Wisconsin Highway Research Program

Determining a Temperature-Density Relationship After Completed Rolling of HMA

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Determining a Temperature-Density Relationship After Completed Rolling of HMA

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16. Abstract

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This research investigation has found a model that has not reinforced this theory. The research has shown that testing a road for density the morning following paving will not result in a significant difference in density than if it is tested the same day of paving.

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CHAPTER 1. INTRODUCTION

1.1 INTRODUCTION

Quality of asphalt pavement and payment to asphalt concrete pavement contractors are based upon a number of factors, one of which is whether or not the appropriate asphalt density has been achieved. Asphalt concrete is laid down at high temperatures and cools to ambient temperatures overnight. As materials cool, they tend to shrink or become denser. This research is applying that theory to asphaltic materials. Currently, the State of Wisconsin Department of Transportation (WisDOT) measures the density of asphalt with nuclear density gauges; the operator of the gauge measures the density of the pavement the day it is placed. The purpose of this study is to determine if the density of asphalt paving increases overnight and should be tested the day following paving or a correction factor should be applied to readings obtained on the day of paving.

1.2 RESEARCH HYPOTHESIS

The density of hot-mix asphalt increases as the temperature decreases due to volumetric properties of the asphalt binder. The increase in density is significant such that the field density should be measured after the pavement has cooled to the ambient temperature at which the pavement is open to traffic.

1.3 PROBLEM STATEMENT

The Wisconsin Department of Transportation (WisDOT) is investigating the correlation between the density and temperature of newly placed asphalt pavement. This

research is attempting to validate the hypothesis that asphalt concrete pavement increases in density as its temperature falls, using both field and lab-based data.

1.4 OBJECTIVES

The primary objective of this study is to establish a correlation between asphalt density as measured immediately after finish (cold) rolling and the density measured the following day using the nuclear gauge method of testing. If a correlation is found, the appropriate time to measure asphalt density, or a factor to adjust the field density, will be determined and a recommendation will be made for WisDOT to adopt a plan for measuring asphalt densities that accounts for the change in density.

Should no correlation be found, or if the difference between measuring the day of paving as opposed to the day after is found to be statistically insignificant, then this study would recommend that density readings do not need to be taken on the same day as the paving, which is current policy. This will allow WisDOT personnel to better schedule their inspection and measurement activities.

1.5 BENEFITS

The benefits of this study will include knowledge that will allow contractors and WisDOT to further understand the behavior of asphalt under temperature changes, so that they will be able to more accurately estimate the actual pavement density. This will promote consistency in terms of measurement, quality, and compensation to the industry.

1.6 BACKGROUND

Existing specifications require that density in all WisDOT asphalt paving jobs to be measured in terms of percent total maximum specific gravity (G_{MM}) after finishing rolling. This has traditionally been performed when the pavement is at a temperature range of 100-120ºF. A nuclear density gauge operator follows the finish roller and takes five random four-minute tests per lot (WisDOT 1999).

The average of those five readings is compared to minimum percent of maximum specific gravity (G_{MM}) requirements and payment per lot to the contractor is determined according to Tables 1.1 and 1.2 (WisDOT 1999). For example, if the average percent compaction for a high traffic volume (HV) mix was found to be 91%, the contractor, by Table 1.2, would receive 98% of the contract price.

Table 1.1 1996 Required Density (WisDOT 1996)

Location	Course Layer	Percent of Target Maximum Density	
		HV Mixes	MV and LV Mixes
Traffic Lanes (1)	Binder	92.0 (2) (3)	91.0 (3)
	Surface	92.0 (2)	91.0
Shoulders and Appurtenances	Binder	89.0	89.0
	Surface	89.0	89.0

(1) Includes parking lanes as determined by the engineer.
(2) Lots compacted to less than 89.0 percent are unacceptable.
(3) Minimum reduced by one percent for HV mixes and two percent for MV and LV mixes for the first lift of lower layer constructed on crushed aggregate or recycled base courses.

Table 1.2 Adjusted Payment Schedules (WisDOT 1996)

Type HV

Percent of Lot Density Below Specified Minimum	*Payment Factor (Percent of Contract Price)*
From 0.5 - 1.0 inclusive	98
From 1.1 - 1.5 inclusive	95
From 1.6 - 2.0 inclusive	91
From 2.1 - 2.5 inclusive	85
From 2.6 - 3.0 inclusive	70
More than 3.0	*

Types MV and LV

Percent of Lot Density Below Specified Minimum	*Payment Factor (Percent of Contract Price)*
From 0.5 - 1.0 inclusive	97
From 1.1 - 2.0 inclusive	94
From 2.1 - 3.0 inclusive	90
From 3.1 - 4.0 inclusive	80
From 4.1 - 5.0 inclusive	65
More than 5.0	*

1.7 METHODOLOGY

The methodology for this study involves several tasks:

1. Perform a literature review to study the previous and relevant research that has been done in this field;
2. Collect density and temperature data from ten asphalt paving projects from different contractors, including HV, MV, LV, and SuperPave mix designs. (Seven field projects were visited in 1999 and the final three were visited in 2000.)
3. Compact and measure density of loose mix samples at the University of Wisconsin – Madison Asphalt Laboratory to confirm the data from the field.

4. Investigate project variables, both attribute and measurable, that may explain the relationship between asphalt density and temperature;
5. Develop a correlation that relates the density of newly placed asphalt pavement to its temperature or change in temperature;
6. If no correlation is found, evaluate whether there is a statistically significant difference between the densities as measured the day of and the day following paving; and
7. Determine how these results can be implemented by WisDOT to ensure quality pavement and fair payment to contractors.

1.8 DEFINITIONS

This section defines terms associated with this study.

1.8.1 Lot

The Wisconsin Department of Transportation (WisDOT) defines a lot as 750 tons of placed asphalt material.

1.8.2 HV, MV, and LV Mixes

WisDOT defines an HV mix for use with high traffic volume, a MV mix for medium traffic volume, and an LV mix for low traffic volumes.

1.8.3 SuperPave Mix

The SUerior PERforming Asphalt PAVEment system is a mix design system that seeks designs that perform better under extreme temperatures and heavy traffic roads.

1.8.4 G_{MM}

G_{MM} is the specific gravity of an asphalt mix.

1.8.5 Job Mix Formula

The values from the mix design that satisfy a project's specification requirements are denoted as a job mix formula.

1.9 LITERATURE REVIEW

One important task in any research investigation is to study previous and relevant literature. This task involves systematically identifying and obtaining research pertinent to the investigation currently being studied. As this investigation may be one of the first on this topic, a limited amount of research was found concerning the correlation between asphalt density before and after cooling; however, several articles were found concerning nuclear density gauge implementation that may prove useful based upon factors they found important.

1. A 1988 study by Gemayel and Mamlouk investigated the effects of different mix components on several engineering properties of asphalt mixtures, including density. The study found that the laboratory results were more consistent than field results. Although this study made use of coring as opposed to nuclear density gauges, it noted that a number of different compaction techniques as well as the inconsistency of the subbase support layer could have led to greater field density variability.

2. A 1989 Canadian study by White, Heiman, Huber, Besant, and Bergan concluded that the final density of a pavement depends upon its cooling rate. The most significant control factors were found to be pavement thickness and initial mix temperature. Other important factors were wind speed, thickness of the existing pavement structure, and ambient

temperature. Pavement cooling charts were developed for different pavement thicknesses to determine how long a pavement can be rolled before density ceases to increase.

3. The Federal Highway Administration conducted a study evaluating lift thickness, material composition, density of underlying material, depth sensitivity, and surface roughness (FWHA 1991). Several nuclear density gauge models were used in the study. Under controlled laboratory conditions, researchers found that chemical composition is a significant source of error in nuclear density readings. The lab results showed that depth sensitivity varied between gauges. Field data led the researchers to believe that the discrepancy between gauge readings and core sample densities can be attributed to the chemical components of the mixture.

4. A 1994 study by Sanders, Rath, and Parker, Jr. used both nuclear gauge and core methods to determine density. Both the contractor and highway department took measurements from four projects. The analyses indicated no statistically significant difference between the testers or the measurements obtained by different methods. The study did identify, however, that the means of the measurements were statistically different and that density variability was dependent on the type of mix.

5. A 1996 study by Hanna, Russell, and Schmitt concluded that nuclear density gauges measure density lower than cores at low densities (below 145.8 pcf) and higher than cores at high densities (above 145.8 pcf). In addition, implementing a correlation equation for converting nuclear density readings to predicted core densities is more accurate than using actual nuclear density readings.

The literature review demonstrated that much research has been performed concerning nuclear density. The type of mix, subgrade material, and cooling rate can all affect the final density of the mix.

1.10 NUCLEAR DENSITY GAUGE OPERATION

The theory behind asphalt nuclear density testing focuses on the concept that dense materials absorb more radiation than less dense materials. A small radioactive gamma-emitting source is placed at the base of the nuclear gauge with a Geiger-Muller tube strategically positioned in the base of the gauge to detect the reflected radiation not absorbed or scattered by the material (FWHA 1991). The amount of gamma radiation detected by the tube (number of counts) is then converted via an algorithm to produce the density reading. This process is commonly known as the backscatter method. The gamma rays are directed downward into the asphalt and are absorbed or scattered by the asphalt. As technology develops in this area, the process will continue to become more refined (Hanna et al. 1996).

1.10.1 NUCLEAR DENSITY GAUGES

Seaman and Troxler are two manufacturers whose gauges are currently used in the Wisconsin asphalt paving industry. A gauge from one of these two manufacturers was used for each project, depending on what the contractor had available.

Nuclear density gauges base their readings on the ratio of two measurements. For example, Troxler gauges base their readings on the ratio of the standard count to the test count. The standard count is performed after the machine has warmed up and test counts are performed at each location. Seaman gauge readings are based on the ratio of an air gap test

to a contact test. As the two measurements are performed back to back, temperature effects are minimized.

1.11 SUMMARY

The objective of this study is to find a correlation between the density and temperature of hot mix asphaltic concrete. Once that correlation is found, the best time to measure the density will be determined, or an adjustment factor will be implemented if densities are taken the day of paving. If no significant correlation is found, or if there is no significant difference between the densities from day 1 to day 2, the research will show that the density of the asphalt can be taken either the day of or the day after paving.

The following chapter will describe the work plan both in the lab and on site and describe each project in detail. Analysis of the data will then take place in later chapters and conclusions will be based on the statistical analysis presented.

CHAPTER 2. DATA COLLECTION

2.1 METHODOLOGY

The data collection method incorporated was a random selection of points along the newly paved road. A total of thirty points per project were taken, with a few exceptions when time did not permit (At least fifteen data points were taken for every project, regardless). For the first round of seven projects, field measurements were performed between August 2, 1999 and November 17, 1999. Data collections on the last three projects used in this study were performed July 7, 2000 through July 13, 2000. A work plan was delivered to each contractor prior to the project data being collected. That work plan can be found in Appendix A, pages 43-45.

To estimate the density at each location, three one-minute tests were conducted in the same location following cold rolling (the data collection form is located in Appendix A, pages 40-42). During the first test, the gauge was outlined with chalk and numbered for easy detection. Between tests, the gauge was lifted from the pavement and then placed in the same orientation. The temperature of the HMA was taken during the first test using a heat gun. The temperature of the HMA surface for these measurements varied between 73 and 147 degrees Fahrenheit, with an average of 116 degrees.

Between 5am and 6am the following morning, after the HMA had cooled, measurements resumed, utilizing the same testing locations as the previous day. Three readings for each location were again taken using the same nuclear density gauge. The temperature of the asphalt was also recorded; these temperatures varied between 43 and 102

degrees Fahrenheit, averaging 71 degrees. Analysis of the collected data is presented in Chapter 3.

2.2 PROJECTS

Data were collected from three Type-HV, five Type-MV, one Type-LV, and one SuperPave paving projects. The ten projects were selected based upon the mix type, timing, and logistics. The Wisconsin Asphalt Paving Association (WAPA) provided the first five projects and the final five were added at a later date. All project locations were tested twice, once on the day of paving and then once the following morning after the HMA had cooled. Both the density of the pavement and its surface temperature were recorded. In all projects, a conscious effort was made to stay out of the wheel paths of traffic, and a minimum of eighteen inches separated the gauge from the edge of the paving. Random locations on the shoulder, center of the lane, and middle of the road were selected. Distances between testing locations were also randomized. Figure 2.1 shows a sample test location in the center of the lane.

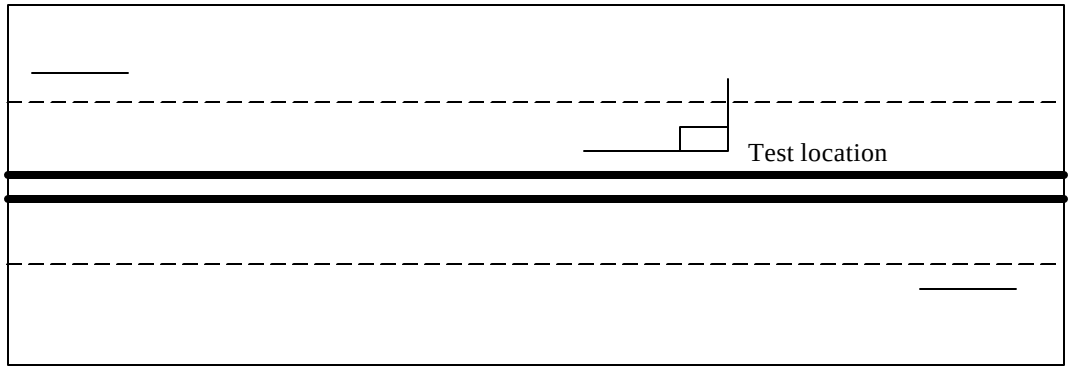

Figure 2.1 Sample Testing Location

Some of the projects were open to traffic. In those projects, there were a limited number of points that were driven over between the two measurements. Analysis has shown that these locations fall within the range of the data, not skewing the analysis. Table 2.1 lists all the projects surveyed.

Table 2.1 Projects Selected for Research (1999)

Project	Contractor	Job	Job Location	Start Date	Mix	G_{MM}
1	A (1)	Volk Field	Camp Douglas	8/2/99	HV	2.502
2	B	CTH Q	Oneida Co.	8/24/99	LV	2.464
3	C (1)	HWY 67	Elkhorn	8/26/99	HV	2.514
4	D (1)	HWY 18	Wauk./Jeff. Co.	9/9/99	HV	2.512
5	E (1)	HWY 140	Clinton	10/11/99	MV	2.458
6	C (2)	Town Line Rd.	East Troy	11/4/99	MV	2.488
7	D (2)	Memphis Rd.	Madison	11/16/99	MV	2.476
8	A (2)	STH 18	Fennimore	07/07/00	SP	2.495
9	C (3)	CTH A	Milford	07/11/00	MV	2.483
10	E (2)	STH 81	Monroe	07/12/00	MV	2.454

*A (2) indicates second project from contractor A
*SP = SuperPave

2.2.1 Volk Field – Camp Douglas, WI

Volk Field is an Air Force Base at Camp Douglas about one and a half hours west of Madison, Wisconsin. A runway approximately 2 miles long and 15 lanes wide was being constructed; total of 55,000 tons of asphalt. One paving lane was used for testing. The mix was of the HV type and the data were recorded on August 2nd and 3rd, 1999. Data collection began at 4pm and continued for 3 hours on August 2nd. Early morning temperatures the following day (between 6am and 9am) rose into the 70's due to the sun and the pavement had warmed up to approximately 85 degrees Fahrenheit by completion the following morning.

The project was not open to traffic. A short portion of the runway was used for testing, approximately 400 feet. Because the runway was closed to traffic, all twenty data points were taken randomly throughout the lane. A Troxler 3440 gauge was used.

2.2.2 CTH Q – Oneida Co., WI

This project is a two-lane highway located about three hours north of Madison near Rhinelander. The highway is rural and not very highly traveled. About 10 cars traveled on the road between testing times. The mix was of an LV type (the only LV tested) and site data were collected on August 24th and 25th, 1999. Data collection began at noon on the 24th, with afternoon temperatures in the 80's. The pavement construction was 2 miles long, a total of 8,000 tons. Due to the fact that this project was tested during the summer, morning air temperatures (5am to 8am) varied from about 62 degrees to 74 degrees Fahrenheit. The weather was partly cloudy and slightly foggy in the morning. Data points were taken over a half-mile stretch on the southbound lane. A Troxler 3440 gauge was used.

2.2.3 STH 67 – Elkhorn, WI

Highway 67 is a six-lane commercial highway that runs near Elkhorn, WI and was closed to traffic. The mix was of the HV type and the data were collected on August 26th and 27th, 1999 from the far west lane (southbound). Three-quarters of a mile were paved, using a total of 5,000 tons of asphalt. Temperatures were in the mid-80's on the 26th during testing (from noon to 6pm) and rose quickly from the 60's at 6am to the high 70's at noon on the 27th, and it was partly cloudy with light fog in the morning hours. The pavement heated to

well over 90 degrees over the course of the morning tests. The Seaman C-200 gauge was used.

2.2.4 USH 18 – Waukesha and Jefferson Counties, WI

Highway 18 runs east and west just south of Interstate 94, the portion tested was located in Waukesha and Jefferson Counties. Highway 18 is a two-lane highway making use of an HV mix. The total constructed pavement was 18 miles long and used 62,000 tons of asphalt. Site data were collected on September 9th and 10th, 1999 on the westbound lane. Temperatures for the research were cool, in the mid-60's on September 9th (2pm-6pm) and remaining cool on the 10th, with temperatures not passing 60 degrees by the time the data collection was completed at 10am. The portion selected for testing was open to traffic. Fortunately, light traffic was on the road and the majority of collection points were out of the wheel paths of traffic. The Seaman C-100 gauge was used.

2.2.5 STH 140 – Clinton, WI

Highway 140 runs north and south a few miles east of Beloit, WI. The southbound lane of the two-lane highway was tested, an MV mix being utilized. The project was 6 miles long and 20,000 tons of asphalt was used. Site data were collected on October 11th and 12th, 1999. The road was open to traffic, but there was light traffic during testing. The weather for this project was cool and sunny, with temperatures on the 11th in the 50's and not passing 50 on the 12th. The Troxler 3440 gauge was used.

2.2.6 Town Line Road – East Troy, WI

Town Line Road was a 2-mile long resurfacing project that comprised 9000 tons of MV type mix. The southbound lane of the two-lane road was tested. The data were collected on November 4th and 5th, 1999. Due to the late start (5pm) of the project, only fifteen data points were measured before it was too dark to safely work. There was little traffic on the road during the testing, though it was in a residential area. Temperatures were in the low 50's on the 4th and in the 40's from 6am to 8am the following morning. The Seaman C-200 gauge was used.

2.2.7 Memphis Road – Madison, WI

Located near East Washington Avenue on the east side of Madison, about one block of Memphis Road was paved, making it the smallest project studied. Due to time constraints, both day one and day two measurements were performed back to back on November 16th, 1999 from 9am to 5pm and the temperature varied that day from 35 degrees Fahrenheit in the morning to the low 40's by mid-afternoon. An MV mix was used in the project and there was approximately 100 tons of asphalt used for paving. There was approximately a thirty-degree temperature differential in the asphalt between the measurements. No vehicular traffic was recorded although the road was in a residential neighborhood. The Seaman C-75 gauge was used.

2.2.8 STH 18 – Fennimore, WI

Located just West of Fennimore, WI (about 30 minutes north of Platteville), this section of STH 18 (10 miles long) was the only SuperPave job included in this study. The

site data were collected on July 7th and 8th, 2000 and the eastbound lane of the two-lane highway was used. The job consisted of 50,000 tons of asphalt paving. The road was not closed, however, there was artificial light over the measured portion of the roadway overnight. Ambient temperature at the site was 75ºF on the 7th (testing was performed between 2pm and 5pm) and in the mid-60's the following morning (between 5am and 8am). Troxler 3440 gauge was used.

2.2.9 CTH A – Milford, WI

The portion of HWY A that was used in the study runs east-west just north of I-94 in Milford, WI and is 2 miles long. The westbound lane of the two-lane road was tested on July 11th and 12th, 2000. An MV type mix was used to pave, with a total of 9,000 tons of asphalt placed. The road was closed; however, light traffic did pass over the road overnight. The temperature on the 11th (from 10am to 2pm) reached near 80ºF during data collection, and varied from 60ºF to 65ºF during the morning collection (6am-10am). A Seaman G-200 gauge was used.

2.2.10 STH 81 – Monroe, WI

Hwy 81 is located on hilly terrain that runs from Monroe to Argyle and was paved with a total of 53,000 tons of asphalt using an MV type mix over 13 miles. It was humid for both days of the study, July 12th and 13th, 2000, and fog became thick during the morning portion of the research. The tested portion of the two-lane highway runs northwest. The temperature reached 80ºF on the 12th during data collection (2pm-5pm), and remained in the

low 60's the following morning (5am-8am). Although the road was closed to thru traffic, there was light traffic on the road overnight. A Troxler 3440 gauge was used.

2.3 NUCLEAR DENSITY GAUGES

A total of four (4) nuclear density gauges were used in this study: (1) Troxler 3440, (2) Seaman C-200, (3) Seaman C-100, and (4) Seaman C-75. These models are commonly used by WisDOT and by the paving contractors. The gauges were furnished by the contractors and operated by an employee of the contractor or by a University of Wisconsin researcher. Regardless of who ran the gauge, a research assistant from the University of Wisconsin was present at all times to observe the process and to collect and transcribe the data. All gauges were factory or contractor calibrated prior to the start of the project. Both a one-minute air gap test and a one-minute contact test were run when using the Seaman machines. The theory behind the air gap method is to reduce the effect of varying chemical composition of the mixture on the test reading (Seaman 1993). Table 2.2 lists the projects and the type of gauge used.

