |
| 12064             | 7.666083 | 2405   | 0.840771 | 2401   | 7.185171 |
| 12070             | 7.661765 | 2603   | 0.844171 | 2604   | 7.193914 |
| 12077             | 7.674178 | 2801   | 0.8466   | 2805   | 7.206543 |
| 12084             | 7.676876 | 3004   | 0.847086 | 3002   | 7.212371 |
| 12091             | 7.68659  | 3202   | 0.849029 | 3203   | 7.2352   |
| 12098             | 7.699543 | 3405   | 0.851457 | 3403   | 7.245886 |
| 12123             | 7.695765 | 3603   | 0.853886 | 3604   | 7.233743 |
| 12128             | 7.697924 | 3801   | 0.860686 | 3805   | 7.251714 |

|       |          |       |          |
|-------|----------|-------|----------|
| 4004  | 0.859229 | 4002  | 7.243457 |
| 4203  | 0.865543 | 4204  | 7.257543 |
| 4406  | 0.867971 | 4405  | 7.259    |
| 4505  | 0.865543 | 4504  | 7.230829 |
| 4604  | 0.870886 | 4602  | 7.269686 |
| 4803  | 0.869914 | 4804  | 7.264829 |
| 5002  | 0.8738   | 5006  | 7.274543 |
| 6061  | 0.880114 | 6024  | 7.316314 |
| 7025  | 0.882057 | 6970  | 7.305629 |
| 8074  | 0.888371 | 8027  | 7.362457 |
| 9017  | 0.895171 | 8970  | 7.385771 |
| 10065 | 0.908286 | 10018 | 7.409086 |

TABLE A-14  
DATA FOR  
FIGURE A-14

| jump to 62<br>kPa |          | 41 kPa |          | 62 kPa |          |
|-------------------|----------|--------|----------|--------|----------|
| N                 | %        | N      | %        | N      | %        |
| 1                 | 0.229365 | 1      | 2.299587 | 1      | 5.479937 |
| 11                | 0.359968 | 10     | 3.954254 | 3      | 7.253333 |
| 51                | 0.512698 | 49     | 4.96346  | 6      | 7.604127 |
| 100               | 0.583397 | 96     | 5.176635 | 8      | 7.70181  |
| 148               | 0.616857 | 144    | 5.254889 | 11     | 7.781143 |
| 199               | 0.635746 | 194    | 5.308317 | 53     | 8.645175 |
| 249               | 0.647079 | 251    | 5.352032 | 99     | 9.018095 |
| 299               | 0.661651 | 300    | 5.364984 | 145    | 9.185937 |
| 400               | 0.682698 | 400    | 5.42381  | 194    | 9.320857 |
| 499               | 0.695651 | 500    | 5.455651 | 250    | 9.407206 |
| 599               | 0.705365 | 600    | 5.479397 | 302    | 9.443365 |
| 700               | 0.710222 | 699    | 5.506921 | 399    | 9.504889 |
| 798               | 0.719397 | 799    | 5.50854  | 500    | 9.552381 |
| 899               | 0.718857 | 899    | 5.531746 | 600    | 9.588    |
| 998               | 0.726952 | 999    | 5.546857 | 701    | 9.633333 |
| 1099              | 0.73127  | 1100   | 5.534444 | 801    | 9.641968 |
| 1200              | 0.728032 | 2000   | 5.613778 | 899    | 9.664095 |
| 1299              | 0.732889 | 3057   | 5.648317 | 1000   | 9.657619 |
| 1400              | 0.740984 | 3965   | 5.69473  | 1101   | 9.684603 |
| 1499              | 0.753937 | 4267   | 5.712    | 1201   | 9.715905 |
| 1601              | 0.750698 | 4569   | 5.736286 | 1300   | 9.68946  |
| 1700              | 0.754476 | 4872   | 5.714159 | 1400   | 9.719683 |
| 1801              | 0.758254 | 5174   | 5.740603 | 1501   | 9.763937 |
| 1898              | 0.76527  | 6988   | 5.78054  | 1600   | 9.763397 |
| 1998              | 0.766889 | 8802   | 5.693111 | 1701   | 9.755841 |
| 3100              | 0.786317 | 10314  | 5.709841 | 1799   | 9.766095 |
| 4007              | 0.792794 | 12733  | 5.802127 | 1900   | 9.763937 |
| 5217              | 0.810063 | 15152  | 5.805365 | 2002   | 9.756921 |
| 6124              | 0.821397 | 20292  | 5.870127 | 2300   | 9.770413 |
| 8241              | 0.839746 | 25130  | 5.818317 | 2566   | 9.759079 |
| 10358             | 1.253683 | 30874  | 5.764349 | 2868   | 9.82546  |

|       |          |       |          |      |          |
|-------|----------|-------|----------|------|----------|
| 10380 | 2.404286 | 31177 | 5.741683 | 3171 | 9.778508 |
| 10415 | 2.956921 | 31479 | 5.791873 | 3474 | 9.799556 |
| 10502 | 3.404318 | 31781 | 5.761111 | 3776 | 9.827619 |
| 20990 | 4.143683 | 32084 | 5.755175 | 4079 | 9.848127 |
| 21001 | 4.710349 | 32386 | 5.753556 | 4381 | 9.820603 |
| 21004 | 4.874413 | 32688 | 5.749238 | 4684 | 9.854603 |
| 21006 | 5.200381 | 32991 | 5.748698 | 4986 | 9.835175 |
| 21008 | 5.431905 | 33293 | 5.754095 | 5288 | 9.871333 |
| 21012 | 5.902508 | 33596 | 5.748698 | 6195 | 9.872413 |
| 21016 | 6.34073  | 33898 | 5.795111 | 6498 | 9.885905 |
| 21019 | 6.655365 |       |          | 6800 | 9.89346  |
| 21038 | 7.841587 |       |          | 7102 | 9.897238 |
| 21061 | 8.526444 |       |          | 7405 | 9.941492 |
| 21122 | 9.071524 |       |          | 7707 | 9.959302 |
| 21188 | 9.340286 |       |          | 8009 | 9.973333 |
| 23467 | 10.00302 |       |          | 8312 | 9.990063 |
| 25886 | 10.1687  |       |          |      |          |

TABLE A-15  
DATA FOR  
FIGURE A-15

| 41 kPa |          | 83 kPa |          | 124 kPa |          | 165 kPa |          | 207 kPa |          |
|--------|----------|--------|----------|---------|----------|---------|----------|---------|----------|
| N      | %        | N      | %        | N       | %        | N       | %        | N       | %        |
| 1      | 0.143683 | 1      | 0.845045 | 1       | 1.299552 | 1       | 2.557009 | 1       | 2.86842  |
| 6      | 0.214381 | 6      | 0.95266  | 6       | 1.367012 | 6       | 2.697326 | 6       | 3.522515 |
| 11     | 0.242444 | 12     | 1.004666 | 11      | 1.437171 | 11      | 2.807422 | 11      | 3.742705 |
| 49     | 0.33581  | 55     | 1.110736 | 49      | 1.639012 | 52      | 3.18358  | 49      | 4.412451 |
| 101    | 0.376286 | 110    | 1.217441 | 101     | 1.715108 | 105     | 3.323898 | 98      | 4.641277 |
| 149    | 0.393016 | 156    | 1.284387 | 151     | 1.76152  | 156     | 3.361675 | 146     | 4.75515  |
| 195    | 0.40273  | 206    | 1.337669 | 201     | 1.809012 | 205     | 3.426437 | 191     | 4.821531 |
| 250    | 0.416222 | 262    | 1.364114 | 260     | 1.850028 | 260     | 3.458818 | 242     | 4.87442  |
| 304    | 0.425937 | 314    | 1.38553  | 311     | 1.865139 | 315     | 3.501993 | 297     | 4.922451 |
| 351    | 0.433492 | 361    | 1.391466 | 361     | 1.875933 | 366     | 3.521422 | 340     | 4.965086 |
| 404    | 0.443746 | 413    | 1.402799 | 418     | 1.890504 | 425     | 3.536533 | 390     | 4.992071 |
| 449    | 0.448063 | 454    | 1.406577 | 454     | 1.889425 | 452     | 3.55812  | 451     | 5.040642 |
| 524    | 0.457238 | 500    | 1.416291 | 500     | 1.916949 | 503     | 3.655802 | 498     | 5.053594 |
| 617    | 0.465873 | 602    | 1.413593 | 603     | 1.930981 | 605     | 3.675771 | 602     | 5.102166 |
| 717    | 0.474508 | 705    | 1.438418 | 705     | 1.939076 | 705     | 3.668215 | 705     | 5.122134 |
| 817    | 0.478825 | 803    | 1.451371 | 803     | 1.94879  | 803     | 3.67685  | 803     | 5.170166 |
| 919    | 0.490698 | 901    | 1.468101 | 906     | 1.975774 | 905     | 3.69466  | 906     | 5.198229 |
| 1016   | 0.494476 | 1004   | 1.458387 | 1003    | 1.984949 | 1002    | 3.698437 | 1003    | 5.217658 |
| 1216   | 0.50527  | 1203   | 1.48412  | 1204    | 1.975774 | 1201    | 3.711929 | 1203    | 5.279721 |
| 1419   | 0.510667 | 1401   | 1.480882 | 1405    | 2.004917 | 1405    | 3.717866 | 1405    | 5.286198 |
| 1616   | 0.515524 | 1604   | 1.505168 | 1605    | 2.006536 | 1605    | 3.723802 | 1601    | 5.320737 |
| 1816   | 0.517683 | 1801   | 1.509485 | 1801    | 2.020568 | 1802    | 3.737295 | 1801    | 5.346642 |
| 2016   | 0.52254  | 2000   | 1.514342 | 2002    | 2.026504 | 2003    | 3.769675 | 2006    | 5.360134 |
| 2217   | 0.529556 | 2203   | 1.533771 | 2203    | 2.035679 | 2205    | 3.759961 | 2201    | 5.379023 |
| 2416   | 0.532794 | 2401   | 1.557517 | 2404    | 2.039996 | 2402    | 3.772374 | 2406    | 5.395753 |
| 2616   | 0.541429 | 2603   | 1.554818 | 2605    | 2.037838 | 2603    | 3.803675 | 2606    | 5.428674 |
| 2817   | 0.542508 | 2801   | 1.564901 | 2801    | 2.038377 | 2805    | 3.77939  | 2801    | 5.436229 |
| 3018   | 0.546286 | 3001   | 1.582171 | 3003    | 2.059425 | 3002    | 3.818787 | 3001    | 5.438928 |
| 3218   | 0.549524 | 3200   | 1.58325  | 3204    | 2.028663 | 3204    | 3.809612 | 3201    | 5.443785 |
| 3418   | 0.553841 | 3401   | 1.590266 | 3406    | 2.049711 | 3406    | 3.811231 | 3402    | 5.486959 |