Table 2.2 Nuclear Density Gauge Models Used

Project	Contractor	Type of Gauge
1	A (1)	Troxler 3440
2	B (1)	Troxler 3440
3	C (1)	Seaman C-200
4	D (1)	Seaman C-100
5	E (1)	Troxler 3440
6	C (2)	Seaman C-200
7	D (2)	Seaman C-75
8	A (2)	Troxler 3440
9	C (3)	Seaman C-200
10	E (2)	Troxler 3440

Figure 2.2 Seaman C-200 Gauge in use

2.4 JOB MIX FORMULAS

To assist the lab, a mix design was collected for each project. A mix design, also known as a Job Mix Formula (JMF) is a contractor's submittal of proposed materials and corresponding volumetric proportions that are to be used in the asphalt mixture. Material source, specific gravity, and proposed volumetric percentages are presented in detail. Mix properties listed include aggregate gradation, asphalt cement content, air voids, stability, flow, Voids in Mineral Aggregate (VMA), and Theoretical Maximum Density. These mix properties are commonly used to establish quality control charts for monitoring asphalt mixture production.

2.5 HOT MIX ASPHALT (HMA) MATERIALS

Samples of the aggregates and asphalt cement were collected from each project with the assistance of personnel at the plant site. Aggregates were collected for future geologic and mixture property analysis, if needed. In addition, eighteen (18) 5-kilogram loose mix samples were collected from the trucks that were to transport the material to the job site. The samples were compacted for testing by the asphalt laboratory at the University of Wisconsin – Madison. The purpose of laboratory testing is to conduct a parallel study on the impact of cooling on density using the controlled laboratory environment.

2.6 LAB PROCEDURE

Laboratory analysis is the benchmark for determining density change. As this is a physical method of measurement, it is bound to provide a more accurate and consistent estimate than using a nuclear density gauge. The results attained through site data analysis should mimic those found through lab testing.

The procedure for the lab testing was as follows. The mix samples that were drawn from the asphalt trucks were compacted and measured. First, the correct compaction and air voids needed to be achieved. Using a gyratory compactor, trial and error found the correct number of gyrations for each mix. The University of Wisconsin – Madison Asphalt Laboratory was utilized for all lab tests.

Specimens were compacted at 120 ºC (248ºF). Each compacted sample was weighed and marked with an identification label on its top face. Markings were made at four locations (approximately every quarter turn) along the side of the specimen. This was to identify the locations where each measurement was taken to maintain consistency between

the first and second measurements. A set of calipers (the tool to measure length and hence volume) was modified by adding a metal plate attachment 2.5 mm wide and 8.9 mm long to each jaw. This modification helped to reduce the potential that the jaw might indent the specimen or fall in a void in the specimen, and thus result in measurements that may be unusually low. Figure 2.2 is a photo of the modified calipers.

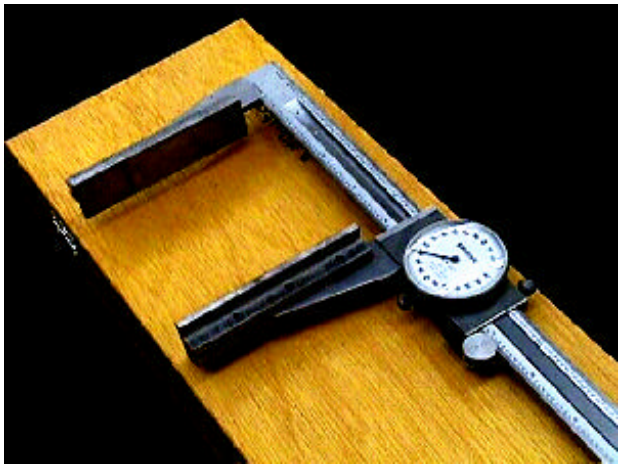

Figure 2.3 Modified Calipers

A compacted sample was first placed in an oven for an hour to allow its temperature to stabilize at 140 ºF. The first set of eight measurements was taken at that point. Four readings were taken for both the height and the diameter of the specimen at the marked locations. The second set of measurements, at the same locations, was taken at room temperature (77ºF), after the specimen had cooled overnight. The caliper measurements were then averaged and used to calculate volumes. Sample measurements were recorded in millimeters, and volumes were converted from cubic millimeters to cubic feet. An example of a measurement is given in Figure 2.3.

For the purposes of this study, a decrease in volume of the specimen in the lab indicated an increase in density. For consistency in this controlled experiment, the same lab

technician used the same tools throughout the study. The laboratory environment remained consistent to prevent environmental variables from affecting the analysis.

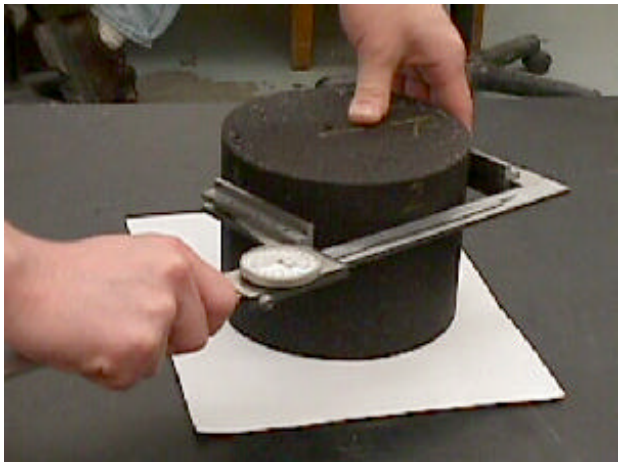

Figure 2.4 Sample Measurement

2.7 SUMMARY

Chapter 2 discussed the method of data collection for this project. At each data location, three one-minute measurements were taken on the day of paving while the asphalt was hot and then again the following morning after the asphalt had cooled. The surface temperature of the asphalt was taken at each data point during the first one-minute test.

Each paving project that was studied was then listed along with attributes and weather conditions. Following a brief discussion of the mix properties of hot mix asphalt, the lab procedure was presented, including the heating and measuring of the materials.

Chapter 3 outlines the different methods of analysis incorporated to build a model of the temperature-density relationship of hot mix asphalt.

CHAPTER 3. DATA ANALYSIS

3.1 BACKGROUND

The acquired site data were evaluated using SAS, a statistical software package that utilizes the method of least squares regression to model data. A total of 1,596 rows of data, including the project, replicate number, gauge type, pavement temperature, density, location point, day, and contractor, were input into a database, which is shown in Appendix B, pages 51-86.

In the analysis, the following assumption was used, that all residuals are Independent, Identically Distributed, and follow a Normal curve with a mean of zero and variance of σ^2. All analyses were performed using an alpha value (significance level) of 5%, meaning that if a p-value greater than 5% was found, the result was not significant.

Before any analysis could begin, however, the data needed to be checked to ensure that there were no problems in terms of time-dependence that violate the assumption that the data are independent. A study of the data indicated that only the fifth project proved to be time-dependent. A plot of the density changes versus data point (numbered 1-30) shows that there is a trend in the change in density for the fifth project. Therefore, since this project violated the assumptions, it was removed from the data set and future analysis. The plot of this data can be shown on the following page in Figure 3.1. The remainder of the project plots, Figures A1-A10, can be seen in Appendix B, pages 45-49. These ten plots show the averages for each day in comparison to each other. A random difference between the two series is expected and is found in all but Figure A5.

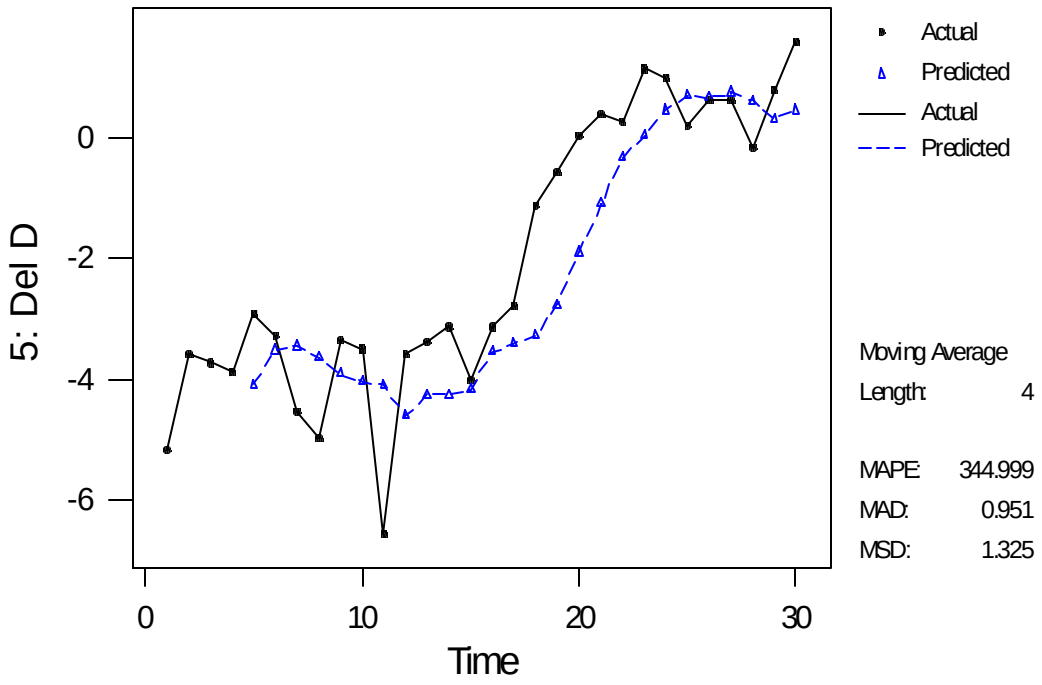

Figure 3.1: Time Order Plot for Project #5 Including Moving Average

3.2 ANALYSIS OF DATA

In addition to the site data evaluation, the loose-mix samples were taken to the lab, compacted and analyzed as described in Section 2.6: Lab Procedure. Similar analyses were performed for both the site data and lab data and are explained below.

3.2.1 ANALYSIS BY MIX TYPE

The values of density measured were studied with respect to the mix type evaluated. Mix type is defined in this research as the mix category for each level of traffic volume. Type 1 is an LV mix, Type 2 is and MV mix, Type 3 is an HV mix, and Type 4 is a SuperPave specification mix.

The box plot as shown in Figure 3.2 compares the densities measured for each mix type as measured in the field. The lower horizontal edge of the box indicates the first quartile value, while the upper horizontal edge of the box indicates the third quartile value. The line within the box indicates the average of the data. The vertical lines show the range of all the data. The box plot indicates that though there may be variations to the densities for each mix type, the differences range between 0.2 and 2%, which can be considered insignificant.

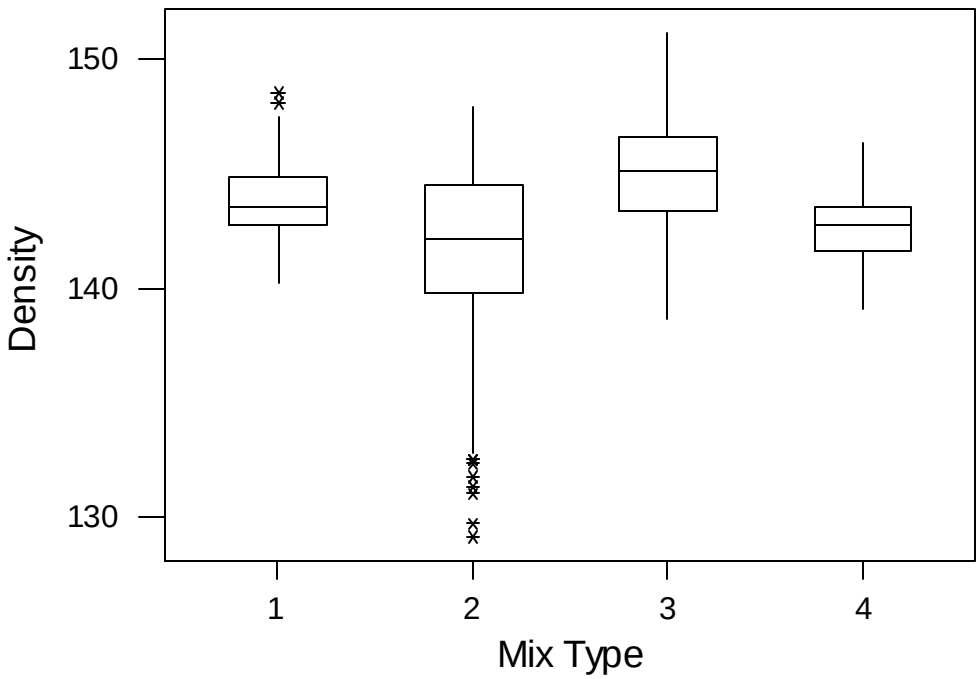

Figure 3.2 Box Plot for Density Measurements Comparing Mix Types –Site

Figure 3.3 on the following page compares the densities measured for each mix type based on lab data. Although the averages are higher than that in the field, the difference ranges between mix types are smaller. Again, the difference between mix types is insignificant.

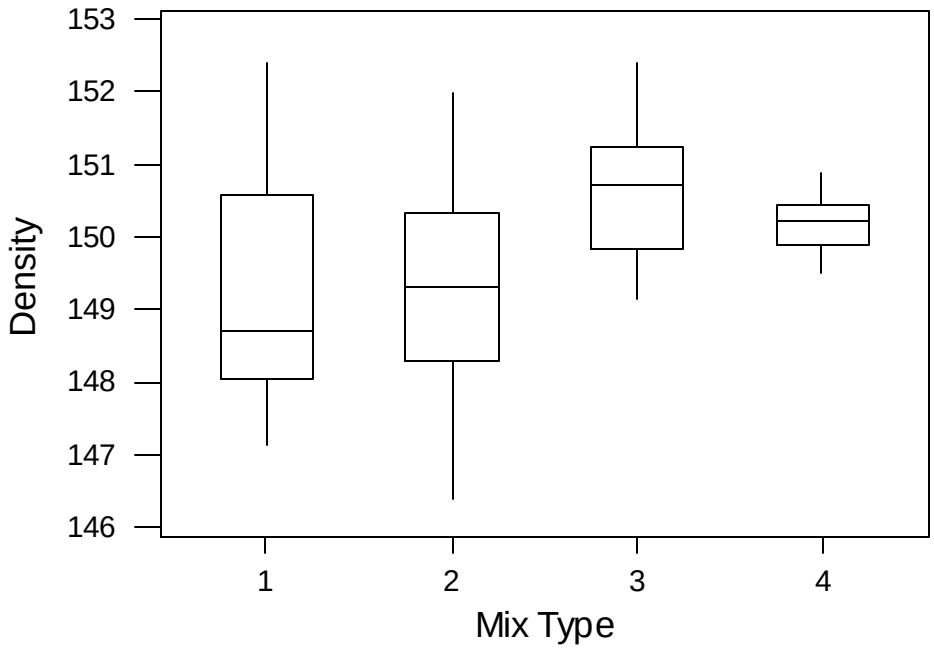

Figure 3.3 Box Plot for Density Measurements Comparing Mix Types – Lab

3.2.2 ANALYSIS BY GAUGES

Figure 3.4 on the following page shows a box plot of density values compared based on the type of gauge used in their measurements. Four types of gauges were used in this research. Gauge 1 is a Troxler 3440 model gauge, Gauge 2 is a Seaman C-200 model gauge, Gauge 3 is a Seaman C-100 model gauge, and Gauge 4 is a Seaman C-75 model gauge. The box plot shows that the type of gauge used has some effect on the density value measured. Once again, however, the differences due to those effects are not statistically significant. There is a difference of 3.5% between the gauges with the highest and lowest average density measurements. This suggests that regardless of the type of gauge used in the measurement of

densities, the results were equally reliable. Therefore, the effect of gauge type is insignificant.

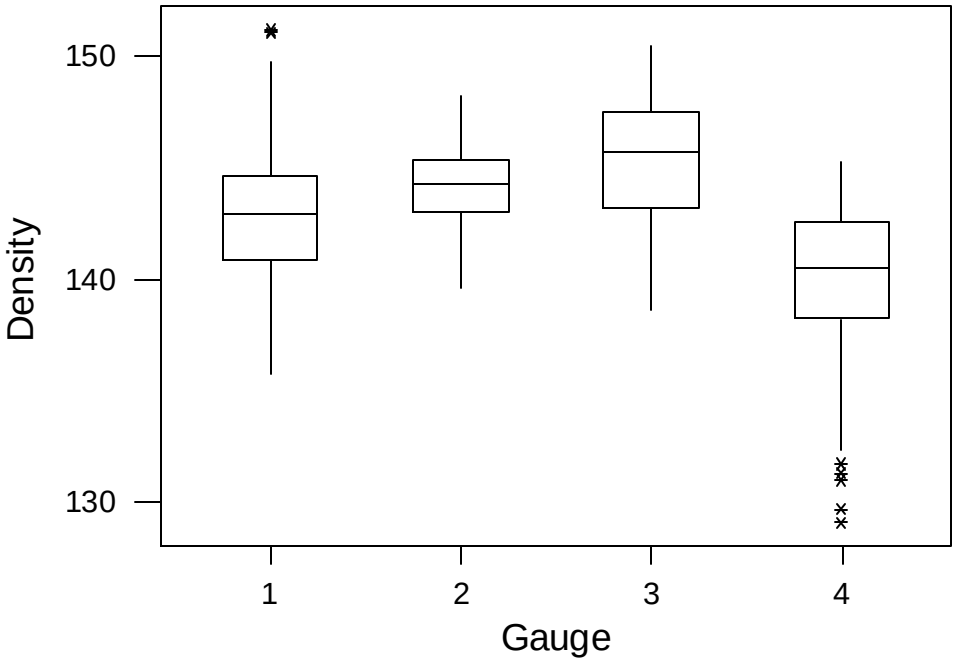

Figure 3.4 Box Plot Comparing Density Measurements Based on Gauge Type

3.2.3 ANALYSIS BY DAY

Figure 3.5 is a plot comparing the average density measurements based on the day that the measurements were taken, Day 1 being the day the pavement was rolled, and Day 2 being the day after. It was considered a possibility that the density of the pavement may change from the first to second day. From the chart, it can be seen that although there is a slight increase in the average densities from day 1 to day 2, the increase is rather small, and can be considered insignificant, since the difference is less than 1% in magnitude.

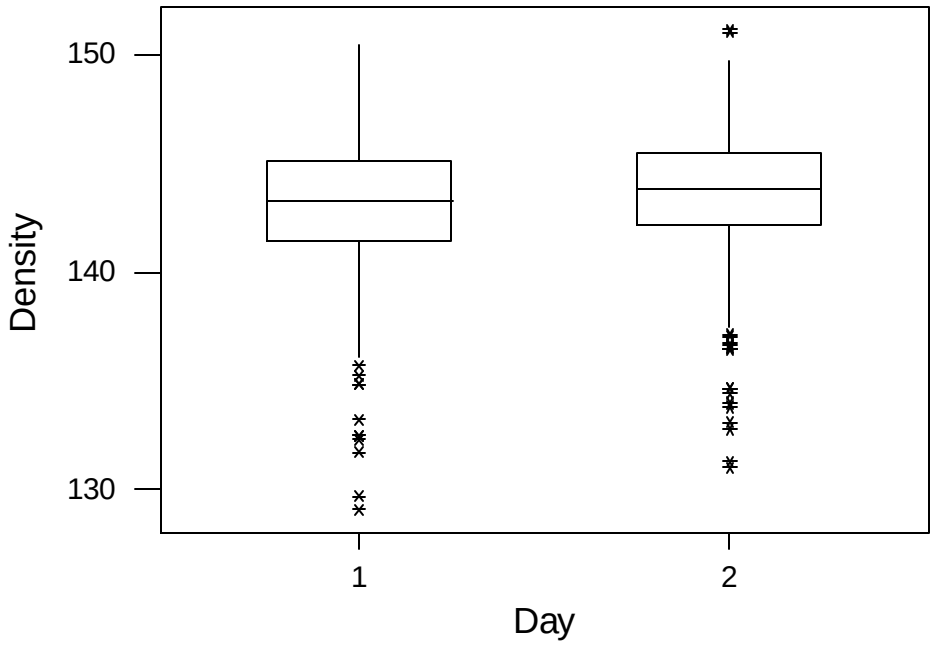

Figure 3.5 Comparison of Density Measurements by Day – Site

Figure 3.6 on the following page presents similar results to the site data but this boxplot is based upon lab data. The densities on Day 2 were just 0.09% higher than that on Day 1. Again, the densities from the lab were higher than that from the site, but the consistency between Day 1 and Day 2 remained as the differences in days were low.

3.3 ANALYSIS OF COMPLETE DATA SET

During data collection, detailed information regarding the projects and the materials used in the each project were logged. Not all of the information has a role in explaining the density of the pavement. Statistical analysis was conducted as a process to eliminate the information that is not relevant and to obtain the ones that are important.