|       |          |       |          |       |          |      |          |       |          |
|-------|----------|-------|----------|-------|----------|------|----------|-------|----------|
| 3618  | 0.556    | 3601  | 1.595123 | 3602  | 2.046473 | 3603 | 3.825802 | 3602  | 5.474547 |
| 3819  | 0.560317 | 3802  | 1.59944  | 3804  | 2.037298 | 3805 | 3.838215 | 3802  | 5.481563 |
| 4019  | 0.563016 | 4002  | 1.582171 | 4001  | 2.040536 | 4002 | 3.84739  | 4003  | 5.515563 |
| 4215  | 0.564635 | 4204  | 1.602679 | 4205  | 2.05079  | 4204 | 3.852787 | 4204  | 5.520959 |
| 4415  | 0.570032 | 4404  | 1.609155 | 4402  | 2.060504 | 4401 | 3.859802 | 4404  | 5.554959 |
| 4616  | 0.57219  | 4600  | 1.618329 | 4604  | 2.045393 | 4603 | 3.874914 | 4605  | 5.556039 |
| 4817  | 0.575968 | 4804  | 1.615631 | 4802  | 2.073457 | 4806 | 3.885707 | 4806  | 5.563055 |
| 5018  | 0.578127 | 5003  | 1.618869 | 5004  | 2.070758 | 4964 | 3.894342 | 5002  | 5.567912 |
| 5973  | 0.592159 | 6051  | 1.628044 | 6007  | 2.086949 | 6013 | 3.891644 | 5982  | 5.590578 |
| 7023  | 0.598635 | 7099  | 1.640456 | 7059  | 2.11879  | 7062 | 3.952628 | 7032  | 5.668293 |
| 7969  | 0.609429 | 8043  | 1.661504 | 8006  | 2.129584 | 8007 | 3.951009 | 7978  | 5.703912 |
| 9019  | 0.616444 | 9091  | 1.650171 | 9058  | 2.164123 | 9057 | 3.980152 | 9028  | 5.760039 |
| 9859  | 0.622381 | 9929  | 1.66798  | 9900  | 2.161965 | 9896 | 3.994183 | 9868  | 5.736293 |
| 9964  | 0.622921 | 10034 | 1.665821 | 10005 | 2.158727 |      |          | 9973  | 5.70715  |
| 10069 | 0.624    | 10139 | 1.635599 | 10110 | 2.175996 |      |          | 10079 | 5.726578 |

TABLE A-16  
DATA FOR  
FIGURE A-16

| 41 kPa |          | 83 kPa |          | 124 kPa |          | 165 kPa |          |
|--------|----------|--------|----------|---------|----------|---------|----------|
| N      | %        | N      | %        | N       | %        | N       | %        |
| 1      | 0.59591  | 1      | 0.820854 | 1       | 1.844016 | 1       | 2.658473 |
| 6      | 0.65125  | 6      | 0.959092 | 6       | 2.108642 | 6       | 3.017901 |
| 11     | 0.682281 | 11     | 1.023371 | 11      | 2.29262  | 11      | 3.351965 |
| 52     | 0.75624  | 49     | 1.209602 | 49      | 2.758841 | 49      | 4.071362 |
| 107    | 0.774859 | 100    | 1.286056 | 99      | 3.018641 | 102     | 4.393695 |
| 151    | 0.800202 | 146    | 1.316912 | 145     | 3.116617 | 156     | 4.48878  |
| 202    | 0.822959 | 201    | 1.388567 | 205     | 3.188233 | 215     | 4.60944  |
| 248    | 0.818821 | 249    | 1.362471 | 256     | 3.203472 | 268     | 4.635765 |
| 299    | 0.83382  | 303    | 1.383808 | 290     | 3.242479 | 304     | 4.667406 |
| 350    | 0.841578 | 356    | 1.404687 | 356     | 3.261429 | 348     | 4.707092 |
| 391    | 0.85968  | 398    | 1.411084 | 404     | 3.320568 | 395     | 4.740879 |
| 447    | 0.867437 | 456    | 1.462093 | 456     | 3.356391 | 454     | 4.780029 |
| 503    | 0.867955 | 504    | 1.470839 | 504     | 3.405545 | 505     | 4.798263 |
| 601    | 0.874678 | 602    | 1.455506 | 602     | 3.411455 | 604     | 4.797786 |
| 703    | 0.880885 | 701    | 1.503151 | 704     | 3.416457 | 703     | 4.791435 |
| 805    | 0.876747 | 801    | 1.489026 | 802     | 3.421747 | 803     | 4.849125 |
| 902    | 0.893297 | 903    | 1.509986 | 904     | 3.427036 | 904     | 4.867649 |
| 1004   | 0.898469 | 1004   | 1.500355 | 1001    | 3.432326 | 1004    | 4.882998 |
| 1204   | 0.895883 | 1204   | 1.520841 | 1201    | 3.442905 | 1205    | 4.914224 |
| 1405   | 0.896918 | 1405   | 1.533892 | 1401    | 3.453484 | 1401    | 4.961858 |
| 1604   | 0.922777 | 1605   | 1.54056  | 1601    | 3.510215 | 1601    | 4.98197  |
| 1804   | 0.925881 | 1801   | 1.583415 | 1806    | 3.530636 | 1804    | 5.014785 |
| 2004   | 0.924329 | 2002   | 1.572853 | 2004    | 3.55799  | 2003    | 5.01849  |
| 2204   | 0.927432 | 2203   | 1.558607 | 2201    | 3.580419 | 2202    | 5.021136 |
| 2404   | 0.93519  | 2404   | 1.598998 | 2403    | 3.584935 | 2406    | 5.048129 |
| 2604   | 0.941396 | 2605   | 1.633159 | 2605    | 3.589451 | 2604    | 5.03278  |
| 2804   | 0.948637 | 2801   | 1.625335 | 2802    | 3.593967 | 2804    | 5.045482 |
| 3004   | 0.956912 | 3002   | 1.615089 | 3004    | 3.604106 | 3003    | 5.067711 |
| 3204   | 0.957947 | 3204   | 1.600752 | 3202    | 3.609938 | 3203    | 5.107406 |

|       |          |      |          |       |          |       |          |
|-------|----------|------|----------|-------|----------|-------|----------|
| 3403  | 0.962084 | 3405 | 1.63291  | 3404  | 3.61421  | 3402  | 5.086964 |
| 3601  | 0.971911 | 3602 | 1.60756  | 3601  | 3.622902 | 3601  | 5.10591  |
| 3804  | 0.975014 | 3804 | 1.619201 | 3804  | 3.643697 | 3806  | 5.119066 |
| 4003  | 0.996122 | 4005 | 1.640229 | 4002  | 3.664493 | 4005  | 5.065792 |
| 4202  | 1.015259 | 4202 | 1.636239 | 4205  | 3.668024 | 4205  | 5.099657 |
| 4405  | 1.011638 | 4404 | 1.649499 | 4402  | 3.676853 | 4405  | 5.09601  |
| 4803  | 1.017327 | 4804 | 1.662293 | 4803  | 3.683465 | 4804  | 5.123103 |
| 4997  | 1.022499 | 5001 | 1.642896 | 5006  | 3.688418 | 5004  | 5.133523 |
| 6151  | 1.048359 | 5993 | 1.658036 | 6024  | 3.697919 | 6035  | 5.111745 |
| 6990  | 1.066461 | 7045 | 1.662212 | 7074  | 3.705915 | 7086  | 5.148083 |
| 8038  | 1.089735 | 7993 | 1.669209 | 8018  | 3.730245 | 8033  | 5.201033 |
| 9087  | 1.115595 | 9045 | 1.664753 | 9069  | 3.761704 | 9084  | 5.236333 |
| 10030 | 1.138868 | 9992 | 1.727296 | 10014 | 3.778371 | 10030 | 5.214428 |