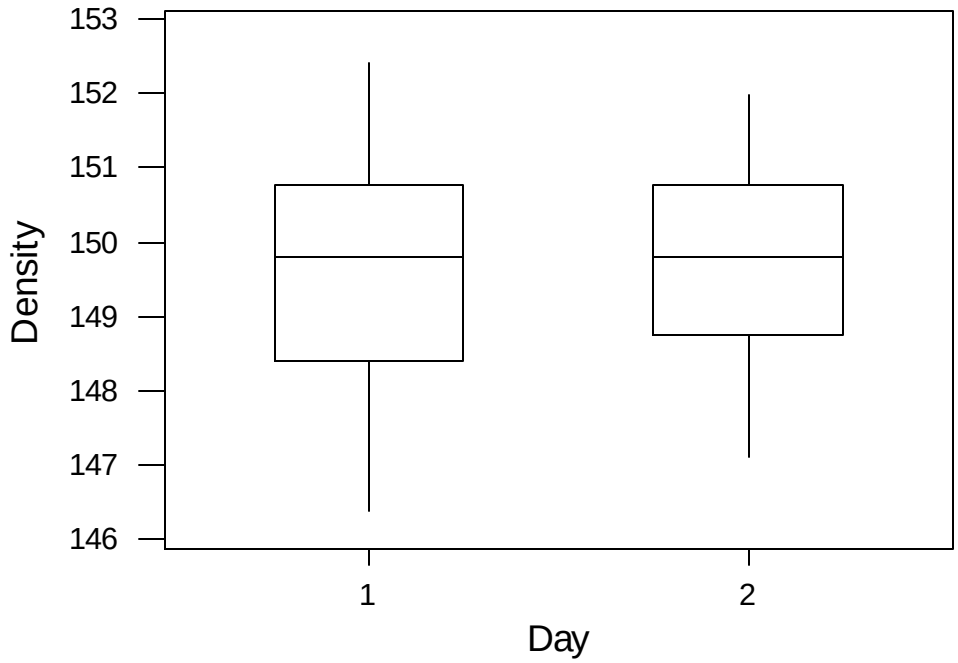

Figure 3.6 Comparison of Density Measurements by Day - Lab

As previously mentioned, the statistical analysis was performed using the SAS statistical software. The goal was to fit a reliable model that can describe or explain the data. Variables that were not important in fitting the model were systematically removed during each step of the analysis by applying the backward elimination method. The model was reduced to one that included the type of gauge, pavement temperature at which the measurement was taken, mix type, day of measurement, and some interactions of these factors.

The final result of the analysis indicates that the factors that were significant in explaining pavement density after rolling compaction were gauge type, temperature (of the

pavement), mix type, day, and the interactions of gauge type and temperature, gauge type and mix type, gauge type and day, temperature and mix type, and temperature and day. These factors resulted in p-values that were less than 0.05 in the ANOVA, which is shown in Table 3.1. An r-squared value of 61% was achieved for the resultant model.

Table 3.1 ANOVA Table of Final Model

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	19	7253.45032	381.76054	114.09	<.0001
Error	1396	4671.19860	3.34613		
Corrected Total	1415	11924.64892			

R-Square	Coeff Var	Root MSE	Dens Mean
0.608274	1.276677	1.829243	143.2816

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Gauge	3	956.820224	318.940075	95.32	<.0001
Temp	1	176.793195	176.793195	52.84	<.0001
MType	3	153.047143	51.015714	15.25	<.0001
Day	1	80.352816	80.352816	24.01	<.0001
Temp*Gauge	3	798.349784	266.116595	79.53	<.0001
Gauge*Mtype	1	1931.092619	1931.092619	577.11	<.0001
Gauge*Day	3	537.279910	179.093303	53.52	<.0001
Temp*MType	3	51.337155	17.112385	5.11	0.0016
Temp*Day	1	160.403112	160.403112	47.94	<.0001

The analysis resulted in the following relationship:

$$\text{Density} = 112.525 + 20.955*G1 + 27.344*G2 + 30.126*G3 + 0.312*T + 3.757*M1 + 4.141*M2 + 1.792*M3 - 0.314*D1 - 0.190*T*G1 - 0.306*T*G2 - 0.330*T*G3 - 7.903*G1*M2 + 4.641*G1*D1 + 9.051*G2*D1 + 9.734*G3*D1 - 0.012*T*M2 + 0.023*T*M3 - 0.084*T*D1 \quad (1)$$

Where G(1,2,3) = gauge
T = pavement temperature
M(1,2,3) = mix type
D(1,2) = day

All the variables in the equation take on a value of 1 or 0, with the exception of pavement temperature, which takes on its actual value at the time of measurement. For instance, if the density measurement is taken for mix type 3 on the first day using gauge 1, then M3, D1, and G1 would each take on a value of 1, while all the other variables (except temperature) would equal 0.

It should be noted that the resultant equation is only adequate for showing the factors that pavement density is dependent upon. The model shown in equation (1) is an explanatory model that shows the significant factors that impact pavement density. This model should not be viewed as a predictive model. Although the r-squared value of 61% indicates a valid model, it should not be used to predict future pavement densities.

In order to find out the nature and significance of the relationships between variables the complete data set was also analyzed for correlation between the variables considered. The result of this analysis is shown in Table 3.2. As seen in the table, there is a clear correlation between pavement temperature and day. This is very logical in this study, since the measurements on day 1 were taken briefly after the mix is rolled on the pavement when the pavement temperature is still elevated, while the measurements on day 2 were taken at ambient temperature after the pavement had cooled overnight. However, during analysis, it was determined that both variables are necessary in the model, as the r-squared value of the model and the p-values of the variables are highly affected by the elimination of one or the other.

Table 3.2 Table of Correlation between Variables Evaluated

	Gauge	Temp	Mix Type	Day
Gauge	--	-0.171	-0.012	0.000
Temp	0.171	--	-0.005	-0.877
Mix Type	-0.012	-0.005	--	0.000
Day	0.000	-0.877	0.000	--

3.4 LAB DATA ANALYSIS

In an effort to reproduce the site data in the lab, loose-mix samples were pulled from each project. Ten samples of loose mix were randomly selected, compacted, and tested.

Table 3.3 Comparison of Lab Data to Site Data

Project		Density Change* (pcf)					Gauge
		Lab Data		Site Data			
		Average	Interval	Average	Interval	Mix	
1	A (1)	-0.092	3.87	0.550	3.46	HV	Troxler 3440
2	B	0.255	0.97	0.153	3.77	LV	Troxler 3440
3	C (1)	-0.219	0.75	0.559	2.27	HV	Seaman C-200
4	D (1)	0.207	4.05	-1.191	3.77	HV	Seaman C-100
5	E (1)	-0.076	0.57	-2.031	8.13	MV	Troxler 3440
6	C (2)	0.224	0.40	-0.535	2.47	MV	Seaman C-200
7	D (2)	0.563	2.20	-0.060	2.60	MV	Seaman C-75
8	A (2)	0.104	0.591	1.00	2.57	SP	Troxler 3440
9	C (3)	0.170	0.540	1.57	4.47	MV	Seaman C-200
10	E (2)	0.172	0.882	0.39	2.87	MV	Troxler 3440
	Averages	0.154	1.482	0.217	3.64		

*A positive change in density is an increase

* Project 5 was excluded from analysis of the site data

Table 3.3 shows that the lab data did not always match the site data in terms of average change in density and data interval. The controlled conditions of the lab resulted in smaller intervals. A majority of projects went through an increase in density in the lab from day 1 to day 2. However, the increases in density were low, averaging about 0.13 pcf, whereas the average of the site data indicates an increase in 0.217 pcf. Neither difference (lab or site) is statistically significant.

The data acquired from the lab has been previously analyzed in this chapter. Two separate methods were used, analysis by mix type, and analysis by day. Below, Table 3.4 shows the ANOVA Table for all lab data. This table again shows that the density did not vary significantly between days.

Table 3.4 ANOVA Table for Lab Density

```
Analysis of Variance for Density
Source     DF        SS        MS        F        P
Day         1      0.65      0.65     0.33    0.565
Error     196    383.19      1.96
Total     197    383.84
                                   Individual 95% CIs For Mean
                                   Based on Pooled StDev
Day         N      Mean     StDev  -+---------+---------+---------+-----
1          99    149.47      1.48  (-------------*-------------)
2          99    149.58      1.31        (-------------*-------------)
                                   -+---------+---------+---------+-----
Pooled StDev =     1.40         149.20    149.40    149.60    149.80
```

Laboratory analysis is the benchmark for determining density change, as a physical measurement is taken. The measurement method (using calipers) provides a more accurate estimate of density than using a nuclear gauge. As no statistically significant change in density was found, this agrees with the results from the site data. A change in pavement temperature or mix type does not significantly change the density of an asphalt mix. The

difference between lab and site data is that density changes and intervals in the lab were smaller on average.

The laboratory conditions were always consistent. All lab samples were tested by the same person at the same temperatures under the same laboratory conditions with the same set of calipers. Conditions on site were inconsistent, as humidity, wind speed, and ambient temperature varied. The controlled condition in the lab may account for the smaller intervals and lower average changes in density.

3.5 SUMMARY OF CHAPTER 3

Box plots were incorporated to make comparisons between the average densities based on various factors – gauge type used, mix type, and day of compaction, for both site and lab data. Each comparison showed that while there were differences in the measured densities based upon different dependent variables, the differences due to each factor were insignificant.

Statistical analysis resulted in an explanatory model that included the gauge type, mix type, day of compaction, pavement temperature, and some interactions of these variables. However, due to the fact that mix types will vary with project and contractor, the model derived cannot be applied as a predictive model.

The lab investigation supported the results that were obtained from field data. It showed that the effect of pavement temperature is marginal, and should not result in an increase in density.

Chapter 4 lists the conclusions that can be drawn based upon these results and explores ideas for future analysis.

CHAPTER 4: CONCLUSIONS

4.1 SUMMARY

The hypothesis that asphalt pavement becomes denser when its temperature decreases has led to this study, which serves to find a correlation between the density and temperature of hot mix asphalt. A total of ten projects were sampled from 1999 and the year 2000 in an effort to determine this correlation.

Chapter 1 outlined the background, objectives, and benefits of this study. It also included a literature review and described nuclear density gauges and their operation.

Chapter 2 discussed the manner of data collection on site and in the lab, and explained the ten projects in the study, summarizing the characteristics of the pavement in each project. It also described the properties and design of asphalt paving.

Chapter 3 presented the results of statistical analyses of the projects, using different methods in an attempt to find a model that would explain which factors explain the density of hot mix asphaltic concrete. Statistical analysis included ANOVA, correlation, and box plots. These were performed using the SAS software. Most of the projects demonstrated slight increases in densities, but three projects did show decreases in densities overnight. Despite that, both the lab and site data indicated no statistically significant changes in density from Day 1 to Day 2, which is the focal point of this research.

4.2 SUMMARY OF FINDINGS

Ten different hot mix asphalt paving projects were surveyed from August 1999 to July 2000 to test the hypothesis that asphalt mixtures increases in density as they cool. Examining all site projects through statistical analyses led to the following conclusions:

- Statistical analysis found that the variables in this study that were significant to modeling the density response to temperature were mix type, gauge model, day of measurement, and pavement temperature at time of measurement.
- The model best able to explain the pavement density has an r-squared of 61%. This suggests that there are variables that were not considered which may contribute to variation of the density of asphalt pavements. The value of r-squared is relatively high considering the many factors that impact pavement density.
- Based on both field and lab analysis, there are no statistically significant increases in density from Day 1 to Day 2, though the average density for Day 2 was marginally higher than Day 1. The increase was of a magnitude less than 0.5%. Similarly there were no significant increases in density with a cooling in pavement temperature. However, the temperature becomes significant when other factors are added.
- Different gauges and mix types did not have a significant effect on density if analyzed individually. However, they are shown to be significant when other variables are included.
- Based on the data and characteristics that were studied in this research, only an explanatory, and not a predictive, model for density can be obtained. Other

variables such as material composition need to be considered. A predictive model for pavement density may be fairly complicated because it may involve many other factors.

4.3 RECOMMENDATIONS

An explanatory model has been developed that correlates the asphalt density to several variables. However, as the density on Day 2 was found to be insignificantly higher than the density on Day 1, measuring a pavement the day of paving should not produce different results than if the pavement is measured the following morning. Although this information means that a contractor would not be likely to receive a higher payment if the densities are recorded on the day following paving, it does indicate that there does not need to be a rush for WisDOT to record densities the day of paving.

4.4 RECOMMENDATIONS FOR FUTURE RESEARCH

A predictive model could not be derived from the information available in this study due to the fact that different asphalt mixes will react in different ways and only a few types of mixes have been explored in this study. A logical step would be to introduce and analyze additional variables that may help to further explain how the density of an asphalt mix is affected by changes in temperature. Some considerations include mix properties such as aggregate gradation. Isolating some variables would help in leading to a better understanding of how asphalt behaves under a temperature change.

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APPENDIX A

SAMPLE DATA SHEET AND WORK PLAN

Determining a Temperature-Density Relationship after Completed Rolling of Hot Mix Asphalt

Project: Date:
Contractor: Gauge Model:
Weather: Operator:

Day 1				Day 2			
Location	Density	Temp.		Location	Density	Temp.	
1				1			
Std Dev.				Std Dev.		ΔT	ΔDensity
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			

10				10			
11				11			
12				12			
13				13			
14				14			
15				15			
16				16			
17				17			
18				18			
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29				29			
30				30			

Determining a Temperature-Density Relationship after Completed Rolling of Hot-Mix Asphalt

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RESEARCH OBJECTIVES

The primary objective of this study is to determine whether asphalt density significantly increases after cooling and if a statistically significant correlation exists between asphalt density as measured after finish rolling and the following day using the nuclear gauge method of testing the density.

BENEFITS

The benefits of this study will include knowledge that will allow contractors and WisDOT to better estimate the asphalt density. This will promote consistency in terms of measurement and compensation in the industry.

WORK PLAN

A total of four contractors will be asked to provide one project that can be used for data collection. A minimum of 2 HV and 2 MV projects will be chosen in order to determine if mix-design is a factor in density and cooling. In addition, nuclear density gauges from Troxler and Seaman will be used.

The testing method is as follows:

1) The contractor will provide the nuclear density gauge as well as a method, such as a heat gun, to measure the asphalt temperature. The method of measuring the temperature is to remain the same throughout the course of the research. UW – Madison may place a thermocouple in the pavement to correlate the accuracy of the heat gun.

2) Information should be provided to the University of Wisconsin – Madison concerning the mix design, total thickness of the asphalt and the surface thickness. In addition, a 1-gallon liquid asphalt cement sample, and samples of stockpiled aggregates should be provided, as well as 18 loose-mix samples, each weighing 5kg, 3 each from a total of 6 trucks. Containers for these samples are to be provided by the contractors, and can be returned to the contractor at a later date.
3) One or more research assistants from the University of Wisconsin – Madison will arrive on-site during the day of the paving in order to measure and record the asphalt density and temperature in thirty (30) random locations. Each measurement will be taken three times to ensure precision. Locations will be marked using either chalk or paint so they can be used again the following morning when the asphalt has cooled. Testing locations should be away from where water can collect, out of the shade, and away from any environmental conditions that may alter the tests.
4) Test locations can be the same as the random testing normally done during paving unless the road is open to traffic. If open to traffic, all locations must be outside of the wheel paths of traffic, such as the center of the driving lane or paved shoulder. All locations chosen must have the same pavement structure below the new pavement. Sites that vary from PCC, base or HMA for the surface being overlaid should not be used.
5) Consistency in measurement is crucial to the success of this project. To that end, the University of Wisconsin - Madison asks that the person appointed to help the research assistants remain the same for both days of measurement. The researchers also ask that the appointed person arrive on-site one-half hour before construction begins the morning following the tested paving in order to start measuring the pavement before the temperature rises again. This would give the greatest range in pavement temperature to detect the density change.
6) If rain should fall during or before production of the mix that would contribute to excess internal moisture in the aggregate, testing should be postponed to a more suitable day. The plant should record the moisture of the aggregate going into the drum daily during the test period. In order to be tested, the moisture content will need to be less than 5.5%.

7) All nuclear density testing shall follow procedures set forth in Section 407 of the Standard Specifications as modified for QMP, Asphaltic Nuclear Density, with the exception of random site selection. The nuclear gauges are to be calibrated using a calibration block as necessary. Calibration sheets, if available, should be provided by the contractor.
8) Quality control charts during production are to be provided to UW – Madison.

FACILITIES AVAILABLE

As stated above, the University asks that all contractors provide their own measuring equipment in the form of a nuclear density gauge and heat gun. Also, containers to hold the asphalt cement, aggregate, and loose mix should also be provided by the contractor. In addition, a person to aid the data collectors will be very helpful.

NECESSARY MATERIALS (PROVIDED BY CONTRACTOR)

-Nuclear Density Machine

-Heat Gun

-Eighteen 5-kg Loose Mix Samples (6 each from 3 trucks)

-Mix Design

-Base material information; number of lifts; lift thickness

-Aggregate and AC samples

SUMMARY

The researchers at the University of Wisconsin – Madison look forward to working with you on this worthwhile project. Should you have any questions or if this Work Plan is not straightforward, feel free to call Professor Awad S. Hanna at (608) 263.8903 or his research assistant Stephen Schoenfelder at (414) 975.7886.