TABLE A-  
17 DATA  
FOR  
FIGURE  
A-17

| 41 kPa |          | 83 kPa |          | 124 kPa |          |
|--------|----------|--------|----------|---------|----------|
| N      | %        | N      | %        | N       | %        |
| 1      | 0.531507 | 1      | 2.72     | 1       | 6.34558  |
| 6      | 0.600046 | 6      | 3.306635 | 6       | 6.845326 |
| 11     | 0.636745 | 11     | 3.628825 | 11      | 7.157802 |
| 51     | 0.755475 | 49     | 4.893841 | 50      | 8.145422 |
| 101    | 0.816999 | 91     | 5.306159 | 93      | 8.459517 |
| 155    | 0.859094 | 148    | 5.588952 | 150     | 8.731517 |
| 207    | 0.879602 | 202    | 5.71146  | 195     | 8.822183 |
| 251    | 0.896332 | 248    | 5.770286 | 252     | 8.939834 |
| 300    | 0.908205 | 294    | 5.823714 | 301     | 8.947929 |
| 354    | 0.921697 | 347    | 5.871206 | 356     | 9.062882 |
| 404    | 0.93303  | 397    | 5.892794 | 409     | 9.128183 |
| 458    | 0.941665 | 445    | 5.918698 | 459     | 9.169199 |
| 500    | 0.9503   | 486    | 5.948921 | 504     | 9.176215 |
| 603    | 0.96757  | 603    | 6.025556 | 604     | 9.199961 |
| 703    | 0.976745 | 705    | 6.058476 | 702     | 9.229104 |
| 801    | 0.985919 | 803    | 6.078984 | 800     | 9.256088 |
| 904    | 0.995634 | 901    | 6.10219  | 903     | 9.264723 |
| 1002   | 1.003189 | 1004   | 6.124857 | 1001    | 9.281993 |
| 1204   | 1.01884  | 1204   | 6.172349 | 1200    | 9.314374 |
| 1405   | 1.032332 | 1404   | 6.20581  | 1404    | 9.356469 |
| 1601   | 1.041507 | 1605   | 6.228476 | 1604    | 9.350533 |
| 1802   | 1.053919 | 1805   | 6.23873  | 1800    | 9.398025 |
| 2004   | 1.062015 | 2001   | 6.251683 | 2000    | 9.433644 |
| 2200   | 1.067411 | 2202   | 6.286222 | 2200    | 9.442279 |
| 2402   | 1.075507 | 2402   | 6.304571 | 2401    | 9.476818 |
| 2604   | 1.079824 | 2603   | 6.319683 | 2601    | 9.451993 |

|       |          |       |          |       |          |
|-------|----------|-------|----------|-------|----------|
| 2801  | 1.0863   | 2804  | 6.332635 | 2802  | 9.437422 |
| 3003  | 1.089538 | 3005  | 6.343968 | 3003  | 9.45631  |
| 3201  | 1.096554 | 3202  | 6.346667 | 3203  | 9.47412  |
| 3403  | 1.098713 | 3403  | 6.367714 | 3405  | 9.466025 |
| 3601  | 1.107348 | 3604  | 6.37527  | 3601  | 9.509739 |
| 3803  | 1.110046 | 3801  | 6.39146  | 3801  | 9.513517 |
| 4001  | 1.113824 | 4003  | 6.396317 | 4000  | 9.555612 |
| 4203  | 1.116523 | 4205  | 6.405492 | 4200  | 9.586914 |
| 4401  | 1.118681 | 4402  | 6.417365 | 4402  | 9.550215 |
| 4604  | 1.125697 | 4604  | 6.42546  | 4601  | 9.574501 |
| 4802  | 1.128396 | 4801  | 6.434635 | 4801  | 9.602564 |
| 5005  | 1.133253 | 5003  | 6.440032 | 4971  | 9.607422 |
| 5924  | 1.146205 | 6000  | 6.497238 | 6033  | 9.620914 |
| 6976  | 1.162396 | 7052  | 6.503714 | 7080  | 9.579898 |
| 7923  | 1.169951 | 7999  | 6.518825 | 8023  | 9.62631  |
| 8975  | 1.181824 | 9051  | 6.542032 | 9071  | 9.677041 |
| 9922  | 1.190999 | 10000 | 6.554444 | 10015 | 9.731009 |
| 10027 | 1.189919 | 10105 | 6.560381 | 10224 | 9.736406 |

TABLE A-  
18 DATA  
FOR  
FIGURE  
A-18

| Density<br>N | 97.84%<br>% | Density<br>N | 93.51%<br>% | Density<br>N | 91.84%<br>% |
|--------------|-------------|--------------|-------------|--------------|-------------|
| 1            | 1.106892    | 1            | 1.042123    | 1            | 1.132801    |
| 6            | 1.203496    | 6            | 1.14952     | 6            | 1.360547    |
| 11           | 1.245051    | 11           | 1.194314    | 11           | 1.455531    |
| 49           | 1.440416    | 55           | 1.43879     | 47           | 1.708102    |
| 104          | 1.558607    | 105          | 1.551044    | 102          | 1.801467    |
| 149          | 1.617972    | 154          | 1.616885    | 151          | 1.875404    |
| 198          | 1.644416    | 201          | 1.65952     | 199          | 1.885118    |
| 254          | 1.694067    | 254          | 1.696219    | 252          | 1.907245    |
| 304          | 1.717273    | 307          | 1.726441    | 302          | 1.927753    |
| 353          | 1.741019    | 360          | 1.745869    | 357          | 1.939626    |
| 402          | 1.763686    | 406          | 1.763139    | 406          | 1.94934     |
| 452          | 1.77448     | 458          | 1.782568    | 452          | 1.94988     |
| 501          | 1.789051    | 505          | 1.799838    | 504          | 1.959594    |
| 605          | 1.800924    | 604          | 1.829759    | 601          | 1.98442     |
| 702          | 1.823051    | 702          | 1.857542    | 704          | 2.008705    |
| 807          | 1.829527    | 804          | 1.883189    | 801          | 1.988198    |
| 903          | 1.838162    | 900          | 1.906698    | 904          | 2.029213    |
| 1001         | 1.865146    | 1005         | 1.930207    | 1002         | 2.038928    |
| 1202         | 1.887813    | 1205         | 1.975088    | 1202         | 2.061594    |
| 1406         | 1.90994     | 1406         | 2.005543    | 1405         | 2.070769    |
| 1603         | 1.918035    | 1606         | 2.016792    | 1601         | 2.083182    |
| 1802         | 1.937464    | 1803         | 2.023806    | 1803         | 2.090737    |
| 2000         | 1.948257    | 2002         | 2.033521    | 2003         | 2.104229    |
| 2204         | 1.935305    | 2207         | 2.039395    | 2202         | 2.109086    |
| 2402         | 1.974702    | 2405         | 2.04527     | 2401         | 2.140388    |
| 2601         | 1.968226    | 2605         | 2.053994    | 2600         | 2.142007    |

|       |          |       |          |       |          |
|-------|----------|-------|----------|-------|----------|
| 2804  | 1.982797 | 2801  | 2.059287 | 2803  | 2.154959 |
| 3003  | 2.003845 | 3005  | 2.067493 | 3002  | 2.158198 |
| 3201  | 1.988194 | 3205  | 2.073316 | 3201  | 2.165213 |
| 3405  | 2.004384 | 3402  | 2.079139 | 3400  | 2.172229 |
| 3603  | 2.004384 | 3601  | 2.084962 | 3604  | 2.171115 |
| 3802  | 2.002226 | 3803  | 2.090786 | 3803  | 2.180325 |
| 4001  | 2.009781 | 4003  | 2.096609 | 4003  | 2.140928 |
| 4201  | 2.02921  | 4202  | 2.102432 | 4202  | 2.157118 |
| 4401  | 2.030829 | 4402  | 2.108255 | 4402  | 2.166293 |
| 4605  | 2.032988 | 4602  | 2.112225 | 4602  | 2.178705 |
| 4804  | 2.034607 | 4801  | 2.114343 | 4801  | 2.177626 |
| 5004  | 2.052416 | 5001  | 2.11646  | 5001  | 2.163594 |
| 6058  | 2.050797 | 6069  | 2.135518 | 6041  | 2.197055 |
| 7003  | 2.072384 | 7013  | 2.142929 | 6986  | 2.218642 |
| 8053  | 2.087496 | 8062  | 2.172575 | 8036  | 2.219721 |
| 9103  | 2.09721  | 9110  | 2.182103 | 9086  | 2.215404 |
| 10048 | 2.084797 | 10054 | 2.197455 | 10031 | 2.245086 |
| 10993 | 2.093972 | 10159 | 2.194809 | 15072 | 2.256959 |
| 12043 | 2.110702 | 10264 | 2.200632 | 20007 | 2.268293 |

TABLE A-  
19 DATA  
FOR  
FIGURE  
A-19

| One FT |          | No FT |          |
|--------|----------|-------|----------|
| N      | %        | N     | %        |
| 1      | 1.217531 | 1     | 0.845045 |
| 6      | 1.277436 | 6     | 0.95266  |
| 11     | 1.347594 | 12    | 1.004666 |
| 49     | 1.649817 | 55    | 1.110736 |
| 101    | 1.827912 | 105   | 1.201422 |
| 148    | 1.905086 | 151   | 1.281689 |
| 195    | 1.939086 | 199   | 1.320203 |
| 248    | 1.973086 | 249   | 1.362495 |
| 301    | 2.010864 | 304   | 1.38445  |
| 347    | 2.044864 | 351   | 1.395783 |
| 352    | 2.048642 | 356   | 1.396323 |
| 398    | 2.082642 | 403   | 1.397942 |
| 450    | 2.113575 | 454   | 1.406577 |
| 503    | 2.141575 | 500   | 1.416291 |
| 615    | 2.155575 | 602   | 1.413593 |
| 703    | 2.169575 | 705   | 1.438418 |
| 806    | 2.183575 | 803   | 1.451371 |
| 905    | 2.197575 | 901   | 1.468101 |
| 1004   | 2.208775 | 1004  | 1.458387 |
| 1202   | 2.231175 | 1203  | 1.48412  |
| 1401   | 2.242375 | 1401  | 1.480882 |
| 1604   | 2.253575 | 1604  | 1.505168 |
| 1803   | 2.261975 | 1801  | 1.509485 |
| 2001   | 2.267575 | 2000  | 1.514342 |
| 2203   | 2.273175 | 2203  | 1.533771 |
| 2401   | 2.285293 | 2401  | 1.557517 |

|      |          |       |          |
|------|----------|-------|----------|
| 2599 | 2.298515 | 2603  | 1.554818 |
| 2798 | 2.309309 | 2801  | 1.564901 |
| 2996 | 2.312007 | 3001  | 1.582171 |
| 3194 | 2.316864 | 3200  | 1.58325  |
| 3393 | 2.32442  | 3401  | 1.590266 |
| 3591 | 2.331975 | 3601  | 1.595123 |
| 3988 | 2.343353 | 4002  | 1.582171 |
| 4186 | 2.346753 | 4204  | 1.602679 |
| 4384 | 2.349153 | 4404  | 1.609155 |
| 4582 | 2.351553 | 4600  | 1.618329 |
| 4781 | 2.351953 | 4804  | 1.615631 |
| 4979 | 2.352353 | 5003  | 1.618869 |
| 5078 | 2.352553 | 5107  | 1.613472 |
| 5971 | 2.354353 | 6051  | 1.628044 |
| 6962 | 2.368277 | 7099  | 1.640456 |
| 8053 | 2.373531 | 8043  | 1.661504 |
| 9044 | 2.380547 | 9091  | 1.650171 |
| 9937 | 2.385404 | 10034 | 1.665821 |

TABLE A-  
20 DATA  
FOR  
FIGURE  
A-20

| jump to 83<br>kPa |          | 28 kPa |          | 83 kPa |          |
|-------------------|----------|--------|----------|--------|----------|
| N                 | %        | N      | %        | N      | %        |
| 10465             | 0.402603 | 1      | 0.142476 | 1      | 0.820854 |
| 10466             | 0.593104 | 6      | 0.165683 | 6      | 0.959092 |
| 10471             | 0.674056 | 11     | 0.180254 | 11     | 1.023371 |
| 10512             | 0.900723 | 51     | 0.22073  | 49     | 1.209602 |
| 10560             | 0.978977 | 101    | 0.250413 | 100    | 1.286056 |
| 10609             | 1.02485  | 147    | 0.261746 | 151    | 1.313077 |
| 10661             | 1.062088 | 193    | 0.261206 | 201    | 1.388567 |
| 10716             | 1.080977 | 247    | 0.273079 | 254    | 1.373019 |
| 10761             | 1.112279 | 293    | 0.276317 | 303    | 1.383808 |
| 10809             | 1.113898 | 340    | 0.269302 | 351    | 1.436948 |
| 10865             | 1.14466  | 397    | 0.279556 | 408    | 1.430652 |
| 10912             | 1.153295 | 443    | 0.282794 | 456    | 1.462093 |
| 10957             | 1.171104 | 501    | 0.290349 | 504    | 1.470839 |
| 10962             | 1.168945 | 600    | 0.290349 | 602    | 1.455506 |
| 10967             | 1.167326 | 704    | 0.297365 | 701    | 1.503151 |
| 10973             | 1.172723 | 804    | 0.290889 | 801    | 1.489026 |
| 10978             | 1.173802 | 900    | 0.299524 | 903    | 1.509986 |
| 10983             | 1.172723 | 1004   | 0.294667 | 1004   | 1.500355 |
| 10993             | 1.175961 | 1202   | 0.302762 | 1204   | 1.520841 |
| 11004             | 1.187295 | 1401   | 0.309238 | 1405   | 1.533892 |
| 11014             | 1.182437 | 1603   | 0.319492 | 1605   | 1.54056  |
| 11024             | 1.183517 | 1902   | 0.327048 | 1904   | 1.56347  |
| 11034             | 1.182437 | 2100   | 0.325429 | 2105   | 1.562215 |

|       |          |      |          |       |          |
|-------|----------|------|----------|-------|----------|
| 11045 | 1.184056 | 2403 | 0.32381  | 2301  | 1.586928 |
| 11055 | 1.189453 | 2804 | 0.32273  | 2502  | 1.591328 |
| 11065 | 1.185675 | 3001 | 0.329746 | 2904  | 1.626137 |
| 11076 | 1.188374 | 3203 | 0.33946  | 3106  | 1.628716 |
| 11086 | 1.187834 | 3404 | 0.335143 | 3302  | 1.611983 |
| 11096 | 1.188914 | 3601 | 0.330286 | 3503  | 1.609123 |
| 11106 | 1.191612 | 3803 | 0.330825 | 3705  | 1.620264 |
| 11320 | 1.21158  | 4000 | 0.341079 | 3902  | 1.619381 |
| 11392 | 1.215898 | 4200 | 0.334603 | 4301  | 1.621666 |
| 11474 | 1.254215 | 4400 | 0.343238 | 4503  | 1.63769  |
| 11555 | 1.260691 | 4503 | 0.347556 | 4705  | 1.63648  |
| 11559 | 1.261231 | 4903 | 0.345397 | 4902  | 1.641032 |
| 11564 | 1.260691 | 5013 | 0.349175 | 5001  | 1.642896 |
| 11569 | 1.257993 | 5747 | 0.35619  | 6098  | 1.655277 |
| 11576 | 1.260152 | 6376 | 0.35619  | 7571  | 1.654361 |
| 11581 | 1.259072 | 7214 | 0.369143 | 8729  | 1.659899 |
| 11586 | 1.252056 | 7949 | 0.385873 | 9571  | 1.679465 |
|       |          | 9101 | 0.399365 | 10413 | 1.679121 |
|       |          | 9206 | 0.39181  | 10518 | 1.690279 |

TABLE A-  
21 DATA  
FOR  
FIGURE  
A-21

| 28 kPa |          | jump to 83<br>kPa |          | 83 kPa |          |
|--------|----------|-------------------|----------|--------|----------|
| N      | %        | N                 | %        | N      | %        |
| 1      | 0.154896 | 10364             | 0.593118 | 1      | 2.72     |
| 6      | 0.195912 | 10365             | 1.769093 | 6      | 3.306635 |
| 11     | 0.226674 | 10369             | 2.007093 | 11     | 3.628825 |
| 50     | 0.308705 | 10413             | 3.040586 | 49     | 4.893841 |
| 101    | 0.340547 | 10466             | 3.554903 | 106    | 5.412476 |
| 150    | 0.355118 | 10518             | 3.74649  | 161    | 5.615937 |
| 192    | 0.372388 | 10560             | 3.825824 | 207    | 5.724413 |
| 252    | 0.383182 | 10601             | 3.891125 | 253    | 5.781079 |
| 257    | 0.38588  | 10606             | 3.887347 | 258    | 5.787556 |
| 302    | 0.383721 | 10652             | 3.942935 | 304    | 5.83019  |
| 347    | 0.396134 | 10697             | 3.966141 | 352    | 5.878762 |
| 397    | 0.404229 | 10749             | 4.012014 | 402    | 5.89819  |
| 452    | 0.409086 | 10820             | 4.055728 | 459    | 5.921397 |
| 496    | 0.417721 | 10938             | 4.105919 | 505    | 5.969968 |
| 628    | 0.429055 | 10944             | 4.112935 | 603    | 6.025556 |
| 728    | 0.432293 | 10949             | 4.116713 | 705    | 6.058476 |
| 827    | 0.436071 | 10959             | 4.110236 | 803    | 6.078984 |
| 927    | 0.446864 | 10964             | 4.115093 | 901    | 6.10219  |
| 1027   | 0.451182 | 10969             | 4.122649 | 1004   | 6.124857 |
| 1226   | 0.461436 | 10980             | 4.135601 | 1204   | 6.172349 |
| 1423   | 0.468991 | 10990             | 4.140998 | 1404   | 6.20581  |
| 1628   | 0.475467 | 11000             | 4.152871 | 1605   | 6.228476 |

|       |          |       |          |       |          |
|-------|----------|-------|----------|-------|----------|
| 1824  | 0.477086 | 11010 | 4.156649 | 1805  | 6.23873  |
| 2024  | 0.484102 | 11072 | 4.174998 | 2001  | 6.251683 |
| 2224  | 0.48842  | 11082 | 4.182554 | 2202  | 6.286222 |
| 2426  | 0.491118 | 11093 | 4.185792 | 2402  | 6.304571 |
| 2626  | 0.496515 | 11209 | 4.196046 | 2603  | 6.319683 |
| 2824  | 0.500293 | 11219 | 4.191189 | 2804  | 6.332635 |
| 3025  | 0.512166 | 11230 | 4.204681 | 3005  | 6.343968 |
| 3225  | 0.504071 | 11240 | 4.219252 | 3202  | 6.346667 |
| 3426  | 0.507309 | 11250 | 4.22303  | 3403  | 6.367714 |
| 3626  | 0.516483 | 11260 | 4.219252 | 3604  | 6.37527  |
| 3827  | 0.517023 | 11271 | 4.221411 | 3801  | 6.39146  |
| 4027  | 0.522959 | 11281 | 4.20522  | 4003  | 6.396317 |
| 4228  | 0.516483 | 11291 | 4.214935 | 4205  | 6.405492 |
| 4428  | 0.529436 | 11301 | 4.217093 | 4402  | 6.417365 |
| 4624  | 0.534293 | 11312 | 4.214395 | 4604  | 6.42546  |
| 4825  | 0.534832 | 11322 | 4.212776 | 4801  | 6.434635 |
| 5018  | 0.540769 | 11332 | 4.22249  | 5003  | 6.440032 |
| 6067  | 0.557499 | 11384 | 4.22357  | 6000  | 6.497238 |
| 7010  | 0.553182 | 11465 | 4.232205 | 6947  | 6.486444 |
| 8058  | 0.566134 |       |          | 7999  | 6.518825 |
| 9001  | 0.57315  |       |          | 8946  | 6.54581  |
| 10154 | 0.591499 |       |          | 10000 | 6.554444 |
| 10259 | 0.592578 |       |          | 10105 | 6.560381 |
| 10364 | 0.593118 |       |          |       |          |