APPENDIX B

ANALYTICAL FIGURES

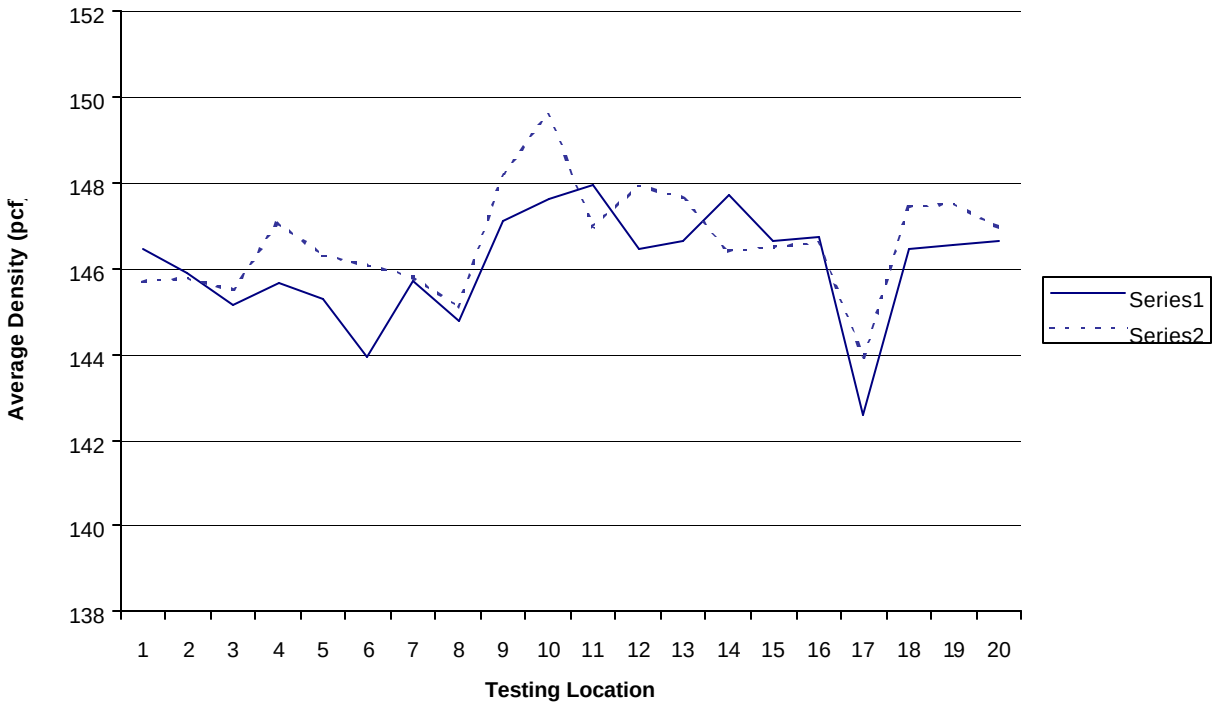

Figure B1: Average Density at Each Testing Location – Project 1

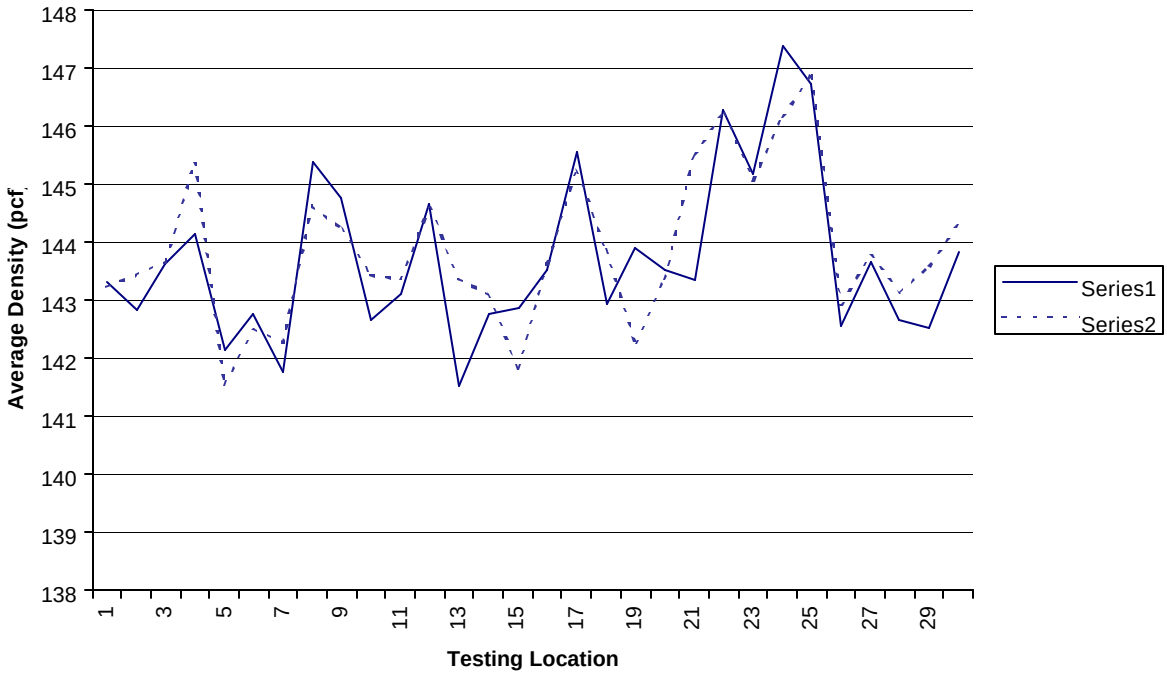

Figure B2: Average Density at Each Testing Location – Project 2

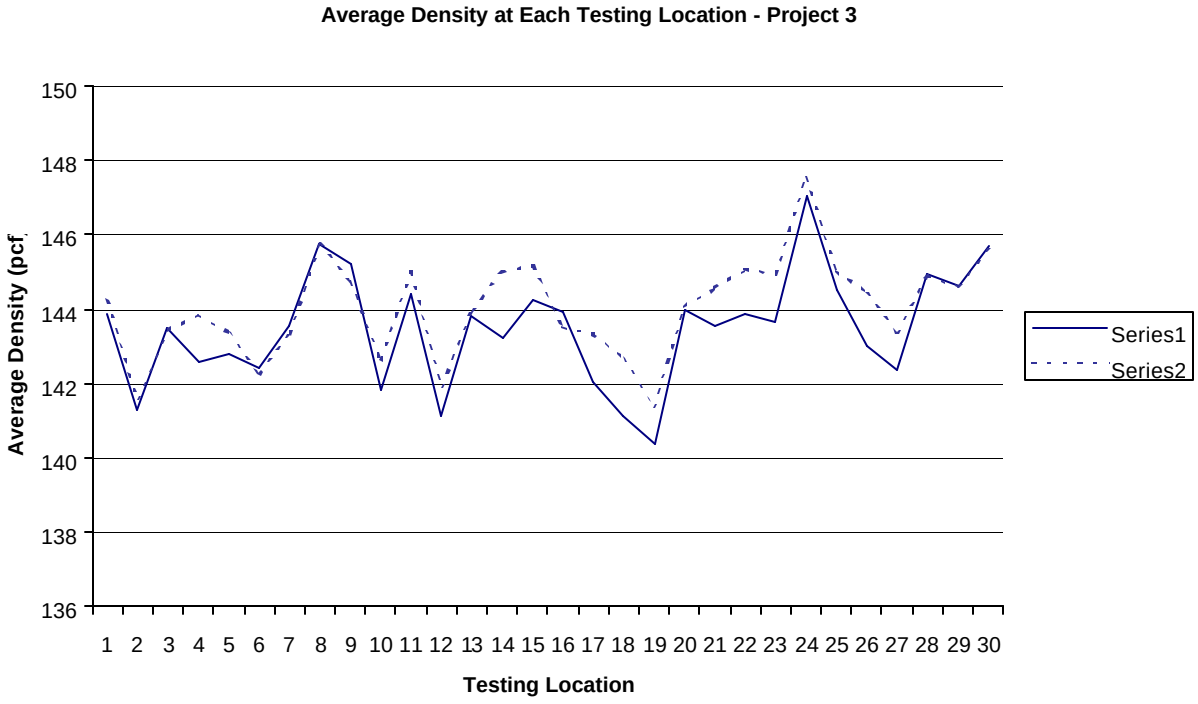

Figure B3: Average Density at Each Testing Location – Project 3

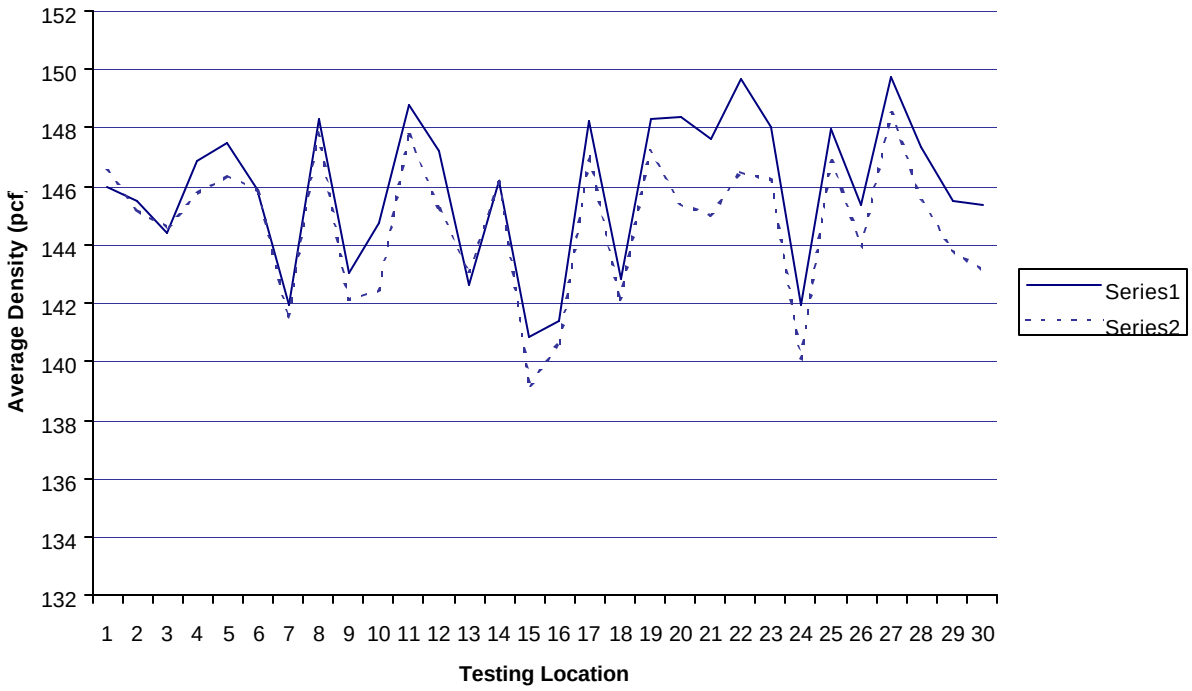

Figure B4: Average Density at Each Testing Location – Project 4

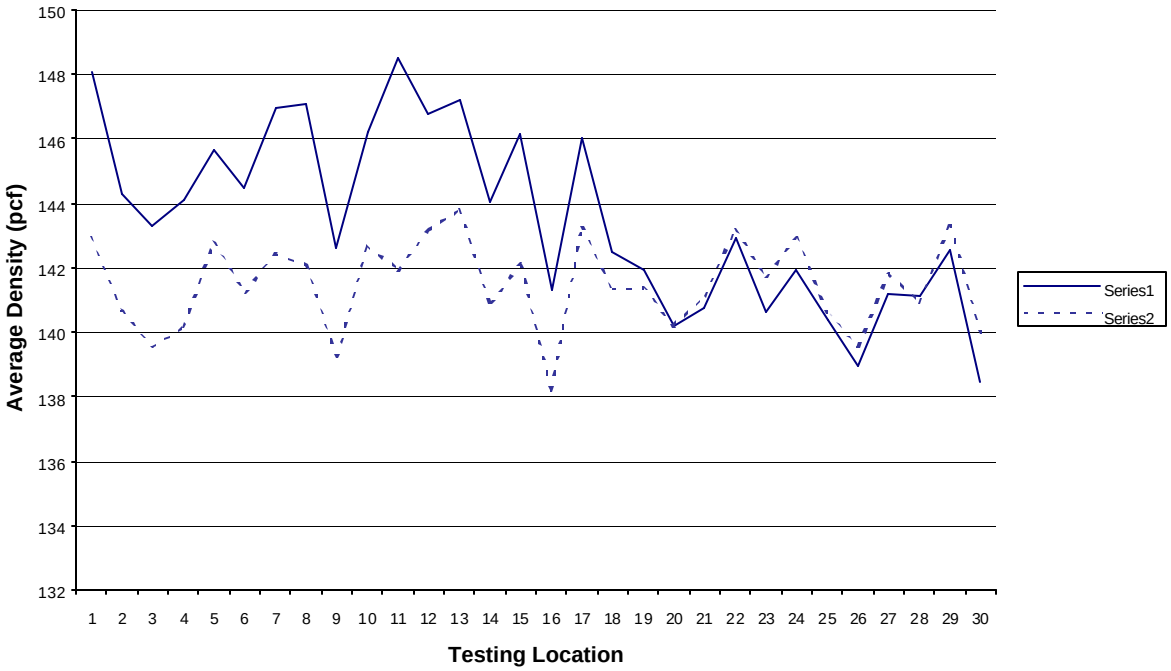

Figure B5: Average Density at Each Testing Location – Project 5

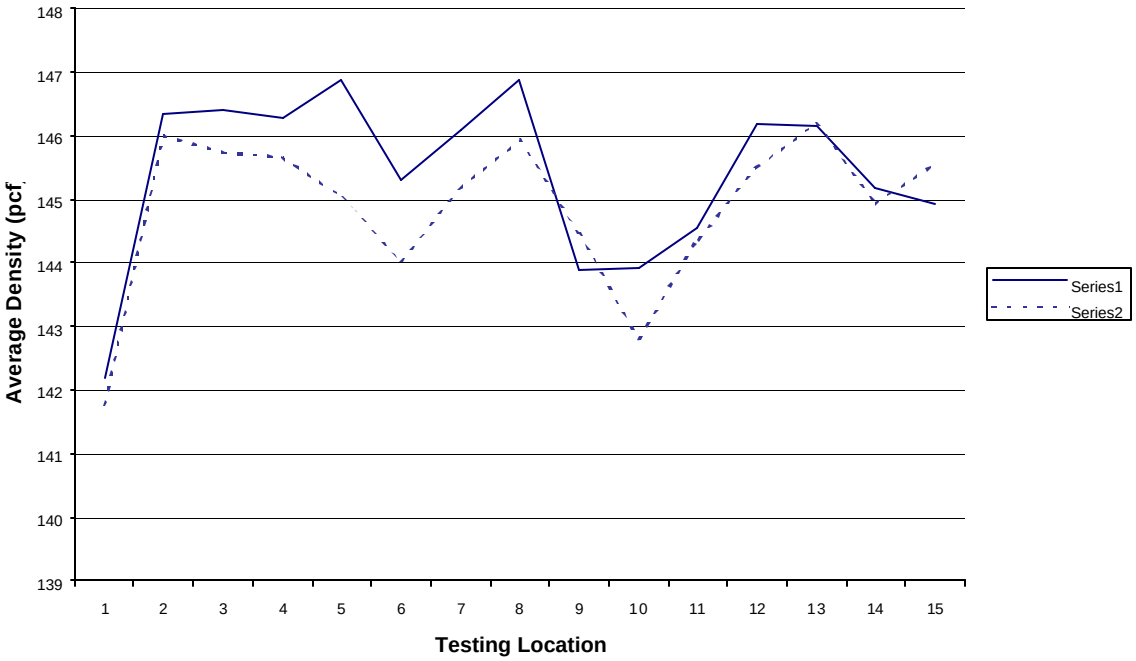

Figure B6: Average Density at Each Testing Location – Project 6

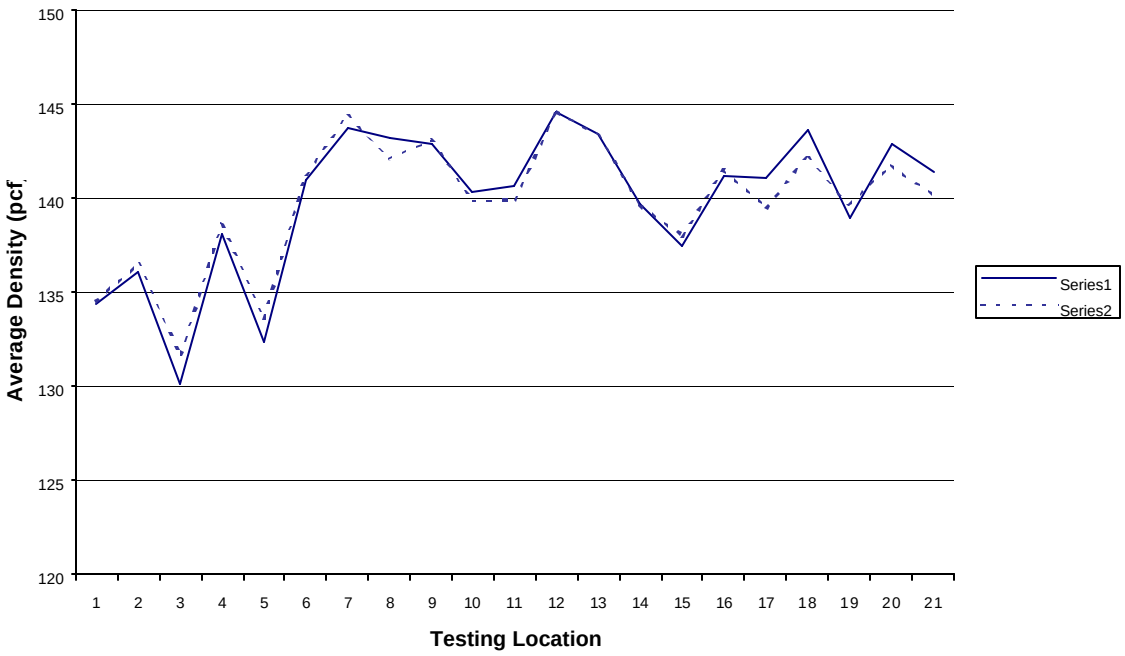

Figure B7: Average Density at Each Testing Location – Project 7

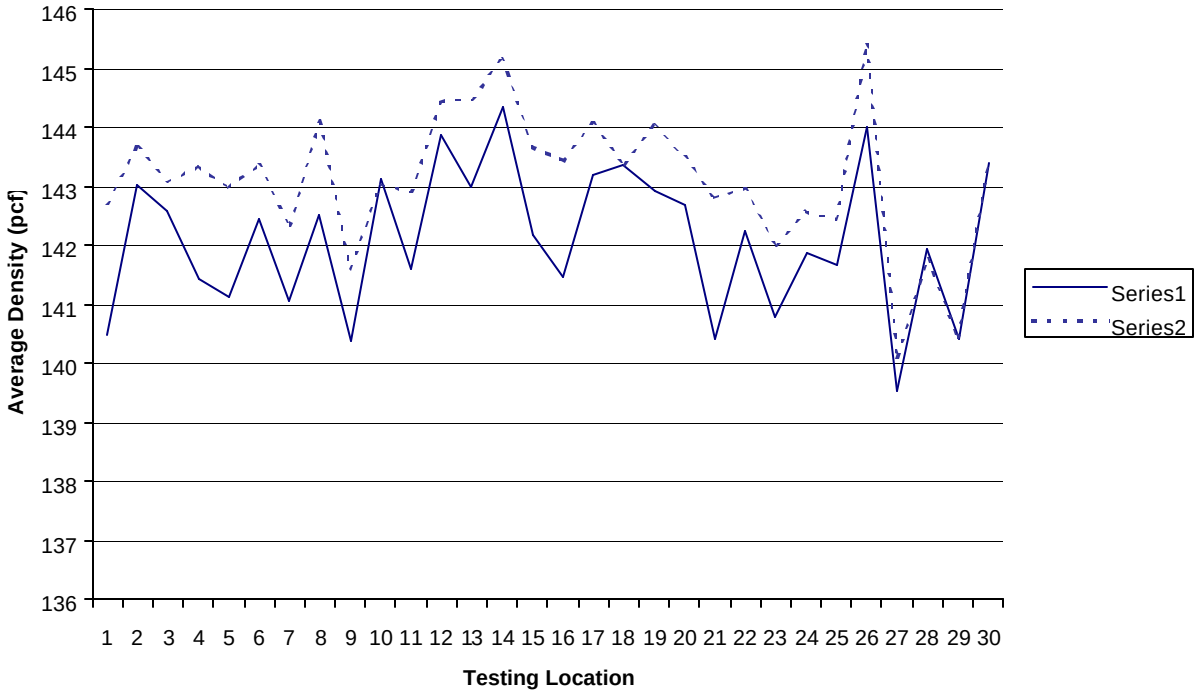

Figure B8: Average Density at Each Testing Location – Project 8

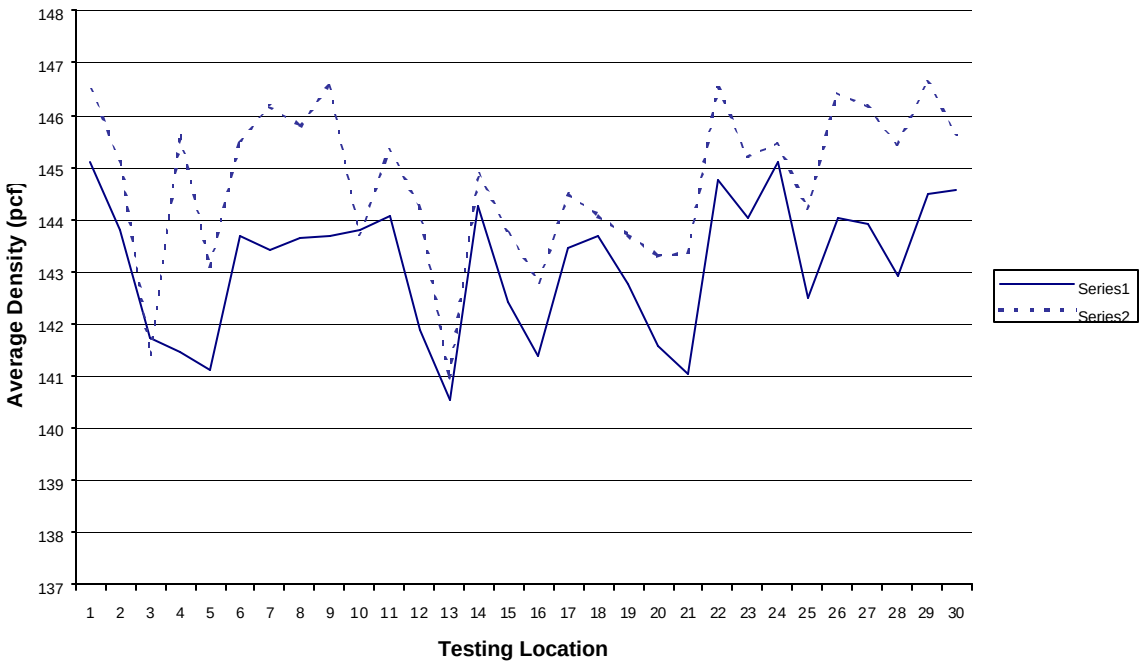

Figure B9: Average Density at Each Testing Location – Project 9

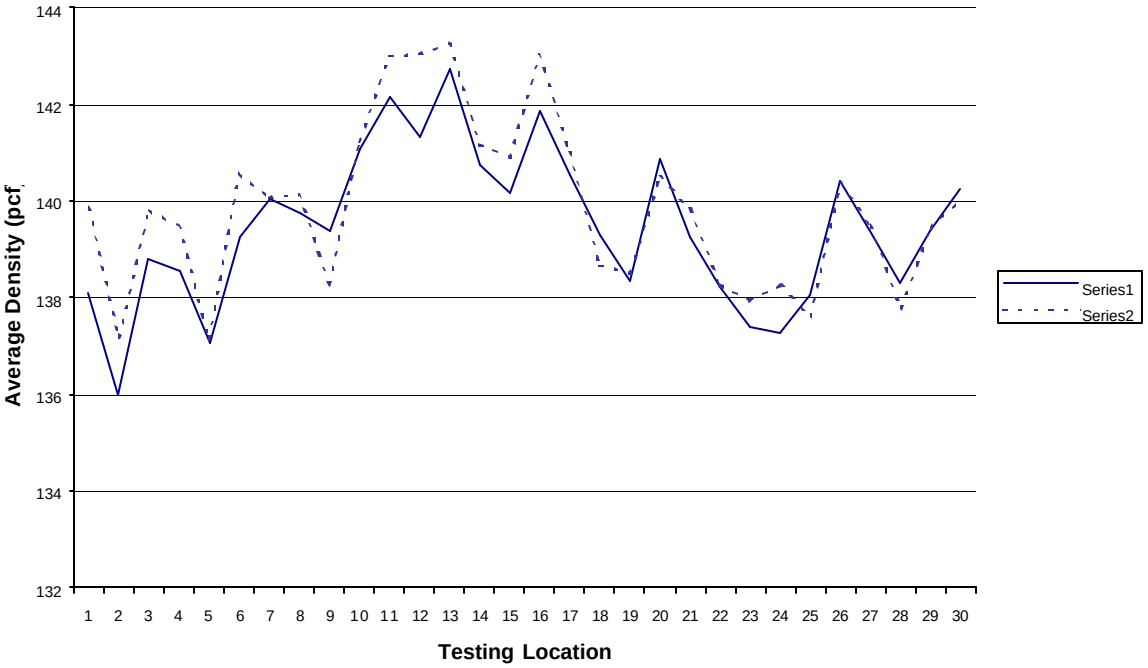

Figure B10: Average Density at Each Testing Location – Project 10

APPENDIX C

RAW DATA

C1 TABLE OF SITE DATA

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1	1	1	1	112	146.0	1	1	1
2	1	2	1	112	146.9	1	1	1
3	1	3	1	112	146.4	1	1	1
4	1	1	1	110	145.8	2	1	1
5	1	2	1	110	146.0	2	1	1
6	1	3	1	110	145.8	2	1	1
7	1	1	1	111	146.1	3	1	1
8	1	2	1	111	144.2	3	1	1
9	1	3	1	111	145.2	3	1	1
10	1	1	1	110	144.2	4	1	1
11	1	2	1	110	146.1	4	1	1
12	1	3	1	110	146.7	4	1	1
13	1	1	1	110	145.4	5	1	1
14	1	2	1	110	144.5	5	1	1
15	1	3	1	110	146.0	5	1	1
16	1	1	1	111	143.4	6	1	1
17	1	2	1	111	144.5	6	1	1
18	1	3	1	111	143.9	6	1	1
19	1	1	1	110	145.1	7	1	1
20	1	2	1	110	146.0	7	1	1
21	1	3	1	110	146.0	7	1	1
22	1	1	1	106	145.7	8	1	1
23	1	2	1	106	143.7	8	1	1
24	1	3	1	106	144.9	8	1	1
25	1	1	1	108	146.0	9	1	1
26	1	2	1	108	148.1	9	1	1
27	1	3	1	108	147.2	9	1	1
28	1	1	1	109	147.5	10	1	1
29	1	2	1	109	147.5	10	1	1
30	1	3	1	109	147.8	10	1	1
31	1	1	1	107	148.5	11	1	1
32	1	2	1	107	148.2	11	1	1
33	1	3	1	107	147.2	11	1	1
34	1	1	1	107	146.3	12	1	1
35	1	2	1	107	145.7	12	1	1
36	1	3	1	107	147.3	12	1	1
37	1	1	1	104	145.1	13	1	1
38	1	2	1	104	146.7	13	1	1
39	1	3	1	104	148.1	13	1	1
40	1	1	1	104	146.0	14	1	1
41	1	2	1	104	149.3	14	1	1
42	1	3	1	104	147.8	14	1	1
43	1	1	1	104	146.7	15	1	1
44	1	2	1	104	146.9	15	1	1