TABLE  
A-22  
DATA  
FOR  
FIGURE  
A-22

| 41 kPa |          | 83 kPa |          | 124 kPa |          | 165 kPa |          | 207 kPa |          |
|--------|----------|--------|----------|---------|----------|---------|----------|---------|----------|
| N      | %        | N      | %        | N       | %        | N       | %        | N       | %        |
| 1      | 0.593111 | 1      | 2.422099 | 1       | 5.21981  | 1       | 5.999651 | 1       | 6.814039 |
| 6      | 0.681079 | 6      | 2.57375  | 6       | 5.483714 | 6       | 6.571714 | 6       | 7.084959 |
| 11     | 0.723714 | 11     | 2.632035 | 11      | 5.60946  | 11      | 6.811333 | 11      | 7.307309 |
| 49     | 0.828413 | 51     | 2.829019 | 50      | 5.923556 | 56      | 7.408222 | 52      | 7.982991 |
| 94     | 0.860794 | 101    | 2.902416 | 105     | 6.037429 | 107     | 7.602508 | 106     | 8.22261  |
| 151    | 0.881841 | 160    | 2.951527 | 160     | 6.090857 | 165     | 7.711524 | 162     | 8.333245 |
| 200    | 0.892635 | 210    | 2.974194 | 212     | 6.135111 | 218     | 7.76981  | 218     | 8.396928 |
| 250    | 0.906127 | 246    | 2.986607 | 246     | 6.151302 | 251     | 7.798952 | 255     | 8.436864 |
| 298    | 0.912063 | 298    | 2.999019 | 297     | 6.163714 | 303     | 7.825937 | 306     | 8.483817 |
| 350    | 0.916921 | 352    | 3.006035 | 348     | 6.174508 | 357     | 7.854    | 355     | 8.489213 |
| 400    | 0.921238 | 406    | 3.024924 | 401     | 6.190698 | 409     | 7.868571 | 408     | 8.526451 |
| 443    | 0.922857 | 453    | 3.0314   | 448     | 6.202571 | 457     | 7.898794 | 454     | 8.553436 |
| 506    | 0.928254 | 503    | 3.041115 | 505     | 6.217143 | 506     | 7.920921 | 502     | 8.56261  |
| 606    | 0.931492 | 603    | 3.043273 | 601     | 6.219841 | 603     | 7.932254 | 603     | 8.587975 |
| 708    | 0.936349 | 703    | 3.064861 | 706     | 6.237111 | 704     | 7.942508 | 706     | 8.612801 |
| 802    | 0.939048 | 802    | 3.063242 | 804     | 6.245206 | 802     | 7.954381 | 803     | 8.603626 |
| 901    | 0.942825 | 902    | 3.056765 | 901     | 6.252762 | 902     | 7.949524 | 902     | 8.633848 |
| 1000   | 0.945524 | 1006   | 3.071337 | 1004    | 6.263556 | 1005    | 7.946286 | 1004    | 8.655975 |
| 1204   | 0.949841 | 1202   | 3.067559 | 1205    | 6.271111 | 1206    | 7.977048 | 1205    | 8.662451 |
| 1403   | 0.954159 | 1405   | 3.074035 | 1403    | 6.269492 | 1402    | 7.987302 | 1404    | 8.707245 |
| 1601   | 0.959556 | 1604   | 3.08375  | 1604    | 6.286762 | 1607    | 8.004032 | 1604    | 8.679721 |

|       |          |       |          |       |          |       |          |       |          |
|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|
| 1800  | 0.962254 | 1805  | 3.095083 | 1805  | 6.362857 | 1804  | 7.988921 | 1803  | 8.721277 |
| 2003  | 0.963873 | 2005  | 3.106416 | 2003  | 6.373111 | 2005  | 8.016444 | 2006  | 8.721277 |
| 2202  | 0.96819  | 2205  | 3.112892 | 2204  | 6.371492 | 2202  | 8.018603 | 2206  | 8.731531 |
| 2401  | 0.96927  | 2401  | 3.122607 | 2401  | 6.373111 | 2402  | 8.029937 | 2406  | 8.745023 |
| 2600  | 0.973048 | 2605  | 3.112892 | 2603  | 6.377429 | 2605  | 8.036952 | 2608  | 8.74934  |
| 2804  | 0.974127 | 2802  | 3.128543 | 2803  | 6.384444 | 2802  | 8.034794 | 2806  | 8.758515 |
| 3003  | 0.975206 | 3003  | 3.136638 | 3001  | 6.39254  | 3004  | 8.045048 | 3006  | 8.762832 |
| 3202  | 0.979524 | 3204  | 3.137178 | 3204  | 6.392    | 3206  | 8.032635 | 3204  | 8.752578 |
| 3401  | 0.980603 | 3405  | 3.142035 | 3401  | 6.404413 | 3405  | 8.04127  | 3401  | 8.78388  |
| 3600  | 0.982762 | 3601  | 3.131781 | 3605  | 6.399556 | 3603  | 8.04019  | 3604  | 8.760134 |
| 3801  | 0.982222 | 3802  | 3.135019 | 3803  | 6.397397 | 3802  | 8.048825 | 3805  | 8.791436 |
| 4004  | 0.984381 | 4004  | 3.13394  | 4002  | 6.398476 | 4003  | 8.056381 | 4005  | 8.798991 |
| 4205  | 0.98654  | 4205  | 3.130162 | 4205  | 6.406032 | 4202  | 8.04127  | 4201  | 8.802769 |
| 4404  | 0.986    | 4402  | 3.155527 | 4404  | 6.417905 | 4401  | 8.076349 | 4402  | 8.797912 |
| 4603  | 0.989778 | 4603  | 3.140416 | 4602  | 6.430857 | 4605  | 8.056921 | 4602  | 8.81842  |
| 4802  | 0.989778 | 4804  | 3.142575 | 4804  | 6.431397 | 4804  | 8.055302 | 4803  | 8.821658 |
| 5002  | 0.988698 | 5001  | 3.149051 | 5003  | 6.431397 | 5003  | 8.060159 | 5004  | 8.790356 |
| 6012  | 0.997873 | 6007  | 3.149591 | 6020  | 6.439492 | 6031  | 8.087143 | 5973  | 8.847023 |
| 7063  | 0.998952 | 7057  | 3.147972 | 7071  | 6.433016 | 7080  | 8.101175 | 7020  | 8.884261 |
| 8006  | 1.004889 | 8001  | 3.212194 | 8013  | 6.465397 | 8023  | 8.066635 | 7963  | 8.88534  |
| 9054  | 1.009746 | 9050  | 3.183591 | 9061  | 6.47619  | 9072  | 8.055841 | 9011  | 8.936071 |
| 10207 | 1.012984 | 11044 | 3.198702 | 10109 | 6.465397 | 10121 | 8.070413 | 10059 | 8.923658 |

TABLE A-  
23 DATA  
FOR  
FIGURE  
A-23

| 41 kPa |          | 83 kPa |          | 124 kPa |          | 165 kPa |          |
|--------|----------|--------|----------|---------|----------|---------|----------|
| N      | %        | N      | %        | N       | %        | N       | %        |
| 1      | 0.789012 | 1      | 3.087524 | 1       | 5.776762 | 1       | 7.551778 |
| 6      | 0.859711 | 6      | 3.345492 | 6       | 6.504794 | 6       | 8.122762 |
| 11     | 0.881838 | 11     | 3.506857 | 11      | 6.603556 | 11      | 8.421746 |
| 51     | 0.953616 | 49     | 3.878159 | 49      | 7.235524 | 52      | 9.161651 |
| 104    | 0.9806   | 102    | 4.006603 | 102     | 7.465968 | 105     | 9.40127  |
| 152    | 1.001647 | 151    | 4.047619 | 149     | 7.537206 | 151     | 9.527016 |
| 202    | 1.01352  | 200    | 4.077302 | 195     | 7.574984 | 203     | 9.563714 |
| 253    | 1.019996 | 251    | 4.111302 | 248     | 7.617619 | 255     | 9.592857 |
| 300    | 1.029711 | 298    | 4.123714 | 296     | 7.65     | 307     | 9.652762 |
| 351    | 1.038885 | 351    | 4.150159 | 348     | 7.686698 | 364     | 9.693778 |
| 397    | 1.04806  | 394    | 4.154476 | 389     | 7.692095 | 409     | 9.737492 |
| 448    | 1.052377 | 450    | 4.16527  | 440     | 7.703968 | 469     | 9.74127  |
| 504    | 1.053457 | 502    | 4.173905 | 497     | 7.737968 | 502     | 9.763937 |
| 602    | 1.054536 | 605    | 4.194413 | 608     | 7.775746 | 601     | 9.780127 |
| 704    | 1.062631 | 703    | 4.193873 | 704     | 7.761714 | 703     | 9.789302 |
| 801    | 1.067489 | 803    | 4.19927  | 801     | 7.793556 | 804     | 9.823841 |
| 904    | 1.06425  | 905    | 4.203587 | 905     | 7.796254 | 906     | 9.785524 |
| 1002   | 1.06425  | 1004   | 4.202508 | 1005    | 7.80327  | 1002    | 9.806032 |
| 1203   | 1.072346 | 1204   | 4.211683 | 1205    | 7.826476 | 1204    | 9.819524 |

|      |          |      |          |       |          |      |          |
|------|----------|------|----------|-------|----------|------|----------|
| 1403 | 1.075584 | 1402 | 4.223016 | 1405  | 7.844286 | 1406 | 9.84219  |
| 1601 | 1.083679 | 1601 | 4.225175 | 1604  | 7.851302 | 1607 | 9.850286 |
| 1803 | 1.076663 | 1802 | 4.221937 | 1804  | 7.87073  | 1801 | 9.87781  |
| 2001 | 1.077743 | 2002 | 4.238667 | 2004  | 7.860476 | 2004 | 9.926381 |
| 2204 | 1.084219 | 2202 | 4.235968 | 2204  | 7.882063 | 2206 | 9.916667 |
| 2402 | 1.083139 | 2403 | 4.235429 | 2405  | 7.900952 | 2403 | 9.953905 |
| 2603 | 1.085838 | 2603 | 4.248381 | 2605  | 7.924698 | 2603 | 9.94581  |
| 2804 | 1.078822 | 2804 | 4.254857 | 2805  | 7.918762 | 2804 | 9.954444 |
| 3005 | 1.08206  | 3004 | 4.253238 | 3001  | 7.941968 | 3002 | 9.960381 |
| 3201 | 1.085298 | 3205 | 4.247841 | 3205  | 7.948984 | 3204 | 9.969016 |
| 3405 | 1.079362 | 3405 | 4.28346  | 3405  | 7.961397 | 3405 | 9.97819  |
| 3604 | 1.08152  | 3602 | 4.281841 | 3605  | 7.962476 | 3606 | 9.972254 |
| 3803 | 1.083139 | 3804 | 4.291016 | 3805  | 7.97219  | 3805 | 9.980889 |
| 4004 | 1.0826   | 4004 | 4.28454  | 4005  | 7.95546  | 4004 | 9.973333 |
| 4202 | 1.086917 | 4205 | 4.296413 | 4205  | 7.941429 | 4204 | 9.964159 |
| 4401 | 1.091235 | 4404 | 4.306127 | 4405  | 7.941968 | 4401 | 9.983048 |
| 4605 | 1.092854 | 4605 | 4.302349 | 4606  | 7.954921 | 4604 | 9.997619 |
| 4804 | 1.093933 | 4804 | 4.312063 | 4806  | 7.966254 | 4801 | 9.987905 |
| 5073 | 1.092314 | 4975 | 4.302889 | 5092  | 7.968952 | 5005 | 10.00787 |
| 6121 | 1.097711 | 6030 | 4.316381 | 6142  | 7.985683 | 6014 | 10.0273  |
| 7064 | 1.102568 | 6983 | 4.315302 | 7085  | 7.994857 | 6958 | 10.03917 |
| 8007 | 1.092314 | 7933 | 4.332571 | 8028  | 7.97219  | 7901 | 10.02622 |
| 9055 | 1.105806 | 9004 | 4.322857 | 9076  | 7.964635 | 8950 | 10.03756 |
| 9998 | 1.114441 | 9958 | 4.339048 | 10022 | 8.011587 | 9893 | 10.03432 |

TABLE A-  
24 DATA  
FOR  
FIGURE  
A-24

|      | 41 kPa   |      | 83 kPa   |      | 124 kPa  |
|------|----------|------|----------|------|----------|
| N    | %        | N    | %        | N    | %        |
| 1    | 2.00654  | 1    | 5.638603 | 1    | 8.815175 |
| 6    | 2.272603 | 6    | 6.404952 | 6    | 9.609587 |
| 11   | 2.350857 | 11   | 6.687746 | 11   | 9.935556 |
| 51   | 2.483079 | 51   | 7.320254 | 52   | 10.72619 |
| 99   | 2.528413 | 103  | 7.550159 | 103  | 10.91886 |
| 151  | 2.560794 | 150  | 7.63273  | 150  | 11.02571 |
| 204  | 2.576444 | 202  | 7.689397 | 201  | 11.09533 |
| 252  | 2.587778 | 252  | 7.713143 | 249  | 11.14984 |
| 302  | 2.596952 | 295  | 7.730413 | 294  | 11.12933 |
| 353  | 2.605587 | 354  | 7.747683 | 349  | 11.18762 |
| 400  | 2.611524 | 398  | 7.76981  | 396  | 11.21838 |
| 452  | 2.615302 | 453  | 7.78546  | 448  | 11.23295 |
| 502  | 2.620698 | 504  | 7.815683 | 505  | 11.23727 |
| 601  | 2.627175 | 605  | 7.806508 | 603  | 11.26641 |
| 703  | 2.632032 | 704  | 7.827016 | 701  | 11.28044 |
| 801  | 2.639048 | 805  | 7.83727  | 804  | 11.29124 |
| 902  | 2.644444 | 903  | 7.845905 | 901  | 11.31175 |
| 1005 | 2.647143 | 1006 | 7.843746 | 1005 | 11.2826  |

|       |          |       |          |       |          |
|-------|----------|-------|----------|-------|----------|
| 1205  | 2.653079 | 1204  | 7.866952 | 1205  | 11.33441 |
| 1401  | 2.658476 | 1406  | 7.868571 | 1401  | 11.3587  |
| 1605  | 2.664413 | 1603  | 7.890698 | 1605  | 11.37543 |
| 1805  | 2.666571 | 1804  | 7.88854  | 1805  | 11.3981  |
| 2000  | 2.671429 | 2006  | 7.896635 | 2005  | 11.41483 |
| 2204  | 2.674667 | 2203  | 7.879365 | 2205  | 11.3873  |
| 2405  | 2.677365 | 2405  | 7.88746  | 2405  | 11.40781 |
| 2605  | 2.679524 | 2602  | 7.895016 | 2604  | 11.43102 |
| 2804  | 2.682222 | 2804  | 7.893937 | 2804  | 11.41806 |
| 3005  | 2.681683 | 3001  | 7.909048 | 3004  | 11.44667 |
| 3200  | 2.684381 | 3204  | 7.914444 | 3205  | 11.4553  |
| 3405  | 2.687079 | 3401  | 7.929016 | 3404  | 11.49092 |
| 3606  | 2.687079 | 3604  | 7.925238 | 3602  | 11.458   |
| 3805  | 2.693016 | 3801  | 7.931175 | 3801  | 11.44721 |
| 4004  | 2.693016 | 4004  | 7.937651 | 4006  | 11.44559 |
| 4203  | 2.694095 | 4202  | 7.936032 | 4204  | 11.43803 |
| 4403  | 2.694635 | 4401  | 7.936032 | 4403  | 11.48067 |
| 4602  | 2.697333 | 4601  | 7.936571 | 4602  | 11.47635 |
| 4801  | 2.698413 | 4803  | 7.940889 | 4805  | 11.47851 |
| 5081  | 2.698413 | 5002  | 7.950603 | 5036  | 11.48984 |
| 6026  | 2.707587 | 5865  | 7.954381 | 5980  | 11.56216 |
| 7074  | 2.713524 | 6913  | 7.97219  | 7028  | 11.52276 |
| 8018  | 2.72     | 7856  | 7.97273  | 7972  | 11.58051 |
| 9066  | 2.724857 | 8904  | 7.994317 | 9020  | 11.53787 |
| 10114 | 2.729175 | 9952  | 7.994317 | 10069 | 11.55568 |
| 10219 | 2.728635 | 10057 | 8.001873 | 11012 | 11.4634  |