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
45	1	3	1	104	146.3	15	1	1
46	1	1	1	102	146.9	16	1	1
47	1	2	1	102	147.2	16	1	1
48	1	3	1	102	146.1	16	1	1
49	1	1	1	99	142.2	17	1	1
50	1	2	1	99	142.5	17	1	1
51	1	3	1	99	143.1	17	1	1
52	1	1	1	101	146.9	18	1	1
53	1	2	1	101	146.7	18	1	1
54	1	3	1	101	145.8	18	1	1
55	1	1	1	99	146.6	19	1	1
56	1	2	1	99	146.1	19	1	1
57	1	3	1	99	146.9	19	1	1
58	1	1	1	100	146.0	20	1	1
59	1	2	1	100	146.9	20	1	1
60	1	3	1	100	147.0	20	1	1
61	1	1	1	75	146.1	1	2	1
62	1	2	1	75	145.5	1	2	1
63	1	3	1	75	145.5	1	2	1
64	1	1	1	77	145.5	2	2	1
65	1	2	1	77	145.2	2	2	1
66	1	3	1	77	146.6	2	2	1
67	1	1	1	78	145.7	3	2	1
68	1	2	1	78	145.4	3	2	1
69	1	3	1	78	145.4	3	2	1
70	1	1	1	76	147.5	4	2	1
71	1	2	1	76	147.6	4	2	1
72	1	3	1	76	146.1	4	2	1
73	1	1	1	77	148.4	5	2	1
74	1	2	1	77	145.4	5	2	1
75	1	3	1	77	145.1	5	2	1
76	1	1	1	77	147.0	6	2	1
77	1	2	1	77	146.4	6	2	1
78	1	3	1	77	144.8	6	2	1
79	1	1	1	79	145.4	7	2	1
80	1	2	1	79	145.4	7	2	1
81	1	3	1	79	146.6	7	2	1
82	1	1	1	78	143.9	8	2	1
83	1	2	1	78	146.3	8	2	1
84	1	3	1	78	145.1	8	2	1
85	1	1	1	78	148.4	9	2	1
86	1	2	1	78	147.5	9	2	1
87	1	3	1	78	148.7	9	2	1
88	1	1	1	77	148.1	10	2	1
89	1	2	1	77	151.0	10	2	1

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
90	1	3	1	77	149.7	10	2	1
91	1	1	1	79	147.0	11	2	1
92	1	2	1	79	146.1	11	2	1
93	1	3	1	79	147.8	11	2	1
94	1	1	1	79	148.4	12	2	1
95	1	2	1	79	148.8	12	2	1
96	1	3	1	79	146.6	12	2	1
97	1	1	1	79	147.6	13	2	1
98	1	2	1	79	147.5	13	2	1
99	1	3	1	79	147.8	13	2	1
100	1	1	1	79	146.9	14	2	1
101	1	2	1	79	146.0	14	2	1
102	1	3	1	79	146.3	14	2	1
103	1	1	1	82	146.6	15	2	1
104	1	2	1	82	146.6	15	2	1
105	1	3	1	82	146.3	15	2	1
106	1	1	1	85	146.0	16	2	1
107	1	2	1	85	147.5	16	2	1
108	1	3	1	85	146.3	16	2	1
109	1	1	1	82	144.3	17	2	1
110	1	2	1	82	144.5	17	2	1
111	1	3	1	82	143.0	17	2	1
112	1	1	1	83	151.1	18	2	1
113	1	2	1	83	144.6	18	2	1
114	1	3	1	83	146.6	18	2	1
115	1	1	1	85	147.2	19	2	1
116	1	2	1	85	147.8	19	2	1
117	1	3	1	85	147.5	19	2	1
118	1	1	1	85	147.3	20	2	1
119	1	2	1	85	147.5	20	2	1
120	1	3	1	85	146.0	20	2	1
121	2	1	1	121	143.2	1	1	2
122	2	2	1	121	143.0	1	1	2
123	2	3	1	121	143.7	1	1	2
124	2	1	1	122	142.8	2	1	2
125	2	2	1	122	143.5	2	1	2
126	2	3	1	122	142.2	2	1	2
127	2	1	1	125	144.4	3	1	2
128	2	2	1	125	142.8	3	1	2
129	2	3	1	125	143.7	3	1	2
130	2	1	1	120	143.2	4	1	2
131	2	2	1	120	143.5	4	1	2
132	2	3	1	120	145.7	4	1	2
133	2	1	1	117	141.0	5	1	2
134	2	2	1	117	143.4	5	1	2

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
135	2	3	1	117	142.0	5	1	2
136	2	1	1	113	142.7	6	1	2
137	2	2	1	113	143.5	6	1	2
138	2	3	1	113	142.1	6	1	2
139	2	1	1	114	142.3	7	1	2
140	2	2	1	114	141.2	7	1	2
141	2	3	1	114	141.8	7	1	2
142	2	1	1	116	144.6	8	1	2
143	2	2	1	116	146.1	8	1	2
144	2	3	1	116	145.4	8	1	2
145	2	1	1	122	144.5	9	1	2
146	2	2	1	122	144.4	9	1	2
147	2	3	1	122	145.4	9	1	2
148	2	1	1	122	142.2	10	1	2
149	2	2	1	122	142.8	10	1	2
150	2	3	1	122	143.0	10	1	2
151	2	1	1	123	142.8	11	1	2
152	2	2	1	123	143.2	11	1	2
153	2	3	1	123	143.3	11	1	2
154	2	1	1	124	144.4	12	1	2
155	2	2	1	124	144.1	12	1	2
156	2	3	1	124	145.5	12	1	2
157	2	1	1	122	141.8	13	1	2
158	2	2	1	122	141.7	13	1	2
159	2	3	1	122	141.1	13	1	2
160	2	1	1	124	140.7	14	1	2
161	2	2	1	124	144.0	14	1	2
162	2	3	1	124	143.6	14	1	2
163	2	1	1	122	141.4	15	1	2
164	2	2	1	122	143.3	15	1	2
165	2	3	1	122	143.9	15	1	2
166	2	1	1	120	142.9	16	1	2
167	2	2	1	120	143.4	16	1	2
168	2	3	1	120	144.3	16	1	2
169	2	1	1	116	145.0	17	1	2
170	2	2	1	116	145.9	17	1	2
171	2	3	1	116	145.8	17	1	2
172	2	1	1	125	142.3	18	1	2
173	2	2	1	125	144.0	18	1	2
174	2	3	1	125	142.5	18	1	2
175	2	1	1	145	142.9	19	1	2
176	2	2	1	145	143.8	19	1	2
177	2	3	1	145	145.0	19	1	2
178	2	1	1	128	142.5	20	1	2
179	2	2	1	128	143.3	20	1	2

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
180	2	3	1	128	144.8	20	1	2
181	2	1	1	119	143.5	21	1	2
182	2	2	1	119	143.9	21	1	2
183	2	3	1	119	142.7	21	1	2
184	2	1	1	125	145.3	22	1	2
185	2	2	1	125	146.1	22	1	2
186	2	3	1	125	147.4	22	1	2
187	2	1	1	121	145.1	23	1	2
188	2	2	1	121	145.4	23	1	2
189	2	3	1	121	145.0	23	1	2
190	2	1	1	124	147.2	24	1	2
191	2	2	1	124	148.5	24	1	2
192	2	3	1	124	146.4	24	1	2
193	2	1	1	115	147.2	25	1	2
194	2	2	1	115	147.0	25	1	2
195	2	3	1	115	146.0	25	1	2
196	2	1	1	123	142.8	26	1	2
197	2	2	1	123	142.8	26	1	2
198	2	3	1	123	142.1	26	1	2
199	2	1	1	124	143.5	27	1	2
200	2	2	1	124	142.9	27	1	2
201	2	3	1	124	144.6	27	1	2
202	2	1	1	122	142.4	28	1	2
203	2	2	1	122	143.5	28	1	2
204	2	3	1	122	142.1	28	1	2
205	2	1	1	120	143.1	29	1	2
206	2	2	1	120	142.2	29	1	2
207	2	3	1	120	142.3	29	1	2
208	2	1	1	123	143.6	30	1	2
209	2	2	1	123	143.1	30	1	2
210	2	3	1	123	144.8	30	1	2
211	2	1	1	62	142.7	1	2	2
212	2	2	1	62	143.2	1	2	2
213	2	3	1	62	143.8	1	2	2
214	2	1	1	66	143.9	2	2	2
215	2	2	1	66	142.4	2	2	2
216	2	3	1	66	144.0	2	2	2
217	2	1	1	65	142.9	3	2	2
218	2	2	1	65	143.2	3	2	2
219	2	3	1	65	144.9	3	2	2
220	2	1	1	64	146.1	4	2	2
221	2	2	1	64	146.5	4	2	2
222	2	3	1	64	143.5	4	2	2
223	2	1	1	64	142.3	5	2	2
224	2	2	1	64	140.2	5	2	2

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
225	2	3	1	64	142.2	5	2	2
226	2	1	1	63	142.6	6	2	2
227	2	2	1	63	143.2	6	2	2
228	2	3	1	63	141.7	6	2	2
229	2	1	1	62	142.4	7	2	2
230	2	2	1	62	142.3	7	2	2
231	2	3	1	62	142.1	7	2	2
232	2	1	1	62	144.8	8	2	2
233	2	2	1	62	143.8	8	2	2
234	2	3	1	62	145.3	8	2	2
235	2	1	1	62	144.8	9	2	2
236	2	2	1	62	144.0	9	2	2
237	2	3	1	62	143.9	9	2	2
238	2	1	1	61	145.5	10	2	2
239	2	2	1	61	142.7	10	2	2
240	2	3	1	61	142.1	10	2	2
241	2	1	1	61	143.7	11	2	2
242	2	2	1	61	142.8	11	2	2
243	2	3	1	61	143.6	11	2	2
244	2	1	1	62	144.1	12	2	2
245	2	2	1	62	145.2	12	2	2
246	2	3	1	62	144.5	12	2	2
247	2	1	1	61	143.5	13	2	2
248	2	2	1	61	143.3	13	2	2
249	2	3	1	61	143.3	13	2	2
250	2	1	1	62	143.6	14	2	2
251	2	2	1	62	142.4	14	2	2
252	2	3	1	62	143.3	14	2	2
253	2	1	1	63	143.1	15	2	2
254	2	2	1	63	141.8	15	2	2
255	2	3	1	63	140.6	15	2	2
256	2	1	1	63	143.5	16	2	2
257	2	2	1	63	143.5	16	2	2
258	2	3	1	63	143.9	16	2	2
259	2	1	1	64	144.7	17	2	2
260	2	2	1	64	146.7	17	2	2
261	2	3	1	64	144.3	17	2	2
262	2	1	1	65	143.8	18	2	2
263	2	2	1	65	143.4	18	2	2
264	2	3	1	65	144.4	18	2	2
265	2	1	1	69	142.9	19	2	2
266	2	2	1	69	141.8	19	2	2
267	2	3	1	69	142.1	19	2	2
268	2	1	1	66	143.8	20	2	2
269	2	2	1	66	143.2	20	2	2

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
270	2	3	1	66	143.1	20	2	2
271	2	1	1	64	148.1	21	2	2
272	2	2	1	64	143.9	21	2	2
273	2	3	1	64	144.5	21	2	2
274	2	1	1	66	146.5	22	2	2
275	2	2	1	66	145.7	22	2	2
276	2	3	1	66	146.5	22	2	2
277	2	1	1	67	144.5	23	2	2
278	2	2	1	67	145.9	23	2	2
279	2	3	1	67	144.8	23	2	2
280	2	1	1	68	145.1	24	2	2
281	2	2	1	68	146.7	24	2	2
282	2	3	1	68	146.7	24	2	2
283	2	1	1	68	146.7	25	2	2
284	2	2	1	68	146.5	25	2	2
285	2	3	1	68	147.4	25	2	2
286	2	1	1	70	142.8	26	2	2
287	2	2	1	70	143.0	26	2	2
288	2	3	1	70	143.0	26	2	2
289	2	1	1	71	144.8	27	2	2
290	2	2	1	71	143.7	27	2	2
291	2	3	1	71	142.8	27	2	2
292	2	1	1	72	144.0	28	2	2
293	2	2	1	72	142.7	28	2	2
294	2	3	1	72	142.7	28	2	2
295	2	1	1	73	144.2	29	2	2
296	2	2	1	73	143.2	29	2	2
297	2	3	1	73	143.4	29	2	2
298	2	1	1	74	144.1	30	2	2
299	2	2	1	74	144.3	30	2	2
300	2	3	1	74	144.5	30	2	2
301	3	1	2	130	143.3	1	1	3
302	3	2	2	130	144.1	1	1	3
303	3	3	2	130	144.2	1	1	3
304	3	1	2	139	141.0	2	1	3
305	3	2	2	139	141.1	2	1	3
306	3	3	2	139	141.8	2	1	3
307	3	1	2	137	142.5	3	1	3
308	3	2	2	137	143.3	3	1	3
309	3	3	2	137	144.7	3	1	3
310	3	1	2	128	143.2	4	1	3
311	3	2	2	128	142.0	4	1	3
312	3	3	2	128	142.5	4	1	3
313	3	1	2	130	142.6	5	1	3
314	3	2	2	130	142.6	5	1	3

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
315	3	3	2	130	143.2	5	1	3
316	3	1	2	135	142.7	6	1	3
317	3	2	2	135	142.1	6	1	3
318	3	3	2	135	142.4	6	1	3
319	3	1	2	126	143.0	7	1	3
320	3	2	2	126	143.8	7	1	3
321	3	3	2	126	143.8	7	1	3
322	3	1	2	133	145.8	8	1	3
323	3	2	2	133	145.4	8	1	3
324	3	3	2	133	146.0	8	1	3
325	3	1	2	126	146.0	9	1	3
326	3	2	2	126	144.2	9	1	3
327	3	3	2	126	145.5	9	1	3
328	3	1	2	123	141.3	10	1	3
329	3	2	2	123	141.8	10	1	3
330	3	3	2	123	142.4	10	1	3
331	3	1	2	130	145.5	11	1	3
332	3	2	2	130	143.8	11	1	3
333	3	3	2	130	143.9	11	1	3
334	3	1	2	132	140.9	12	1	3
335	3	2	2	132	141.3	12	1	3
336	3	3	2	132	141.2	12	1	3
337	3	1	2	131	144.3	13	1	3
338	3	2	2	131	143.8	13	1	3
339	3	3	2	131	143.3	13	1	3
340	3	1	2	132	144.5	14	1	3
341	3	2	2	132	142.3	14	1	3
342	3	3	2	132	142.9	14	1	3
343	3	1	2	125	145.6	15	1	3
344	3	2	2	125	143.6	15	1	3
345	3	3	2	125	143.6	15	1	3
346	3	1	2	111	144.2	16	1	3
347	3	2	2	111	143.7	16	1	3
348	3	3	2	111	143.9	16	1	3
349	3	1	2	116	142.3	17	1	3
350	3	2	2	116	142.4	17	1	3
351	3	3	2	116	141.5	17	1	3
352	3	1	2	122	140.5	18	1	3
353	3	2	2	122	141.2	18	1	3
354	3	3	2	122	141.7	18	1	3
355	3	1	2	120	139.6	19	1	3
356	3	2	2	120	140.2	19	1	3
357	3	3	2	120	141.4	19	1	3
358	3	1	2	117	143.2	20	1	3
359	3	2	2	117	145.0	20	1	3

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
360	3	3	2	117	143.7	20	1	3
361	3	1	2	114	143.7	21	1	3
362	3	2	2	114	143.0	21	1	3
363	3	3	2	114	144.0	21	1	3
364	3	1	2	113	144.3	22	1	3
365	3	2	2	113	142.9	22	1	3
366	3	3	2	113	144.4	22	1	3
367	3	1	2	117	143.3	23	1	3
368	3	2	2	117	142.5	23	1	3
369	3	3	2	117	145.1	23	1	3
370	3	1	2	116	147.6	24	1	3
371	3	2	2	116	146.3	24	1	3
372	3	3	2	116	147.3	24	1	3
373	3	1	2	118	144.4	25	1	3
374	3	2	2	118	145.2	25	1	3
375	3	3	2	118	144	25	1	3
376	3	1	2	116	143.3	26	1	3
377	3	2	2	116	143.1	26	1	3
378	3	3	2	116	142.7	26	1	3
379	3	1	2	109	141.4	27	1	3
380	3	2	2	109	142.9	27	1	3
381	3	3	2	109	142.8	27	1	3
382	3	1	2	108	145.1	28	1	3
383	3	2	2	108	144.8	28	1	3
384	3	3	2	108	144.9	28	1	3
385	3	1	2	107	144.3	29	1	3
386	3	2	2	107	144.6	29	1	3
387	3	3	2	107	145	29	1	3
388	3	1	2	109	146.3	30	1	3
389	3	2	2	109	145.5	30	1	3
390	3	3	2	109	145.3	30	1	3
391	3	1	2	70	144.1	1	2	3
392	3	2	2	70	144.3	1	2	3
393	3	3	2	70	144.3	1	2	3
394	3	1	2	69	142.1	2	2	3
395	3	2	2	69	140.5	2	2	3
396	3	3	2	69	142.1	2	2	3
397	3	1	2	71	144.2	3	2	3
398	3	2	2	71	143.8	3	2	3
399	3	3	2	71	142.3	3	2	3
400	3	1	2	72	144	4	2	3
401	3	2	2	72	143.9	4	2	3
402	3	3	2	72	143.6	4	2	3
403	3	1	2	71	144.2	5	2	3
404	3	2	2	71	143.2	5	2	3

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
405	3	3	2	71	142.7	5	2	3
406	3	1	2	73	142.1	6	2	3
407	3	2	2	73	142.1	6	2	3
408	3	3	2	73	142.6	6	2	3
409	3	1	2	73	143.2	7	2	3
410	3	2	2	73	142.9	7	2	3
411	3	3	2	73	143.9	7	2	3
412	3	1	2	73	146.5	8	2	3
413	3	2	2	73	146	8	2	3
414	3	3	2	73	144.8	8	2	3
415	3	1	2	73	144.8	9	2	3
416	3	2	2	73	144.8	9	2	3
417	3	3	2	73	144.6	9	2	3
418	3	1	2	76	143.3	10	2	3
419	3	2	2	76	141.8	10	2	3
420	3	3	2	76	142.8	10	2	3
421	3	1	2	76	144.9	11	2	3
422	3	2	2	76	144.5	11	2	3
423	3	3	2	76	145.6	11	2	3
424	3	1	2	79	142.8	12	2	3
425	3	2	2	79	141.3	12	2	3
426	3	3	2	79	141.6	12	2	3
427	3	1	2	77	143.8	13	2	3
428	3	2	2	77	144.7	13	2	3
429	3	3	2	77	143.4	13	2	3
430	3	1	2	78	145.8	14	2	3
431	3	2	2	78	144.8	14	2	3
432	3	3	2	78	144.4	14	2	3
433	3	1	2	75	145.3	15	2	3
434	3	2	2	75	145.7	15	2	3
435	3	3	2	75	144.5	15	2	3
436	3	1	2	79	142	16	2	3
437	3	2	2	79	144	16	2	3
438	3	3	2	79	144.5	16	2	3
439	3	1	2	80	143.2	17	2	3
440	3	2	2	80	143.1	17	2	3
441	3	3	2	80	143.7	17	2	3
442	3	1	2	80	143.2	18	2	3
443	3	2	2	80	143.1	18	2	3
444	3	3	2	80	141.7	18	2	3
445	3	1	2	82	141.3	19	2	3
446	3	2	2	82	142.4	19	2	3
447	3	3	2	82	140.4	19	2	3
448	3	1	2	84	144.2	20	2	3
449	3	2	2	84	143.8	20	2	3