TABLE A-  
25 DATA  
FOR  
FIGURE  
A-25

| Density | 94.06%   | Density | 95.61%   | Density | 93.76%   | Density | 96.31%   |
|---------|----------|---------|----------|---------|----------|---------|----------|
| N       | %        | N       | %        | N       | %        | N       | %        |
| 1       | 3.586194 | 1       | 3.087524 | 1       | 3.25212  | 1       | 2.973111 |
| 6       | 3.908384 | 6       | 3.345492 | 6       | 3.669834 | 6       | 3.28073  |
| 11      | 4.027654 | 11      | 3.506857 | 11      | 3.848469 | 11      | 3.434    |
| 53      | 4.374131 | 53      | 3.89273  | 53      | 4.193866 | 53      | 3.796127 |
| 101     | 4.46048  | 107     | 4.006603 | 101     | 4.277517 | 101     | 3.895429 |
| 153     | 4.506892 | 166     | 4.059492 | 155     | 4.314755 | 153     | 3.947778 |
| 196     | 4.532257 | 214     | 4.089714 | 208     | 4.342818 | 207     | 3.97854  |
| 254     | 4.553845 | 256     | 4.115079 | 254     | 4.360628 | 249     | 3.996349 |
| 300     | 4.548988 | 304     | 4.129111 | 309     | 4.369802 | 302     | 4.012    |
| 352     | 4.566257 | 356     | 4.149079 | 366     | 4.364945 | 360     | 4.02819  |
| 398     | 4.571654 | 404     | 4.153937 | 412     | 4.383295 | 411     | 4.036825 |
| 454     | 4.580829 | 450     | 4.16527  | 453     | 4.387612 | 456     | 4.040063 |
| 505     | 4.600257 | 502     | 4.173905 | 504     | 4.400025 | 503     | 4.050857 |
| 604     | 4.611591 | 605     | 4.194413 | 602     | 4.412437 | 601     | 4.061651 |
| 702     | 4.601877 | 703     | 4.193873 | 701     | 4.402723 | 705     | 4.075143 |
| 802     | 4.620226 | 803     | 4.19927  | 805     | 4.42431  | 803     | 4.085397 |
| 901     | 4.627242 | 905     | 4.203587 | 904     | 4.425929 | 902     | 4.092952 |
| 1001    | 4.62994  | 1004    | 4.202508 | 1005    | 4.42431  | 1002    | 4.09727  |

|       |          |       |          |      |          |       |          |
|-------|----------|-------|----------|------|----------|-------|----------|
| 1202  | 4.636416 | 1204  | 4.211683 | 1202 | 4.441041 | 1201  | 4.110762 |
| 1405  | 4.646131 | 1402  | 4.223016 | 1406 | 4.450755 | 1401  | 4.119937 |
| 1602  | 4.654226 | 1601  | 4.225175 | 1602 | 4.464247 | 1605  | 4.134508 |
| 1805  | 4.643432 | 1802  | 4.221937 | 1801 | 4.475558 | 1805  | 4.145841 |
| 2002  | 4.652067 | 2002  | 4.238667 | 2006 | 4.47612  | 2005  | 4.157175 |
| 2205  | 4.665019 | 2202  | 4.235968 | 2205 | 4.471263 | 2204  | 4.151778 |
| 2403  | 4.665559 | 2403  | 4.235429 | 2405 | 4.486914 | 2404  | 4.16419  |
| 2601  | 4.670416 | 2603  | 4.248381 | 2605 | 4.482596 | 2604  | 4.174984 |
| 2803  | 4.66394  | 2804  | 4.254857 | 2805 | 4.472882 | 2805  | 4.177143 |
| 3003  | 4.649908 | 3004  | 4.253238 | 3005 | 4.482596 | 3005  | 4.188476 |
| 3203  | 4.660702 | 3205  | 4.247841 | 3205 | 4.497707 | 3205  | 4.189016 |
| 3403  | 4.641273 | 3405  | 4.28346  | 3406 | 4.487993 | 3403  | 4.195492 |
| 3603  | 4.638575 | 3602  | 4.281841 | 3601 | 4.488533 | 3604  | 4.19981  |
| 3804  | 4.64721  | 3804  | 4.291016 | 3801 | 4.490152 | 3805  | 4.201429 |
| 4005  | 4.644511 | 4004  | 4.28454  | 4002 | 4.495009 | 4002  | 4.206825 |
| 4205  | 4.633718 | 4205  | 4.296413 | 4202 | 4.497707 | 4203  | 4.210603 |
| 4405  | 4.631559 | 4404  | 4.306127 | 4403 | 4.501485 | 4401  | 4.208444 |
| 4601  | 4.625623 | 4605  | 4.302349 | 4603 | 4.487993 | 4602  | 4.21546  |
| 4801  | 4.632638 | 4804  | 4.312063 | 4804 | 4.497707 | 4802  | 4.213302 |
| 4991  | 4.624004 | 4975  | 4.302889 | 5005 | 4.480977 | 5001  | 4.221937 |
| 6041  | 4.631019 | 6030  | 4.316381 | 5966 | 4.497707 | 6040  | 4.227333 |
| 7091  | 4.670416 | 7088  | 4.319079 | 7016 | 4.509041 | 7097  | 4.247302 |
| 8036  | 4.678511 | 8038  | 4.340667 | 7961 | 4.502025 | 8049  | 4.251079 |
| 9087  | 4.68121  | 9111  | 4.325016 | 9011 | 4.517675 | 9102  | 4.252698 |
| 10031 | 4.675813 | 10063 | 4.344444 | 9957 | 4.527929 | 10045 | 4.260254 |

TABLE A-  
26 DATA  
FOR  
FIGURE  
A-26

| Ten FT |          | One FT |          | No FT |          | Two FT |          |
|--------|----------|--------|----------|-------|----------|--------|----------|
| N      | %        | N      | %        | N     | %        | N      | %        |
| 1      | 3.728127 | 1      | 3.362765 | 1     | 2.422099 | 1      | 4.013619 |
| 6      | 4.14854  | 6      | 3.567845 | 6     | 2.57375  | 10.5   | 4.289397 |
| 11     | 4.296952 | 11     | 3.72921  | 11    | 2.632035 | 20     | 4.411905 |
| 49     | 4.788603 | 49     | 4.112924 | 51    | 2.829019 | 48.56  | 4.592698 |
| 91     | 4.893841 | 96     | 4.264035 | 101   | 2.902416 | 102.39 | 4.729778 |
| 142    | 4.965619 | 146    | 4.328797 | 152   | 2.941273 | 153.14 | 4.783206 |
| 199    | 4.999619 | 203    | 4.370353 | 210   | 2.974194 | 206.58 | 4.818825 |
| 250    | 5.034698 | 254    | 4.398956 | 252   | 2.983369 | 251.68 | 4.849048 |
| 304    | 5.039016 | 307    | 4.418384 | 303   | 3.001178 | 308.8  | 4.863079 |
| 349    | 5.051429 | 352    | 4.429178 | 352   | 3.006035 | 355.59 | 4.866857 |
| 401    | 5.059524 | 398    | 4.446448 | 406   | 3.024924 | 403.65 | 4.883048 |
| 457    | 5.070317 | 445    | 4.448607 | 459   | 3.03194  | 452.26 | 4.887905 |
| 501    | 5.064381 | 501    | 4.449686 | 503   | 3.041115 | 502.36 | 4.907333 |
| 605    | 5.08381  | 604    | 4.463178 | 603   | 3.043273 | 607.7  | 4.910032 |
| 701    | 5.111873 | 701    | 4.469654 | 703   | 3.064861 | 709.15 | 4.935937 |
| 802    | 5.109714 | 804    | 4.466416 | 802   | 3.063242 | 810.32 | 4.920825 |
| 906    | 5.111873 | 901    | 4.467496 | 902   | 3.056765 | 901.88 | 4.927841 |

|       |          |       |          |       |          |         |          |
|-------|----------|-------|----------|-------|----------|---------|----------|
| 1001  | 5.137778 | 1004  | 4.486384 | 1006  | 3.071337 | 1004.81 | 4.932159 |
| 1202  | 5.144794 | 1205  | 4.504194 | 1202  | 3.067559 | 1210.67 | 4.941333 |
| 1402  | 5.13346  | 1405  | 4.523623 | 1405  | 3.074035 | 1406.37 | 4.945651 |
| 1601  | 5.157746 | 1600  | 4.505813 | 1604  | 3.08375  | 1602.02 | 4.968857 |
| 1804  | 5.160984 | 1801  | 4.516067 | 1805  | 3.095083 | 1808.87 | 4.970476 |
| 2002  | 5.160984 | 2002  | 4.533877 | 2005  | 3.106416 | 2004.84 | 4.984508 |
| 2205  | 5.169079 | 2208  | 4.526861 | 2205  | 3.112892 | 2211.09 | 4.989905 |
| 2403  | 5.149111 | 3004  | 4.514988 | 2401  | 3.122607 | 3006.36 | 5.021206 |
| 2603  | 5.18473  | 4003  | 4.540353 | 2605  | 3.112892 | 4001.99 | 4.995302 |
| 2803  | 5.187968 | 5004  | 4.553845 | 2802  | 3.128543 | 6168.75 | 5.01473  |
| 2904  | 5.204159 | 5534  | 4.549527 | 2905  | 3.128543 | 6379.11 | 5.029302 |
| 3001  | 5.200921 | 7107  | 4.550067 | 3003  | 3.136638 | 6589.53 | 5.018508 |
| 3103  | 5.196603 | 8051  | 4.538194 | 3101  | 3.136099 | 6800.01 | 5.022825 |
| 3204  | 5.207937 | 8995  | 4.56194  | 3204  | 3.137178 | 7010.37 | 5.036317 |
| 3302  | 5.203079 | 9938  | 4.553845 | 3302  | 3.120988 | 7220.79 | 5.016349 |
| 3406  | 5.20254  | 10043 | 4.550607 | 3405  | 3.142035 | 7431.1  | 5.022286 |
| 3603  | 5.204698 |       |          | 3601  | 3.131781 | 7641.63 | 5.022825 |
| 3802  | 5.205238 |       |          | 3802  | 3.135019 | 7851.94 | 5.028762 |
| 4001  | 5.21873  |       |          | 4004  | 3.13394  | 8062.47 | 5.038476 |
| 4205  | 5.211714 |       |          | 4205  | 3.130162 | 8272.78 | 5.038476 |
| 4404  | 5.21981  |       |          | 4402  | 3.155527 | 8483.25 | 5.038476 |
| 4603  | 5.211175 |       |          | 4603  | 3.140416 | 8693.67 | 5.055206 |
| 4802  | 5.220349 |       |          | 4804  | 3.142575 | 8904.09 | 5.040095 |
| 5001  | 5.229524 |       |          | 5001  | 3.149051 | 9114.46 | 5.044952 |
| 5885  | 5.212254 |       |          | 5902  | 3.15175  | 9324.88 | 5.052508 |
| 5990  | 5.211714 |       |          | 6007  | 3.149591 | 9535.35 | 5.036317 |
| 7041  | 5.198762 |       |          | 7057  | 3.147972 | 9745.66 | 5.064921 |
| 8092  | 5.224127 |       |          | 8106  | 3.194384 |         |          |
| 9036  | 5.23654  |       |          | 9050  | 3.183591 |         |          |
| 10086 | 5.248413 |       |          | 11044 | 3.198702 |         |          |