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
450	3	3	2	84	144.2	20	2	3
451	3	1	2	86	144.9	21	2	3
452	3	2	2	86	144.1	21	2	3
453	3	3	2	86	144.7	21	2	3
454	3	1	2	84	145.1	22	2	3
455	3	2	2	84	144.4	22	2	3
456	3	3	2	84	145.7	22	2	3
457	3	1	2	87	144.1	23	2	3
458	3	2	2	87	144.9	23	2	3
459	3	3	2	87	145.8	23	2	3
460	3	1	2	87	146.5	24	2	3
461	3	2	2	87	147.9	24	2	3
462	3	3	2	87	148.2	24	2	3
463	3	1	2	90	145.8	25	2	3
464	3	2	2	90	144	25	2	3
465	3	3	2	90	145.3	25	2	3
466	3	1	2	90	144.8	26	2	3
467	3	2	2	90	145.1	26	2	3
468	3	3	2	90	143.4	26	2	3
469	3	1	2	91	143.9	27	2	3
470	3	2	2	91	142.5	27	2	3
471	3	3	2	91	143.7	27	2	3
472	3	1	2	92	144.4	28	2	3
473	3	2	2	92	145.7	28	2	3
474	3	3	2	92	144.6	28	2	3
475	3	1	2	92	144	29	2	3
476	3	2	2	92	145	29	2	3
477	3	3	2	92	144.8	29	2	3
478	3	1	2	96	145.4	30	2	3
479	3	2	2	96	145	30	2	3
480	3	3	2	96	146.4	30	2	3
481	4	1	3	102	145.1	1	1	4
482	4	2	3	102	145.7	1	1	4
483	4	3	3	102	147.1	1	1	4
484	4	1	3	101	145.6	2	1	4
485	4	2	3	101	145.4	2	1	4
486	4	3	3	101	145.5	2	1	4
487	4	1	3	98	144.6	3	1	4
488	4	2	3	98	143.5	3	1	4
489	4	3	3	98	145	3	1	4
490	4	1	3	108	146.2	4	1	4
491	4	2	3	108	146.8	4	1	4
492	4	3	3	108	147.6	4	1	4
493	4	1	3	100	146.5	5	1	4
494	4	2	3	100	147.9	5	1	4

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
495	4	3	3	100	148	5	1	4
496	4	1	3	102	146.6	6	1	4
497	4	2	3	102	145.6	6	1	4
498	4	3	3	102	145.6	6	1	4
499	4	1	3	90	142	7	1	4
500	4	2	3	90	141.8	7	1	4
501	4	3	3	90	142	7	1	4
502	4	1	3	93	148.4	8	1	4
503	4	2	3	93	147.9	8	1	4
504	4	3	3	93	148.6	8	1	4
505	4	1	3	95	143.1	9	1	4
506	4	2	3	95	142.9	9	1	4
507	4	3	3	95	143	9	1	4
508	4	1	3	101	144.6	10	1	4
509	4	2	3	101	144.9	10	1	4
510	4	3	3	101	144.7	10	1	4
511	4	1	3	105	148.1	11	1	4
512	4	2	3	105	149.5	11	1	4
513	4	3	3	105	148.7	11	1	4
514	4	1	3	101	145.9	12	1	4
515	4	2	3	101	147.6	12	1	4
516	4	3	3	101	148.1	12	1	4
517	4	1	3	105	142.6	13	1	4
518	4	2	3	105	142.4	13	1	4
519	4	3	3	105	142.8	13	1	4
520	4	1	3	103	146.6	14	1	4
521	4	2	3	103	145.3	14	1	4
522	4	3	3	103	146.7	14	1	4
523	4	1	3	106	142	15	1	4
524	4	2	3	106	140.3	15	1	4
525	4	3	3	106	140.3	15	1	4
526	4	1	3	101	141.6	16	1	4
527	4	2	3	101	141.8	16	1	4
528	4	3	3	101	140.7	16	1	4
529	4	1	3	95	148.2	17	1	4
530	4	2	3	95	148.7	17	1	4
531	4	3	3	95	147.7	17	1	4
532	4	1	3	100	143.2	18	1	4
533	4	2	3	100	142.9	18	1	4
534	4	3	3	100	142.4	18	1	4
535	4	1	3	90	148.1	19	1	4
536	4	2	3	90	148.7	19	1	4
537	4	3	3	90	148.2	19	1	4
538	4	1	3	96	148.2	20	1	4
539	4	2	3	96	148.8	20	1	4

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
540	4	3	3	96	148.2	20	1	4
541	4	1	3	100	147.6	21	1	4
542	4	2	3	100	147.5	21	1	4
543	4	3	3	100	147.7	21	1	4
544	4	1	3	95	149.7	22	1	4
545	4	2	3	95	149.9	22	1	4
546	4	3	3	95	149.4	22	1	4
547	4	1	3	97	149.5	23	1	4
548	4	2	3	97	147.6	23	1	4
549	4	3	3	97	147	23	1	4
550	4	1	3	106	141.6	24	1	4
551	4	2	3	106	142.3	24	1	4
552	4	3	3	106	141.9	24	1	4
553	4	1	3	100	147.6	25	1	4
554	4	2	3	100	148.4	25	1	4
555	4	3	3	100	147.8	25	1	4
556	4	1	3	96	145.7	26	1	4
557	4	2	3	96	144.3	26	1	4
558	4	3	3	96	146	26	1	4
559	4	1	3	96	149.6	27	1	4
560	4	2	3	96	149.2	27	1	4
561	4	3	3	96	150.4	27	1	4
562	4	1	3	96	146.9	28	1	4
563	4	2	3	96	147.7	28	1	4
564	4	3	3	96	147.5	28	1	4
565	4	1	3	100	146	29	1	4
566	4	2	3	100	145.5	29	1	4
567	4	3	3	100	145.1	29	1	4
568	4	1	3	95	144.9	30	1	4
569	4	2	3	95	145.9	30	1	4
570	4	3	3	95	145.3	30	1	4
571	4	1	3	102	146.4	1	2	4
572	4	2	3	102	146	1	2	4
573	4	3	3	102	147.2	1	2	4
574	4	1	3	62	144.6	2	2	4
575	4	2	3	62	145	2	2	4
576	4	3	3	62	145.9	2	2	4
577	4	1	3	62	144.7	3	2	4
578	4	2	3	62	144.3	3	2	4
579	4	3	3	62	144.8	3	2	4
580	4	1	3	65	145.3	4	2	4
581	4	2	3	65	146	4	2	4
582	4	3	3	65	146	4	2	4
583	4	1	3	65	146.3	5	2	4
584	4	2	3	65	146	5	2	4

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
585	4	3	3	65	146.8	5	2	4
586	4	1	3	65	145.9	6	2	4
587	4	2	3	65	146.6	6	2	4
588	4	3	3	65	145	6	2	4
589	4	1	3	65	142.4	7	2	4
590	4	2	3	65	140.8	7	2	4
591	4	3	3	65	141.4	7	2	4
592	4	1	3	65	147.7	8	2	4
593	4	2	3	65	148	8	2	4
594	4	3	3	65	147.8	8	2	4
595	4	1	3	65	141.7	9	2	4
596	4	2	3	65	142.5	9	2	4
597	4	3	3	65	142.1	9	2	4
598	4	1	3	67	142.8	10	2	4
599	4	2	3	67	142.4	10	2	4
600	4	3	3	67	142.1	10	2	4
601	4	1	3	64	147.5	11	2	4
602	4	2	3	64	148.5	11	2	4
603	4	3	3	64	147.3	11	2	4
604	4	1	3	64	145.2	12	2	4
605	4	2	3	64	145.1	12	2	4
606	4	3	3	64	145.4	12	2	4
607	4	1	3	65	143	13	2	4
608	4	2	3	65	143	13	2	4
609	4	3	3	65	143.2	13	2	4
610	4	1	3	64	145.9	14	2	4
611	4	2	3	64	146.7	14	2	4
612	4	3	3	64	145.9	14	2	4
613	4	1	3	64	139.9	15	2	4
614	4	2	3	64	138.6	15	2	4
615	4	3	3	64	139.1	15	2	4
616	4	1	3	67	140.6	16	2	4
617	4	2	3	67	140.8	16	2	4
618	4	3	3	67	140.5	16	2	4
619	4	1	3	66	147.4	17	2	4
620	4	2	3	66	146.3	17	2	4
621	4	3	3	66	147.3	17	2	4
622	4	1	3	66	141.8	18	2	4
623	4	2	3	66	143.4	18	2	4
624	4	3	3	66	141.1	18	2	4
625	4	1	3	66	146.7	19	2	4
626	4	2	3	66	147.2	19	2	4
627	4	3	3	66	147.8	19	2	4
628	4	1	3	64	145.8	20	2	4
629	4	2	3	64	144.4	20	2	4

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
630	4	3	3	64	146	20	2	4
631	4	1	3	65	144.9	21	2	4
632	4	2	3	65	144.5	21	2	4
633	4	3	3	65	145.6	21	2	4
634	4	1	3	65	145.9	22	2	4
635	4	2	3	65	146.4	22	2	4
636	4	3	3	65	147.1	22	2	4
637	4	1	3	66	146.5	23	2	4
638	4	2	3	66	145.6	23	2	4
639	4	3	3	66	146.6	23	2	4
640	4	1	3	66	140.2	24	2	4
641	4	2	3	66	140	24	2	4
642	4	3	3	66	140.1	24	2	4
643	4	1	3	63	146.3	25	2	4
644	4	2	3	63	146.6	25	2	4
645	4	3	3	63	147.8	25	2	4
646	4	1	3	66	143.6	26	2	4
647	4	2	3	66	144	26	2	4
648	4	3	3	66	144.2	26	2	4
649	4	1	3	67	148.4	27	2	4
650	4	2	3	67	148.5	27	2	4
651	4	3	3	67	148.7	27	2	4
652	4	1	3	63	145.6	28	2	4
653	4	2	3	63	145.3	28	2	4
654	4	3	3	63	145.6	28	2	4
655	4	1	3	64	143.8	29	2	4
656	4	2	3	64	143.8	29	2	4
657	4	3	3	64	143.9	29	2	4
658	4	1	3	64	143	30	2	4
659	4	2	3	64	142.9	30	2	4
660	4	3	3	64	143.5	30	2	4
661	5	1	1	118	148.9	1	1	5
662	5	2	1	118	147.3	1	1	5
663	5	3	1	118	148.1	1	1	5
664	5	1	1	121	145.2	2	1	5
665	5	2	1	121	144.4	2	1	5
666	5	3	1	121	143.2	2	1	5
667	5	1	1	122	142.1	3	1	5
668	5	2	1	122	143.9	3	1	5
669	5	3	1	122	143.8	3	1	5
670	5	1	1	116	146.3	4	1	5
671	5	2	1	116	142	4	1	5
672	5	3	1	116	143.9	4	1	5
673	5	1	1	120	146.8	5	1	5
674	5	2	1	120	145.4	5	1	5

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
675	5	3	1	120	144.8	5	1	5
676	5	1	1	121	143.9	6	1	5
677	5	2	1	121	144.1	6	1	5
678	5	3	1	121	145.5	6	1	5
679	5	1	1	118	146.9	7	1	5
680	5	2	1	118	147	7	1	5
681	5	3	1	118	147	7	1	5
682	5	1	1	116	146.9	8	1	5
683	5	2	1	116	148.2	8	1	5
684	5	3	1	116	146.1	8	1	5
685	5	1	1	115	141.3	9	1	5
686	5	2	1	115	143.5	9	1	5
687	5	3	1	115	143	9	1	5
688	5	1	1	119	146.3	10	1	5
689	5	2	1	119	146.2	10	1	5
690	5	3	1	119	146.1	10	1	5
691	5	1	1	116	149	11	1	5
692	5	2	1	116	149.3	11	1	5
693	5	3	1	116	147.2	11	1	5
694	5	1	1	118	146.8	12	1	5
695	5	2	1	118	147.2	12	1	5
696	5	3	1	118	146.3	12	1	5
697	5	1	1	117	145.6	13	1	5
698	5	2	1	117	147.7	13	1	5
699	5	3	1	117	148.3	13	1	5
700	5	1	1	117	143.1	14	1	5
701	5	2	1	117	144.7	14	1	5
702	5	3	1	117	144.3	14	1	5
703	5	1	1	116	144.7	15	1	5
704	5	2	1	116	146.9	15	1	5
705	5	3	1	116	146.8	15	1	5
706	5	1	1	117	140.7	16	1	5
707	5	2	1	117	142.5	16	1	5
708	5	3	1	117	140.8	16	1	5
709	5	1	1	115	145.9	17	1	5
710	5	2	1	115	146.5	17	1	5
711	5	3	1	115	145.7	17	1	5
712	5	1	1	118	142.4	18	1	5
713	5	2	1	118	143.8	18	1	5
714	5	3	1	118	141.2	18	1	5
715	5	1	1	115	143.4	19	1	5
716	5	2	1	115	140.8	19	1	5
717	5	3	1	115	141.6	19	1	5
718	5	1	1	119	139.6	20	1	5
719	5	2	1	119	139.6	20	1	5

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
720	5	3	1	119	141.3	20	1	5
721	5	1	1	115	140.4	21	1	5
722	5	2	1	115	140.8	21	1	5
723	5	3	1	115	141.1	21	1	5
724	5	1	1	118	142.9	22	1	5
725	5	2	1	118	142	22	1	5
726	5	3	1	118	143.8	22	1	5
727	5	1	1	119	140.1	23	1	5
728	5	2	1	119	140.8	23	1	5
729	5	3	1	119	140.9	23	1	5
730	5	1	1	114	141.9	24	1	5
731	5	2	1	114	142.4	24	1	5
732	5	3	1	114	141.5	24	1	5
733	5	1	1	119	140	25	1	5
734	5	2	1	119	141.3	25	1	5
735	5	3	1	119	139.9	25	1	5
736	5	1	1	115	138.3	26	1	5
737	5	2	1	115	139.6	26	1	5
738	5	3	1	115	139	26	1	5
739	5	1	1	116	141.1	27	1	5
740	5	2	1	116	140.1	27	1	5
741	5	3	1	116	142.4	27	1	5
742	5	1	1	117	141.2	28	1	5
743	5	2	1	117	141.7	28	1	5
744	5	3	1	117	140.4	28	1	5
745	5	1	1	110	142.6	29	1	5
746	5	2	1	110	141.9	29	1	5
747	5	3	1	110	143.1	29	1	5
748	5	1	1	109	138.5	30	1	5
749	5	2	1	109	138.1	30	1	5
750	5	3	1	109	138.7	30	1	5
751	5	1	1	52	142.4	1	2	5
752	5	2	1	52	143.6	1	2	5
753	5	3	1	52	142.8	1	2	5
754	5	1	1	53	138.8	2	2	5
755	5	2	1	53	142.4	2	2	5
756	5	3	1	53	140.8	2	2	5
757	5	1	1	52	139.9	3	2	5
758	5	2	1	52	139.7	3	2	5
759	5	3	1	52	139	3	2	5
760	5	1	1	53	139.5	4	2	5
761	5	2	1	53	140.1	4	2	5
762	5	3	1	53	140.9	4	2	5
763	5	1	1	53	141.6	5	2	5
764	5	2	1	53	143.4	5	2	5

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
765	5	3	1	53	143.3	5	2	5
766	5	1	1	53	139.7	6	2	5
767	5	2	1	53	142.2	6	2	5
768	5	3	1	53	141.8	6	2	5
769	5	1	1	52	141.8	7	2	5
770	5	2	1	52	142.4	7	2	5
771	5	3	1	52	143.1	7	2	5
772	5	1	1	52	141.9	8	2	5
773	5	2	1	52	142	8	2	5
774	5	3	1	52	142.3	8	2	5
775	5	1	1	51	138.7	9	2	5
776	5	2	1	51	139.8	9	2	5
777	5	3	1	51	139.2	9	2	5
778	5	1	1	53	142	10	2	5
779	5	2	1	53	142.8	10	2	5
780	5	3	1	53	143.3	10	2	5
781	5	1	1	52	141.3	11	2	5
782	5	2	1	52	142.6	11	2	5
783	5	3	1	52	141.9	11	2	5
784	5	1	1	54	142.3	12	2	5
785	5	2	1	54	143.4	12	2	5
786	5	3	1	54	143.8	12	2	5
787	5	1	1	52	144.3	13	2	5
788	5	2	1	52	143.5	13	2	5
789	5	3	1	52	143.6	13	2	5
790	5	1	1	54	140.1	14	2	5
791	5	2	1	54	141.8	14	2	5
792	5	3	1	54	140.8	14	2	5
793	5	1	1	54	141.7	15	2	5
794	5	2	1	54	143	15	2	5
795	5	3	1	54	141.6	15	2	5
796	5	1	1	53	136	16	2	5
797	5	2	1	53	139.8	16	2	5
798	5	3	1	53	138.8	16	2	5
799	5	1	1	53	144.6	17	2	5
800	5	2	1	53	143	17	2	5
801	5	3	1	53	142.1	17	2	5
802	5	1	1	53	141.1	18	2	5
803	5	2	1	53	141.1	18	2	5
804	5	3	1	53	141.8	18	2	5
805	5	1	1	53	141.2	19	2	5
806	5	2	1	53	141	19	2	5
807	5	3	1	53	141.9	19	2	5
808	5	1	1	54	140.8	20	2	5
809	5	2	1	54	140	20	2	5

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
810	5	3	1	54	139.8	20	2	5
811	5	1	1	53	141.8	21	2	5
812	5	2	1	53	141.6	21	2	5
813	5	3	1	53	140	21	2	5
814	5	1	1	53	143.6	22	2	5
815	5	2	1	53	142.9	22	2	5
816	5	3	1	53	143	22	2	5
817	5	1	1	53	141.7	23	2	5
818	5	2	1	53	140.9	23	2	5
819	5	3	1	53	142.6	23	2	5
820	5	1	1	54	143.4	24	2	5
821	5	2	1	54	142.2	24	2	5
822	5	3	1	54	143.2	24	2	5
823	5	1	1	54	141.8	25	2	5
824	5	2	1	54	141	25	2	5
825	5	3	1	54	139	25	2	5
826	5	1	1	55	139.6	26	2	5
827	5	2	1	55	140.1	26	2	5
828	5	3	1	55	139	26	2	5
829	5	1	1	55	141.6	27	2	5
830	5	2	1	55	142.6	27	2	5
831	5	3	1	55	141.2	27	2	5
832	5	1	1	55	141.2	28	2	5
833	5	2	1	55	140.3	28	2	5
834	5	3	1	55	141.3	28	2	5
835	5	1	1	54	143.1	29	2	5
836	5	2	1	54	142.2	29	2	5
837	5	3	1	54	144.7	29	2	5
838	5	1	1	54	139.9	30	2	5
839	5	2	1	54	140.8	30	2	5
840	5	3	1	54	139.3	30	2	5
841	6	1	2	147	141.5	1	1	3
842	6	2	2	147	142.7	1	1	3
843	6	3	2	147	142.4	1	1	3
844	6	1	2	111	145.4	2	1	3
845	6	2	2	111	147.1	2	1	3
846	6	3	2	111	146.5	2	1	3
847	6	1	2	129	146.6	3	1	3
848	6	2	2	129	147.1	3	1	3
849	6	3	2	129	145.5	3	1	3
850	6	1	2	135	146.9	4	1	3
851	6	2	2	135	145.7	4	1	3
852	6	3	2	135	146.2	4	1	3
853	6	1	2	110	145.6	5	1	3
854	6	2	2	110	147.9	5	1	3

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
855	6	3	2	110	147.1	5	1	3
856	6	1	2	112	146	6	1	3
857	6	2	2	112	145.4	6	1	3
858	6	3	2	112	144.5	6	1	3
859	6	1	2	94	146.8	7	1	3
860	6	2	2	94	146.3	7	1	3
861	6	3	2	94	145.2	7	1	3
862	6	1	2	91	147	8	1	3
863	6	2	2	91	146	8	1	3
864	6	3	2	91	147.6	8	1	3
865	6	1	2	119	144.1	9	1	3
866	6	2	2	119	142.9	9	1	3
867	6	3	2	119	144.7	9	1	3
868	6	1	2	114	144.4	10	1	3
869	6	2	2	114	142.9	10	1	3
870	6	3	2	114	144.5	10	1	3
871	6	1	2	100	145.5	11	1	3
872	6	2	2	100	144.3	11	1	3
873	6	3	2	100	143.9	11	1	3
874	6	1	2	103	146.7	12	1	3
875	6	2	2	103	146.4	12	1	3
876	6	3	2	103	145.5	12	1	3
877	6	1	2	105	144.5	13	1	3
878	6	2	2	105	146.7	13	1	3
879	6	3	2	105	147.3	13	1	3
880	6	1	2	100	144.2	14	1	3
881	6	2	2	100	145.3	14	1	3
882	6	3	2	100	146	14	1	3
883	6	1	2	97	144.5	15	1	3
884	6	2	2	97	145.7	15	1	3
885	6	3	2	97	144.6	15	1	3
886	6	1	2	45	141.7	1	2	3
887	6	2	2	45	142	1	2	3
888	6	3	2	45	141.6	1	2	3
889	6	1	2	46	146.4	2	2	3
890	6	2	2	46	145.4	2	2	3
891	6	3	2	46	146.2	2	2	3
892	6	1	2	48	145.7	3	2	3
893	6	2	2	48	145.3	3	2	3
894	6	3	2	48	146.2	3	2	3
895	6	1	2	47	145.4	4	2	3
896	6	2	2	47	146	4	2	3
897	6	3	2	47	145.6	4	2	3
898	6	1	2	44	145.7	5	2	3
899	6	2	2	44	142	5	2	3