TABLE A-  
27 DATA  
FOR  
FIGURE  
A-27

| jump to<br>124 kPa |           | 124 kPa |          | 83 kPa |          |
|--------------------|-----------|---------|----------|--------|----------|
| N                  | %         | N       | %        | N      | %        |
| 10581              | 8.0024127 | 1       | 8.815175 | 1      | 5.638603 |
| 10582              | 8.0213051 | 6       | 9.609587 | 6      | 6.404952 |
| 10587              | 8.0553051 | 11      | 9.935556 | 11     | 6.687746 |
| 10632              | 9.2226384 | 52      | 10.72619 | 51     | 7.320254 |
| 10682              | 10.418575 | 103     | 10.91886 | 103    | 7.550159 |
| 10732              | 10.824416 | 150     | 11.02571 | 150    | 7.63273  |
| 10787              | 11.028956 | 201     | 11.09533 | 202    | 7.689397 |
| 10834              | 11.134194 | 249     | 11.14984 | 252    | 7.713143 |
| 10886              | 11.197877 | 300     | 11.13365 | 300    | 7.737968 |
| 10934              | 11.250765 | 349     | 11.18762 | 354    | 7.747683 |
| 10987              | 11.276131 | 401     | 11.21406 | 403    | 7.76819  |
| 11037              | 11.301496 | 448     | 11.23295 | 453    | 7.78546  |
| 11185              | 11.366257 | 505     | 11.23727 | 504    | 7.815683 |
| 11284              | 11.401877 | 603     | 11.26641 | 605    | 7.806508 |

|       |           |       |          |       |          |
|-------|-----------|-------|----------|-------|----------|
| 11386 | 11.428321 | 701   | 11.28044 | 704   | 7.827016 |
| 11484 | 11.4294   | 804   | 11.29124 | 805   | 7.83727  |
| 11586 | 11.454765 | 901   | 11.31175 | 903   | 7.845905 |
| 11685 | 11.477972 | 1005  | 11.2826  | 1006  | 7.843746 |
| 11882 | 11.492004 | 1205  | 11.33441 | 1204  | 7.866952 |
| 12083 | 11.484988 | 1401  | 11.3587  | 1406  | 7.868571 |
| 12285 | 11.516289 | 1605  | 11.37543 | 1603  | 7.890698 |
| 12487 | 11.528162 | 1805  | 11.3981  | 1804  | 7.88854  |
| 12683 | 11.524384 | 2005  | 11.41483 | 2006  | 7.896635 |
| 12885 | 11.544892 | 2205  | 11.3873  | 2203  | 7.879365 |
| 13086 | 11.558924 | 2405  | 11.40781 | 2405  | 7.88746  |
| 13284 | 11.557845 | 2604  | 11.43102 | 2602  | 7.895016 |
| 13485 | 11.591305 | 2804  | 11.41806 | 2804  | 7.893937 |
| 13682 | 11.596162 | 3004  | 11.44667 | 3001  | 7.909048 |
| 13885 | 11.589146 | 3205  | 11.4553  | 3204  | 7.914444 |
| 14087 | 11.597242 | 3404  | 11.49092 | 3401  | 7.929016 |
| 14284 | 11.613432 | 3602  | 11.458   | 3604  | 7.925238 |
| 14486 | 11.625305 | 3801  | 11.44721 | 3801  | 7.931175 |
| 14683 | 11.620988 | 4006  | 11.44559 | 4004  | 7.937651 |
| 14785 | 11.632321 | 4204  | 11.43803 | 4202  | 7.936032 |
|       |           | 4403  | 11.48067 | 4401  | 7.936032 |
|       |           | 4602  | 11.47635 | 4601  | 7.936571 |
|       |           | 4805  | 11.47851 | 4803  | 7.940889 |
|       |           | 4931  | 11.47743 | 5002  | 7.950603 |
|       |           | 6084  | 11.56162 | 6074  | 7.964095 |
|       |           | 7028  | 11.52276 | 7017  | 7.970032 |
|       |           | 8076  | 11.57403 | 8066  | 7.979746 |
|       |           | 9020  | 11.53787 | 9009  | 7.987841 |
|       |           | 10069 | 11.55568 | 10057 | 8.001873 |

TABLE A-  
28 DATA  
FOR  
FIGURE  
A-28

| N     | %           | N   | %        | N   | %        |
|-------|-------------|-----|----------|-----|----------|
| 10743 | 2.731873016 | 1   | 5.638603 | 1   | 2.00654  |
| 10744 | 5.972666667 | 6   | 6.404952 | 6   | 2.272603 |
| 10749 | 6.424380952 | 11  | 6.687746 | 11  | 2.350857 |
| 10787 | 7.310539683 | 51  | 7.320254 | 51  | 2.483079 |
| 10845 | 7.582       | 108 | 7.558254 | 104 | 2.53219  |
| 10893 | 7.671047619 | 150 | 7.63273  | 151 | 2.560794 |
| 10945 | 7.755238095 | 202 | 7.689397 | 204 | 2.576444 |
| 10991 | 7.787079365 | 252 | 7.713143 | 252 | 2.587778 |
| 11039 | 7.817301587 | 295 | 7.730413 | 302 | 2.596952 |
| 11090 | 7.832952381 | 354 | 7.747683 | 353 | 2.605587 |
| 11136 | 7.856698413 | 398 | 7.76981  | 400 | 2.611524 |
| 11187 | 7.879904762 | 453 | 7.78546  | 452 | 2.615302 |
| 11234 | 7.905269841 | 504 | 7.815683 | 502 | 2.620698 |
| 11239 | 7.910666667 | 605 | 7.806508 | 601 | 2.627175 |
| 11244 | 7.914984127 | 704 | 7.827016 | 703 | 2.632032 |

|       |             |       |          |       |          |
|-------|-------------|-------|----------|-------|----------|
| 11346 | 7.927936508 | 805   | 7.83727  | 801   | 2.639048 |
| 11444 | 7.934412698 | 903   | 7.845905 | 902   | 2.644444 |
| 11546 | 7.95815873  | 1006  | 7.843746 | 1005  | 2.647143 |
| 11746 | 7.997015873 | 1204  | 7.866952 | 1205  | 2.653079 |
| 11947 | 8.02184127  | 1406  | 7.868571 | 1401  | 2.658476 |
| 12147 | 8.042349206 | 1603  | 7.890698 | 1605  | 2.664413 |
| 12347 | 8.045587302 | 1804  | 7.88854  | 1805  | 2.666571 |
| 12548 | 8.074190476 | 2006  | 7.896635 | 2000  | 2.671429 |
| 12748 | 8.075809524 | 2203  | 7.879365 | 2204  | 2.674667 |
| 12944 | 8.06015873  | 2405  | 7.88746  | 2405  | 2.677365 |
| 13144 | 8.089301587 | 2602  | 7.895016 | 2605  | 2.679524 |
| 13345 | 8.114666667 | 2804  | 7.893937 | 2804  | 2.682222 |
| 13546 | 8.126539683 | 3001  | 7.909048 | 3005  | 2.681683 |
| 13747 | 8.154603175 | 3204  | 7.914444 | 3200  | 2.684381 |
| 13946 | 8.16        | 3401  | 7.929016 | 3405  | 2.687079 |
| 14144 | 8.173492063 | 3604  | 7.925238 | 3606  | 2.687079 |
| 14347 | 8.181587302 | 3801  | 7.931175 | 3805  | 2.693016 |
| 14546 | 8.183746032 | 4004  | 7.937651 | 4004  | 2.693016 |
| 14746 | 8.198857143 | 4202  | 7.936032 | 4203  | 2.694095 |
| 14946 | 8.195079365 | 4401  | 7.936032 | 4403  | 2.694635 |
| 15146 | 8.167555556 | 4601  | 7.936571 | 4602  | 2.697333 |
| 15347 | 8.163238095 | 4803  | 7.940889 | 4801  | 2.698413 |
| 15545 | 8.163777778 | 5002  | 7.950603 | 5081  | 2.698413 |
| 16477 | 8.175111111 | 5865  | 7.954381 | 6026  | 2.707587 |
| 17525 | 8.201015873 | 6913  | 7.97219  | 7074  | 2.713524 |
| 18469 | 8.228       | 7856  | 7.97273  | 8018  | 2.72     |
| 19517 | 8.242571429 | 8904  | 7.994317 | 9066  | 2.724857 |
| 20461 | 8.244730159 | 9848  | 8.001873 | 10010 | 2.729175 |
|       |             | 14476 | 8.387494 |       |          |
|       |             | 22476 | 8.392511 |       |          |