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
900	6	3	2	44	147.4	5	2	3
901	6	1	2	45	142.9	6	2	3
902	6	2	2	45	145.5	6	2	3
903	6	3	2	45	143.7	6	2	3
904	6	1	2	45	145.9	7	2	3
905	6	2	2	45	144.7	7	2	3
906	6	3	2	45	144.9	7	2	3
907	6	1	2	43	145.2	8	2	3
908	6	2	2	43	146.4	8	2	3
909	6	3	2	43	146.2	8	2	3
910	6	1	2	47	143.4	9	2	3
911	6	2	2	47	145.2	9	2	3
912	6	3	2	47	144.8	9	2	3
913	6	1	2	44	142.6	10	2	3
914	6	2	2	44	142.4	10	2	3
915	6	3	2	44	143.4	10	2	3
916	6	1	2	46	144.2	11	2	3
917	6	2	2	46	143.7	11	2	3
918	6	3	2	46	145.2	11	2	3
919	6	1	2	45	145.3	12	2	3
920	6	2	2	45	145.7	12	2	3
921	6	3	2	45	145.5	12	2	3
922	6	1	2	48	146.2	13	2	3
923	6	2	2	48	144.6	13	2	3
924	6	3	2	48	147.8	13	2	3
925	6	1	2	46	144.5	14	2	3
926	6	2	2	46	145	14	2	3
927	6	3	2	46	145.3	14	2	3
928	6	1	2	46	145.4	15	2	3
929	6	2	2	46	146.6	15	2	3
930	6	3	2	46	144.7	15	2	3
931	7	1	4	102	134.8	1	1	4
932	7	2	4	102	135.2	1	1	4
933	7	3	4	102	133.2	1	1	4
934	7	1	4	97	134.8	2	1	4
935	7	2	4	97	136.8	2	1	4
936	7	3	4	97	136.8	2	1	4
937	7	1	4	88	129.7	3	1	4
938	7	2	4	88	129.1	3	1	4
939	7	3	4	88	131.7	3	1	4
940	7	1	4	96	138.2	4	1	4
941	7	2	4	96	137.9	4	1	4
942	7	3	4	96	138.3	4	1	4
943	7	1	4	73	132.3	5	1	4
944	7	2	4	73	132.5	5	1	4

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
945	7	3	4	73	132.5	5	1	4
946	7	1	4	97	139.4	6	1	4
947	7	2	4	97	141.6	6	1	4
948	7	3	4	97	141.9	6	1	4
949	7	1	4	110	143.5	7	1	4
950	7	2	4	110	143.2	7	1	4
951	7	3	4	110	144.5	7	1	4
952	7	1	4	108	142.5	8	1	4
953	7	2	4	108	143.4	8	1	4
954	7	3	4	108	143.7	8	1	4
955	7	1	4	110	143	9	1	4
956	7	2	4	110	143.2	9	1	4
957	7	3	4	110	142.4	9	1	4
958	7	1	4	98	141	10	1	4
959	7	2	4	98	140.2	10	1	4
960	7	3	4	98	140	10	1	4
961	7	1	4	97	140.8	11	1	4
962	7	2	4	97	140.3	11	1	4
963	7	3	4	97	140.8	11	1	4
964	7	1	4	102	145.2	12	1	4
965	7	2	4	102	143.9	12	1	4
966	7	3	4	102	144.7	12	1	4
967	7	1	4	102	143.8	13	1	4
968	7	2	4	102	143.8	13	1	4
969	7	3	4	102	142.6	13	1	4
970	7	1	4	105	139.8	14	1	4
971	7	2	4	105	139.8	14	1	4
972	7	3	4	105	139.6	14	1	4
973	7	1	4	112	137.4	15	1	4
974	7	2	4	112	138.4	15	1	4
975	7	3	4	112	136.8	15	1	4
976	7	1	4	108	141.7	16	1	4
977	7	2	4	108	140.8	16	1	4
978	7	3	4	108	141.1	16	1	4
979	7	1	4	101	141.4	17	1	4
980	7	2	4	101	141.3	17	1	4
981	7	3	4	101	140.5	17	1	4
982	7	1	4	100	143.6	18	1	4
983	7	2	4	100	143.9	18	1	4
984	7	3	4	100	143.6	18	1	4
985	7	1	4	115	138.2	19	1	4
986	7	2	4	115	139.7	19	1	4
987	7	3	4	115	139.1	19	1	4
988	7	1	4	100	144	20	1	4
989	7	2	4	100	142.5	20	1	4

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
990	7	3	4	100	142.1	20	1	4
991	7	1	4	92	141.4	21	1	4
992	7	2	4	92	140.8	21	1	4
993	7	3	4	92	142.2	21	1	4
994	7	1	4	69	134.4	1	2	4
995	7	2	4	69	134.6	1	2	4
996	7	3	4	69	134.6	1	2	4
997	7	1	4	66	136.7	2	2	4
998	7	2	4	66	136.6	2	2	4
999	7	3	4	66	136.4	2	2	4
1000	7	1	4	57	131	3	2	4
1001	7	2	4	57	132.8	3	2	4
1002	7	3	4	57	131.3	3	2	4
1003	7	1	4	64	137.7	4	2	4
1004	7	2	4	64	139.1	4	2	4
1005	7	3	4	64	139.1	4	2	4
1006	7	1	4	56	133.8	5	2	4
1007	7	2	4	56	134	5	2	4
1008	7	3	4	56	133.1	5	2	4
1009	7	1	4	73	141.2	6	2	4
1010	7	2	4	73	141	6	2	4
1011	7	3	4	73	141.7	6	2	4
1012	7	1	4	85	144	7	2	4
1013	7	2	4	85	144.4	7	2	4
1014	7	3	4	85	144.8	7	2	4
1015	7	1	4	80	141.5	8	2	4
1016	7	2	4	80	142.8	8	2	4
1017	7	3	4	80	142.1	8	2	4
1018	7	1	4	77	143.2	9	2	4
1019	7	2	4	77	143.5	9	2	4
1020	7	3	4	77	142.6	9	2	4
1021	7	1	4	75	139	10	2	4
1022	7	2	4	75	140.1	10	2	4
1023	7	3	4	75	140.5	10	2	4
1024	7	1	4	67	140	11	2	4
1025	7	2	4	67	139.7	11	2	4
1026	7	3	4	67	140.1	11	2	4
1027	7	1	4	75	145	12	2	4
1028	7	2	4	75	144.8	12	2	4
1029	7	3	4	75	144.1	12	2	4
1030	7	1	4	77	144.7	13	2	4
1031	7	2	4	77	142	13	2	4
1032	7	3	4	77	143.4	13	2	4
1033	7	1	4	79	139.9	14	2	4
1034	7	2	4	79	139	14	2	4

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1035	7	3	4	79	140.1	14	2	4
1036	7	1	4	81	137.7	15	2	4
1037	7	2	4	81	138.2	15	2	4
1038	7	3	4	81	138.2	15	2	4
1039	7	1	4	82	141.4	16	2	4
1040	7	2	4	82	141.6	16	2	4
1041	7	3	4	82	141.6	16	2	4
1042	7	1	4	73	139.7	17	2	4
1043	7	2	4	73	139.3	17	2	4
1044	7	3	4	73	139.6	17	2	4
1045	7	1	4	75	142.6	18	2	4
1046	7	2	4	75	141.9	18	2	4
1047	7	3	4	75	142.1	18	2	4
1048	7	1	4	78	139.2	19	2	4
1049	7	2	4	78	140.5	19	2	4
1050	7	3	4	78	139.3	19	2	4
1051	7	1	4	72	142	20	2	4
1052	7	2	4	72	140.8	20	2	4
1053	7	3	4	72	142.6	20	2	4
1054	7	1	4	67	140.8	21	2	4
1055	7	2	4	67	139.9	21	2	4
1056	7	3	4	67	139.8	21	2	4
1057	8	1	1	109	140.3	1	1	1
1058	8	2	1	109	140.9	1	1	1
1059	8	3	1	109	140.2	1	1	1
1060	8	1	1	116	142.4	2	1	1
1061	8	2	1	116	143.9	2	1	1
1062	8	3	1	116	142.8	2	1	1
1063	8	1	1	110	142.4	3	1	1
1064	8	2	1	110	142.5	3	1	1
1065	8	3	1	110	142.8	3	1	1
1066	8	1	1	113	139.6	4	1	1
1067	8	2	1	113	143.1	4	1	1
1068	8	3	1	113	141.6	4	1	1
1069	8	1	1	113	139.6	5	1	1
1070	8	2	1	113	142.6	5	1	1
1071	8	3	1	113	141.2	5	1	1
1072	8	1	1	114	141.4	6	1	1
1073	8	2	1	114	143.1	6	1	1
1074	8	3	1	114	142.8	6	1	1
1075	8	1	1	113	139.9	7	1	1
1076	8	2	1	113	141.2	7	1	1
1077	8	3	1	113	142.1	7	1	1
1078	8	1	1	115	141.7	8	1	1
1079	8	2	1	115	143.1	8	1	1

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1080	8	3	1	115	142.7	8	1	1
1081	8	1	1	113	139.8	9	1	1
1082	8	2	1	113	141.5	9	1	1
1083	8	3	1	113	139.8	9	1	1
1084	8	1	1	114	142.7	10	1	1
1085	8	2	1	114	142.4	10	1	1
1086	8	3	1	114	144.3	10	1	1
1087	8	1	1	116	141.4	11	1	1
1088	8	2	1	116	141.5	11	1	1
1089	8	3	1	116	141.9	11	1	1
1090	8	1	1	115	142.8	12	1	1
1091	8	2	1	115	142.6	12	1	1
1092	8	3	1	115	146.2	12	1	1
1093	8	1	1	116	142.2	13	1	1
1094	8	2	1	116	142.9	13	1	1
1095	8	3	1	116	143.9	13	1	1
1096	8	1	1	115	144	14	1	1
1097	8	2	1	115	144.5	14	1	1
1098	8	3	1	115	144.5	14	1	1
1099	8	1	1	118	140.8	15	1	1
1100	8	2	1	118	142.9	15	1	1
1101	8	3	1	118	142.8	15	1	1
1102	8	1	1	119	141	16	1	1
1103	8	2	1	119	142.6	16	1	1
1104	8	3	1	119	140.8	16	1	1
1105	8	1	1	118	143	17	1	1
1106	8	2	1	118	142.9	17	1	1
1107	8	3	1	118	143.7	17	1	1
1108	8	1	1	119	142.7	18	1	1
1109	8	2	1	119	142.9	18	1	1
1110	8	3	1	119	144.5	18	1	1
1111	8	1	1	118	142.5	19	1	1
1112	8	2	1	118	143.1	19	1	1
1113	8	3	1	118	143.1	19	1	1
1114	8	1	1	114	143.2	20	1	1
1115	8	2	1	114	142.1	20	1	1
1116	8	3	1	114	142.7	20	1	1
1117	8	1	1	118	140.2	21	1	1
1118	8	2	1	118	140.8	21	1	1
1119	8	3	1	118	140.2	21	1	1
1120	8	1	1	116	141.1	22	1	1
1121	8	2	1	116	142.5	22	1	1
1122	8	3	1	116	143.1	22	1	1
1123	8	1	1	116	140	23	1	1
1124	8	2	1	116	141	23	1	1

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1125	8	3	1	116	141.4	23	1	1
1126	8	1	1	115	141	24	1	1
1127	8	2	1	115	142.4	24	1	1
1128	8	3	1	115	142.2	24	1	1
1129	8	1	1	115	141.1	25	1	1
1130	8	2	1	115	141	25	1	1
1131	8	3	1	115	142.9	25	1	1
1132	8	1	1	115	145.8	26	1	1
1133	8	2	1	115	142.4	26	1	1
1134	8	3	1	115	143.8	26	1	1
1135	8	1	1	114	139.1	27	1	1
1136	8	2	1	114	139.7	27	1	1
1137	8	3	1	114	139.8	27	1	1
1138	8	1	1	110	142.3	28	1	1
1139	8	2	1	110	140.6	28	1	1
1140	8	3	1	110	142.9	28	1	1
1141	8	1	1	113	139.5	29	1	1
1142	8	2	1	113	141.5	29	1	1
1143	8	3	1	113	140.2	29	1	1
1144	8	1	1	113	143	30	1	1
1145	8	2	1	113	143.8	30	1	1
1146	8	3	1	113	143.4	30	1	1
1147	8	1	1	81	142.6	1	2	1
1148	8	2	1	81	142.7	1	2	1
1149	8	3	1	81	142.8	1	2	1
1150	8	1	1	80	142.5	2	2	1
1151	8	2	1	80	144.2	2	2	1
1152	8	3	1	80	144.3	2	2	1
1153	8	1	1	79	141.7	3	2	1
1154	8	2	1	79	142.9	3	2	1
1155	8	3	1	79	144.6	3	2	1
1156	8	1	1	79	142.9	4	2	1
1157	8	2	1	79	143.7	4	2	1
1158	8	3	1	79	143.4	4	2	1
1159	8	1	1	81	142.7	5	2	1
1160	8	2	1	81	143.4	5	2	1
1161	8	3	1	81	142.8	5	2	1
1162	8	1	1	80	142.9	6	2	1
1163	8	2	1	80	142.9	6	2	1
1164	8	3	1	80	144.3	6	2	1
1165	8	1	1	80	143	7	2	1
1166	8	2	1	80	141.9	7	2	1
1167	8	3	1	80	142.1	7	2	1
1168	8	1	1	78	144.8	8	2	1
1169	8	2	1	78	143	8	2	1

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1170	8	3	1	78	144.5	8	2	1
1171	8	1	1	80	142.9	9	2	1
1172	8	2	1	80	140.7	9	2	1
1173	8	3	1	80	141.2	9	2	1
1174	8	1	1	79	142.4	10	2	1
1175	8	2	1	79	143.4	10	2	1
1176	8	3	1	79	143.3	10	2	1
1177	8	1	1	79	142.8	11	2	1
1178	8	2	1	79	142.9	11	2	1
1179	8	3	1	79	143	11	2	1
1180	8	1	1	79	144.9	12	2	1
1181	8	2	1	79	144	12	2	1
1182	8	3	1	79	144.4	12	2	1
1183	8	1	1	79	143.4	13	2	1
1184	8	2	1	79	144.1	13	2	1
1185	8	3	1	79	145.9	13	2	1
1186	8	1	1	79	145.2	14	2	1
1187	8	2	1	79	145.6	14	2	1
1188	8	3	1	79	144.7	14	2	1
1189	8	1	1	79	144.4	15	2	1
1190	8	2	1	79	142.5	15	2	1
1191	8	3	1	79	144.1	15	2	1
1192	8	1	1	79	142.7	16	2	1
1193	8	2	1	79	144.3	16	2	1
1194	8	3	1	79	143.3	16	2	1
1195	8	1	1	78	144.1	17	2	1
1196	8	2	1	78	144.4	17	2	1
1197	8	3	1	78	143.7	17	2	1
1198	8	1	1	79	144.1	18	2	1
1199	8	2	1	79	142.8	18	2	1
1200	8	3	1	79	143.2	18	2	1
1201	8	1	1	79	143.8	19	2	1
1202	8	2	1	79	143.8	19	2	1
1203	8	3	1	79	144.5	19	2	1
1204	8	1	1	77	143.2	20	2	1
1205	8	2	1	77	144	20	2	1
1206	8	3	1	77	143.3	20	2	1
1207	8	1	1	79	143.7	21	2	1
1208	8	2	1	79	142.3	21	2	1
1209	8	3	1	79	142.4	21	2	1
1210	8	1	1	78	142.8	22	2	1
1211	8	2	1	78	142.7	22	2	1
1212	8	3	1	78	143.4	22	2	1
1213	8	1	1	78	143	23	2	1
1214	8	2	1	78	142.1	23	2	1

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1215	8	3	1	78	140.9	23	2	1
1216	8	1	1	77	142.3	24	2	1
1217	8	2	1	77	142.2	24	2	1
1218	8	3	1	77	143.2	24	2	1
1219	8	1	1	78	143.6	25	2	1
1220	8	2	1	78	142	25	2	1
1221	8	3	1	78	141.7	25	2	1
1222	8	1	1	78	145.2	26	2	1
1223	8	2	1	78	144.7	26	2	1
1224	8	3	1	78	146.3	26	2	1
1225	8	1	1	77	140.1	27	2	1
1226	8	2	1	77	140	27	2	1
1227	8	3	1	77	140.2	27	2	1
1228	8	1	1	77	142.2	28	2	1
1229	8	2	1	77	141.5	28	2	1
1230	8	3	1	77	141.6	28	2	1
1231	8	1	1	77	140.1	29	2	1
1232	8	2	1	77	139.6	29	2	1
1233	8	3	1	77	141.6	29	2	1
1234	8	1	1	79	142.3	30	2	1
1235	8	2	1	79	144.2	30	2	1
1236	8	3	1	79	143.7	30	2	1
1237	9	1	2	125	144.9	1	1	3
1238	9	2	2	125	145.2	1	1	3
1239	9	3	2	125	145.2	1	1	3
1240	9	1	2	123	143.5	2	1	3
1241	9	2	2	123	143.8	2	1	3
1242	9	3	2	123	144.1	2	1	3
1243	9	1	2	126	141.7	3	1	3
1244	9	2	2	126	141.8	3	1	3
1245	9	3	2	126	141.7	3	1	3
1246	9	1	2	128	140.8	4	1	3
1247	9	2	2	128	142.2	4	1	3
1248	9	3	2	128	141.4	4	1	3
1249	9	1	2	129	141.8	5	1	3
1250	9	2	2	129	141.1	5	1	3
1251	9	3	2	129	140.4	5	1	3
1252	9	1	2	128	143.2	6	1	3
1253	9	2	2	128	144.3	6	1	3
1254	9	3	2	128	143.6	6	1	3
1255	9	1	2	127	144.9	7	1	3
1256	9	2	2	127	142.4	7	1	3
1257	9	3	2	127	143	7	1	3
1258	9	1	2	124	143.2	8	1	3
1259	9	2	2	124	144.2	8	1	3

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1260	9	3	2	124	143.5	8	1	3
1261	9	1	2	119	143.6	9	1	3
1262	9	2	2	119	143.6	9	1	3
1263	9	3	2	119	143.9	9	1	3
1264	9	1	2	122	142.8	10	1	3
1265	9	2	2	122	144.5	10	1	3
1266	9	3	2	122	144.1	10	1	3
1267	9	1	2	125	144	11	1	3
1268	9	2	2	125	144.1	11	1	3
1269	9	3	2	125	144.1	11	1	3
1270	9	1	2	126	141.5	12	1	3
1271	9	2	2	126	141.9	12	1	3
1272	9	3	2	126	142.3	12	1	3
1273	9	1	2	132	140	13	1	3
1274	9	2	2	132	140.5	13	1	3
1275	9	3	2	132	141.1	13	1	3
1276	9	1	2	126	145.1	14	1	3
1277	9	2	2	126	143.1	14	1	3
1278	9	3	2	126	144.6	14	1	3
1279	9	1	2	131	141.5	15	1	3
1280	9	2	2	131	142.7	15	1	3
1281	9	3	2	131	143	15	1	3
1282	9	1	2	128	140.7	16	1	3
1283	9	2	2	128	141.9	16	1	3
1284	9	3	2	128	141.5	16	1	3
1285	9	1	2	125	143.5	17	1	3
1286	9	2	2	125	142.5	17	1	3
1287	9	3	2	125	144.4	17	1	3
1288	9	1	2	129	143.5	18	1	3
1289	9	2	2	129	143.9	18	1	3
1290	9	3	2	129	143.6	18	1	3
1291	9	1	2	125	143.4	19	1	3
1292	9	2	2	125	142.8	19	1	3
1293	9	3	2	125	142.1	19	1	3
1294	9	1	2	124	142.9	20	1	3
1295	9	2	2	124	142.1	20	1	3
1296	9	3	2	124	139.7	20	1	3
1297	9	1	2	130	140.9	21	1	3
1298	9	2	2	130	140.8	21	1	3
1299	9	3	2	130	141.4	21	1	3
1300	9	1	2	131	145.1	22	1	3
1301	9	2	2	131	144.7	22	1	3
1302	9	3	2	131	144.5	22	1	3
1303	9	1	2	131	144.5	23	1	3
1304	9	2	2	131	143.8	23	1	3

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1305	9	3	2	131	143.8	23	1	3
1306	9	1	2	134	144.9	24	1	3
1307	9	2	2	134	144.8	24	1	3
1308	9	3	2	134	145.6	24	1	3
1309	9	1	2	138	143.3	25	1	3
1310	9	2	2	138	142.5	25	1	3
1311	9	3	2	138	141.7	25	1	3
1312	9	1	2	126	143.5	26	1	3
1313	9	2	2	126	143.8	26	1	3
1314	9	3	2	126	144.8	26	1	3
1315	9	1	2	136	143.1	27	1	3
1316	9	2	2	136	143.8	27	1	3
1317	9	3	2	136	144.8	27	1	3
1318	9	1	2	136	143	28	1	3
1319	9	2	2	136	143.1	28	1	3
1320	9	3	2	136	142.7	28	1	3
1321	9	1	2	141	143.5	29	1	3
1322	9	2	2	141	145	29	1	3
1323	9	3	2	141	145	29	1	3
1324	9	1	2	134	145	30	1	3
1325	9	2	2	134	144.3	30	1	3
1326	9	3	2	134	144.4	30	1	3
1327	9	1	2	78	146.5	1	2	3
1328	9	2	2	78	146.4	1	2	3
1329	9	3	2	78	146.6	1	2	3
1330	9	1	2	79	144.6	2	2	3
1331	9	2	2	79	144.8	2	2	3
1332	9	3	2	79	145.9	2	2	3
1333	9	1	2	76	142.4	3	2	3
1334	9	2	2	76	140.6	3	2	3
1335	9	3	2	76	141.2	3	2	3
1336	9	1	2	76	146	4	2	3
1337	9	2	2	76	145.8	4	2	3
1338	9	3	2	76	145	4	2	3
1339	9	1	2	76	141.9	5	2	3
1340	9	2	2	76	143.7	5	2	3
1341	9	3	2	76	143.7	5	2	3
1342	9	1	2	78	146.4	6	2	3
1343	9	2	2	78	144.1	6	2	3
1344	9	3	2	78	146	6	2	3
1345	9	1	2	79	146.2	7	2	3
1346	9	2	2	79	147.1	7	2	3
1347	9	3	2	79	145.2	7	2	3
1348	9	1	2	79	145.4	8	2	3
1349	9	2	2	79	146	8	2	3

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1350	9	3	2	79	146	8	2	3
1351	9	1	2	80	147.2	9	2	3
1352	9	2	2	80	146.2	9	2	3
1353	9	3	2	80	146.3	9	2	3
1354	9	1	2	81	143.3	10	2	3
1355	9	2	2	81	143.7	10	2	3
1356	9	3	2	81	144.1	10	2	3
1357	9	1	2	81	144.4	11	2	3
1358	9	2	2	81	145.9	11	2	3
1359	9	3	2	81	145.7	11	2	3
1360	9	1	2	80	144.2	12	2	3
1361	9	2	2	80	144.3	12	2	3
1362	9	3	2	80	144.3	12	2	3
1363	9	1	2	79	142.2	13	2	3
1364	9	2	2	79	139.9	13	2	3
1365	9	3	2	79	140.8	13	2	3
1366	9	1	2	80	144.5	14	2	3
1367	9	2	2	80	145.5	14	2	3
1368	9	3	2	80	144.6	14	2	3
1369	9	1	2	79	143.8	15	2	3
1370	9	2	2	79	143.7	15	2	3
1371	9	3	2	79	143.7	15	2	3
1372	9	1	2	79	143.1	16	2	3
1373	9	2	2	79	142.5	16	2	3
1374	9	3	2	79	142.8	16	2	3
1375	9	1	2	80	145.3	17	2	3
1376	9	2	2	80	142.8	17	2	3
1377	9	3	2	80	145.4	17	2	3
1378	9	1	2	80	144.2	18	2	3
1379	9	2	2	80	144	18	2	3
1380	9	3	2	80	144	18	2	3
1381	9	1	2	80	144.1	19	2	3
1382	9	2	2	80	143.1	19	2	3
1383	9	3	2	80	143.9	19	2	3
1384	9	1	2	80	143.3	20	2	3
1385	9	2	2	80	143.8	20	2	3
1386	9	3	2	80	142.8	20	2	3
1387	9	1	2	83	143.7	21	2	3
1388	9	2	2	83	142.2	21	2	3
1389	9	3	2	83	144.2	21	2	3
1390	9	1	2	83	146	22	2	3
1391	9	2	2	83	146.8	22	2	3
1392	9	3	2	83	146.8	22	2	3
1393	9	1	2	82	146.2	23	2	3
1394	9	2	2	82	144.2	23	2	3

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1395	9	3	2	82	145.2	23	2	3
1396	9	1	2	83	145.5	24	2	3
1397	9	2	2	83	144.8	24	2	3
1398	9	3	2	83	146.1	24	2	3
1399	9	1	2	82	145.7	25	2	3
1400	9	2	2	82	143	25	2	3
1401	9	3	2	82	143.9	25	2	3
1402	9	1	2	83	146.4	26	2	3
1403	9	2	2	83	146.3	26	2	3
1404	9	3	2	83	146.6	26	2	3
1405	9	1	2	84	144.7	27	2	3
1406	9	2	2	84	146.3	27	2	3
1407	9	3	2	84	147.5	27	2	3
1408	9	1	2	84	144.9	28	2	3
1409	9	2	2	84	144.6	28	2	3
1410	9	3	2	84	146.8	28	2	3
1411	9	1	2	86	146.5	29	2	3
1412	9	2	2	86	146.6	29	2	3
1413	9	3	2	86	146.8	29	2	3
1414	9	1	2	89	145.1	30	2	3
1415	9	2	2	89	146	30	2	3
1416	9	3	2	89	145.8	30	2	3
1417	10	1	1	127	139.2	1	1	5
1418	10	2	1	127	137.7	1	1	5
1419	10	3	1	127	137.4	1	1	5
1420	10	1	1	126	135.7	2	1	5
1421	10	2	1	126	136.2	2	1	5
1422	10	3	1	126	136.1	2	1	5
1423	10	1	1	122	138.7	3	1	5
1424	10	2	1	122	139.3	3	1	5
1425	10	3	1	122	138.4	3	1	5
1426	10	1	1	127	138.1	4	1	5
1427	10	2	1	127	138.3	4	1	5
1428	10	3	1	127	139.3	4	1	5
1429	10	1	1	124	136.9	5	1	5
1430	10	2	1	124	136.4	5	1	5
1431	10	3	1	124	137.9	5	1	5
1432	10	1	1	127	139.1	6	1	5
1433	10	2	1	127	139.3	6	1	5
1434	10	3	1	127	139.4	6	1	5
1435	10	1	1	129	139.9	7	1	5
1436	10	2	1	129	139.6	7	1	5
1437	10	3	1	129	140.6	7	1	5
1438	10	1	1	128	139.8	8	1	5
1439	10	2	1	128	138.7	8	1	5

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1440	10	3	1	128	140.7	8	1	5
1441	10	1	1	137	139.8	9	1	5
1442	10	2	1	137	138.4	9	1	5
1443	10	3	1	137	139.9	9	1	5
1444	10	1	1	131	140.3	10	1	5
1445	10	2	1	131	141.9	10	1	5
1446	10	3	1	131	141	10	1	5
1447	10	1	1	134	141.5	11	1	5
1448	10	2	1	134	142.4	11	1	5
1449	10	3	1	134	142.6	11	1	5
1450	10	1	1	133	140.9	12	1	5
1451	10	2	1	133	140.7	12	1	5
1452	10	3	1	133	142.4	12	1	5
1453	10	1	1	131	141.2	13	1	5
1454	10	2	1	131	143.8	13	1	5
1455	10	3	1	131	143.2	13	1	5
1456	10	1	1	129	141.4	14	1	5
1457	10	2	1	129	141	14	1	5
1458	10	3	1	129	139.8	14	1	5
1459	10	1	1	133	139.8	15	1	5
1460	10	2	1	133	140.7	15	1	5
1461	10	3	1	133	140	15	1	5
1462	10	1	1	131	143	16	1	5
1463	10	2	1	131	140.5	16	1	5
1464	10	3	1	131	142.1	16	1	5
1465	10	1	1	132	140.4	17	1	5
1466	10	2	1	132	140.9	17	1	5
1467	10	3	1	132	140.3	17	1	5
1468	10	1	1	132	139	18	1	5
1469	10	2	1	132	139.3	18	1	5
1470	10	3	1	132	139.6	18	1	5
1471	10	1	1	133	138.7	19	1	5
1472	10	2	1	133	138.8	19	1	5
1473	10	3	1	133	137.6	19	1	5
1474	10	1	1	129	140.7	20	1	5
1475	10	2	1	129	141.4	20	1	5
1476	10	3	1	129	140.5	20	1	5
1477	10	1	1	123	139.6	21	1	5
1478	10	2	1	123	139.6	21	1	5
1479	10	3	1	123	138.6	21	1	5
1480	10	1	1	121	138.7	22	1	5
1481	10	2	1	121	138.3	22	1	5
1482	10	3	1	121	137.7	22	1	5
1483	10	1	1	120	137.4	23	1	5
1484	10	2	1	120	137.4	23	1	5

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1485	10	3	1	120	137.4	23	1	5
1486	10	1	1	121	138.2	24	1	5
1487	10	2	1	121	137.2	24	1	5
1488	10	3	1	121	136.4	24	1	5
1489	10	1	1	120	138.3	25	1	5
1490	10	2	1	120	137.1	25	1	5
1491	10	3	1	120	138.8	25	1	5
1492	10	1	1	119	140.2	26	1	5
1493	10	2	1	119	140.6	26	1	5
1494	10	3	1	119	140.5	26	1	5
1495	10	1	1	119	138.2	27	1	5
1496	10	2	1	119	140.8	27	1	5
1497	10	3	1	119	139.1	27	1	5
1498	10	1	1	119	138.8	28	1	5
1499	10	2	1	119	138.3	28	1	5
1500	10	3	1	119	137.8	28	1	5
1501	10	1	1	117	139.3	29	1	5
1502	10	2	1	117	139.9	29	1	5
1503	10	3	1	117	138.9	29	1	5
1504	10	1	1	118	139.9	30	1	5
1505	10	2	1	118	140.1	30	1	5
1506	10	3	1	118	140.8	30	1	5
1507	10	1	1	77	139.2	1	2	5
1508	10	2	1	77	140.4	1	2	5
1509	10	3	1	77	140	1	2	5
1510	10	1	1	77	136.5	2	2	5
1511	10	2	1	77	137.1	2	2	5
1512	10	3	1	77	137.9	2	2	5
1513	10	1	1	74	140.2	3	2	5
1514	10	2	1	74	139.8	3	2	5
1515	10	3	1	74	139.4	3	2	5
1516	10	1	1	74	138.6	4	2	5
1517	10	2	1	74	139.8	4	2	5
1518	10	3	1	74	140.1	4	2	5
1519	10	1	1	76	137.9	5	2	5
1520	10	2	1	76	136.5	5	2	5
1521	10	3	1	76	137	5	2	5
1522	10	1	1	77	140.4	6	2	5
1523	10	2	1	77	140.5	6	2	5
1524	10	3	1	77	140.8	6	2	5
1525	10	1	1	76	140	7	2	5
1526	10	2	1	76	140.5	7	2	5
1527	10	3	1	76	139.7	7	2	5
1528	10	1	1	78	140.4	8	2	5
1529	10	2	1	78	138.9	8	2	5

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1530	10	3	1	78	141.1	8	2	5
1531	10	1	1	77	138.1	9	2	5
1532	10	2	1	77	139	9	2	5
1533	10	3	1	77	137.7	9	2	5
1534	10	1	1	79	140.9	10	2	5
1535	10	2	1	79	141.3	10	2	5
1536	10	3	1	79	141.5	10	2	5
1537	10	1	1	80	143.3	11	2	5
1538	10	2	1	80	142.1	11	2	5
1539	10	3	1	80	143.6	11	2	5
1540	10	1	1	81	142.6	12	2	5
1541	10	2	1	81	144.1	12	2	5
1542	10	3	1	81	142.4	12	2	5
1543	10	1	1	80	143	13	2	5
1544	10	2	1	80	143.7	13	2	5
1545	10	3	1	80	143.1	13	2	5
1546	10	1	1	79	141	14	2	5
1547	10	2	1	79	142	14	2	5
1548	10	3	1	79	140.5	14	2	5
1549	10	1	1	79	140.1	15	2	5
1550	10	2	1	79	141.5	15	2	5
1551	10	3	1	79	141.1	15	2	5
1552	10	1	1	80	142	16	2	5
1553	10	2	1	80	143.3	16	2	5
1554	10	3	1	80	143.8	16	2	5
1555	10	1	1	79	139.6	17	2	5
1556	10	2	1	79	142.3	17	2	5
1557	10	3	1	79	141.1	17	2	5
1558	10	1	1	78	138.9	18	2	5
1559	10	2	1	78	138	18	2	5
1560	10	3	1	78	139.1	18	2	5
1561	10	1	1	80	138.7	19	2	5
1562	10	2	1	80	138.9	19	2	5
1563	10	3	1	80	137.9	19	2	5
1564	10	1	1	80	140.2	20	2	5
1565	10	2	1	80	140.6	20	2	5
1566	10	3	1	80	140.7	20	2	5
1567	10	1	1	79	139.0	21	2	5
1568	10	2	1	79	141.1	21	2	5
1569	10	3	1	79	139.4	21	2	5
1570	10	1	1	79	137.9	22	2	5
1571	10	2	1	79	138.1	22	2	5
1572	10	3	1	79	138.8	22	2	5
1573	10	1	1	79	138.4	23	2	5
1574	10	2	1	79	137.6	23	2	5

Row	Project	Replicate	Device	Temp	Density	Point	Day	Contr.
1575	10	3	1	79	137.8	23	2	5
1576	10	1	1	80	137.9	24	2	5
1577	10	2	1	80	138.6	24	2	5
1578	10	3	1	80	138.3	24	2	5
1579	10	1	1	78	137.5	25	2	5
1580	10	2	1	78	137.8	25	2	5
1581	10	3	1	78	137.5	25	2	5
1582	10	1	1	80	140.0	26	2	5
1583	10	2	1	80	140.5	26	2	5
1584	10	3	1	80	140.6	26	2	5
1585	10	1	1	81	138.7	27	2	5
1586	10	2	1	81	140.4	27	2	5
1587	10	3	1	81	139.4	27	2	5
1588	10	1	1	80	138.5	28	2	5
1589	10	2	1	80	137.4	28	2	5
1590	10	3	1	80	137.4	28	2	5
1591	10	1	1	81	140.2	29	2	5
1592	10	2	1	81	138.8	29	2	5
1593	10	3	1	81	139.3	29	2	5
1594	10	1	1	82	139.8	30	2	5
1595	10	2	1	82	139.8	30	2	5
1596	10	3	1	82	140.5	30	2	5

*Temperature is in degrees Fahrenheit
*Density is in pcf (lbs/ft^3)
*Device 1 is Troxler 3440
*Device 2 is Seaman C-200
*Device 3 is Seaman C-100
*Device 4 is Seaman C-75

CI TABLE OF LAB DATA

	A (1)					B				
Spec.	Vol Chg/%	Density Chg	Gsb	Density	Va	Vol Chg/%	Density Chg	Gsb	Density	Va
1	-25747 / -1.016	-1.5311	2.415	150.70	3.48	-1486 / -0.059	-0.0893	2.411	150.45	3.27
2	-22776 / -0.902	-1.3606	2.417	150.82	3.40	-4281 / -0.132	-0.2000	2.399	149.70	3.73
3	40091 / 1.561	2.3425	2.405	150.07	3.89	-16716 / -0.644	-0.9760	2.403	149.95	3.58
4	15762 / 0.603	0.9003	2.419	150.95	3.31	-7043 / -0.284	-0.4327	2.392	149.26	4.02
5	11733 / 0.365	0.5509	2.418	150.88	3.36	-1749 / 0.054	-0.0804	2.400	149.76	3.70
6	18749 / 0.581	0.8749	2.415	150.70	3.50	-4386 / -0.135	-0.2032	2.404	150.01	3.52
7	-6565 / -0.200	-0.2988	2.419	150.95	3.33	-42 / -0.001	-0.0020	2.405	150.07	3.50
8	-6387 / -0.195	-0.2923	2.403	149.95	3.94	-1383 / -0.042	-0.0626	2.392	149.26	4.02
9	-1439 / -0.044	-0.0658	2.418	150.88	3.34	-6024 / -0.186	-0.2800	2.410	150.38	3.28
10	-4455 / -0.136	-0.2025	2.419	150.95	3.31	-4816 / -0.150	-0.2257	2.412	150.51	3.20

	C (1)					D (1)				
Spec.	Vol Chg/%	Density Chg	Gsb	Density	Va	Vol Chg/%	Density Chg	Gsb	Density	Va
1	9896 / 0.394	0.5984	2.411	150.45	3.51	-1078 / -0.041	-0.0602	2.365	147.58	3.77
2	10646 / 0.420	0.6483	2.398	149.64	4.05	-30336 / -1.143	-1.6684	2.339	145.95	4.83
3	2730 / 0.084	0.1248	2.383	148.70	4.63	-50332 / -2.073	-3.0486	2.357	147.08	4.12
4	6407 / 0.193	0.2854	2.400	149.76	3.96	-1644 / -0.063	-0.0930	2.364	147.51	3.84
5	4498 / 0.137	0.2036	2.384	148.76	4.62	18444 / 0.568	0.8421	2.377	148.32	3.30
6	3901 / 0.118	0.1762	2.389	149.07	4.39	22257 / 0.679	0.9992	2.357	147.08	4.09
7	-2181 / -0.068	-0.1036	2.411	150.45	3.50	3739 / 0.113	0.1677	2.375	148.20	3.37
8	1014 / 0.032	0.0490	2.411	150.45	3.52	1792 / 0.092	0.0790	2.360	147.26	3.98
9	2551 / 0.078	0.1166	2.383	148.70	4.63	14288 / 0.428	0.6164	2.343	146.20	4.66
10	1943 / 0.060	0.0887	2.386	148.89	4.54	2201 / 0.068	0.0995	2.353	146.83	4.24

	E (1)					C (2)				
Spec.	Vol Chg/%	Density Chg	Gsb	Density	Va	Vol Chg/%	Density Chg	Gsb	Density	Va
1	2247 / 0.087	0.1285	2.370	147.89	3.59	-2133 / -0.067	-0.1016	2.433	151.82	2.20
2	1818 / 0.070	0.1035	2.371	147.95	3.55	-4207 / -0.132	-0.2011	2.434	151.88	2.17
3	-3131 / -0.120	-0.1783	2.373	148.08	3.47	-5966 / -0.187	-0.2835	2.432	151.76	2.24
4	-537 / -0.020	-0.0302	2.367	147.70	3.72	-9370 / -0.295	-0.4477	2.436	152.01	2.11
5	5381 / 0.166	0.2465	2.378	148.39	3.27	-962 / -0.030	-0.0446	2.423	151.20	2.63
6	8624 / 0.266	0.3940	2.375	148.20	3.38	-3559 / -0.111	-0.1679	2.424	151.26	2.55
7	40 / 0.001	0.0018	2.376	148.26	3.32	-5274 / -0.161	-0.2394	2.382	148.64	4.26
8	2256 / 0.0068	0.1011	2.371	147.95	3.54				0.00	
9	-605 / -0.017	-0.0254	2.378	148.39	3.24	-4700 / -0.145	-0.2189	2.423	151.20	2.62
10	429 / 0.013	0.0192	2.367	147.70	3.70	-6612 / -0.204	-0.3086	2.420	151.01	2.72

	D (2)					A (2)				
Spec.	Vol Chg/%	Density Chg	Gsb	Density	Va	Vol Chg/%	Density Chg	Gsb	Density	Va
1	-21829 / -0.839	-1.2480	2.384	148.76	3.70	-1789 / -0.055	-0.0831	2.418	150.88	3.34
2	-37137 / -1.415	-2.1014	2.380	148.51	3.89	-3578 / -0.110	-0.1651	2.414	150.63	3.51
3	-15251 / -0.602	-0.9076	2.416	150.76	2.44	4525 / 0.129	0.1937	2.414	150.63	3.50
4	-5899 / -0.232	-0.3485	2.406	150.13	2.81	826 / 0.024	0.0355	2.409	150.32	3.71
5	-3356 / -0.105	-0.1597	2.428	151.51	1.93	2222 / 0.068	0.1016	2.406	150.13	3.84
6	-5168 / -0.160	-0.2395	2.401	149.82	3.04	-4773 / -0.147	-0.2213	2.412	150.51	3.59
7	-5213 / -0.159	-0.2381	2.393	149.32	3.37	-5088 / -0.157	-0.2378	2.425	151.32	3.09
8	-3482 / -0.105	-0.1562	2.376	148.26	4.05	-8497 / -0.263	-0.3969	2.421	151.07	3.24
9	-7167 / -0.219	-0.3293	2.407	150.20	2.79	-4260 / -0.132	-0.1996	2.431	151.69	3.84
10	2089 / 0.065	0.0965	2.396	149.51	3.22	-1510 / -0.047	-0.0703	2.418	150.88	3.36

	C (3)					E (2)				
Spec.	Vol Chg/%	Density Chg	Gsb	Density	Va	Vol Chg/%	Density Chg	Gsb	Density	Va
1	-1566 / -0.048	-0.0712	2.391	149.20	3.71	-4716 / -0.144	-0.2156	2.367	147.70	3.70
2	-1739 / -0.053	-0.0793	2.391	149.20	3.71	-1655 / -0.051	-0.7055	2.382	148.64	3.08
3	7673 / 0.234	0.3502	2.397	149.57	3.48	-9256 / -0.283	-0.4217	2.365	147.58	3.79
4	-544 / -0.017	-0.0249	2.391	149.20	3.71	-554 / -0.017	-0.0252	2.382	148.64	3.10
5	3322 / 0.102	0.1530	2.393	149.32	3.62	-728 / -0.022	-0.0329	2.381	148.57	3.13
6	-2369 / -0.073	-0.1087	2.395	149.45	3.53	-3671 / -0.113	-0.1685	2.367	147.70	3.69
7	-4153 / 0.127	-0.1898	2.396	149.51	3.51	-666 / -0.020	-0.0301	2.381	148.57	3.15
8	-1231 / -0.038	-0.0567	2.394	149.39	3.58	-3520 / -0.108	-0.1608	2.361	147.33	3.93
9	-3195 / 0.058	-0.1464	2.390	149.14	3.76	-2954 / -0.090	-0.1342	2.362	147.39	3.91
10	1 / 0.000	0.0000	2.396	149.51	3.51	3865 / 0.118	0.1760	2.363	147.45	3.88