HEAT PENETRATION STUDIES OF STEWED TOMATOES IN 6, 8, AND 17 QUART HOUSEHOLD PRESSURE RETORTS

by

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(Under the Direction of Elizabeth L. Andress)

ABSTRACT

Most current home pressure canning recommendations were developed using standard 17 to 21 quart pressure retorts. Past research suggested the need for longer process schedules in smaller retorts to achieve an equivalent lethality. The objective of this study was to compare heating and cooling characteristics, cumulative lethalities, and potential safe process times during pressure processing of stewed tomatoes in 6, 8, and 17 quart household pressure retorts. Stewed tomatoes were processed in half-pint glass jars at 121.1°C for 25 minutes in 6, 8, and 17 quart pressure retorts. Heat penetration profiles were collected in 15 jars per retort size. Potential process times and cumulative lethal rates were calculated for the destruction of *Clostridium botulinum* spores. The majority of the lethality was achieved during cooling. Calculated process times from the data collected were found to be equivalent. Final conclusions cannot be drawn until data is verified through further research.

INDEX WORDS: Home canning, Heat penetration, *Clostridium botulinum*, Tomatoes, Retort size, Pressure cookers, Pressure Canners

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DEDICATION

To my parents, Casimira and Richard Pakola.

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CHAPTER 1

INTRODUCTION

Botulism is a significant food safety threat to people who can food at home. According to the Centers for Disease Control and Prevention (1998), 71.4 % of the 40 botulism outbreaks between the years of 1990 and 1996 were caused by foods preserved at home. Botulism is a serious neurological disease that often leaves permanent neurological damage and can be fatal if not treated promptly. Botulism is caused by a neurotoxin produced by the bacterium, *Clostridium botulinum*. *C. botulinum* thrives in low acid, anaerobic environments. Low acid foods (pH > 4.6) must be processed at temperatures at or above 240 °F to destroy *C. botulinum* (USDA 1994). Food must be processed under pressure to reach such high temperatures. Particular temperature and process times vary with type and quantity of product. People canning at home are urged not to deviate from the recommendations.

Home canning in smaller pressure retorts is not recommended by the U.S. Department of Agriculture (USDA 1994). The USDA is the leading authority on scientifically derived home canning recommendations. Existing recommendations were determined using standard size home canning pressure retorts that have a 17 or 21 quart capacity. Smaller pressure retorts marketed, as “pressure cookers” are widely available in 4, 6, and 8 quart capacities. “Pressure canner” is a term usually associated with 16 quart and larger capacities. A recent survey by the National Center for Home Food

Preservation indicates that people are using smaller pressure retorts to can food at home (Andress 2001).

Home canning in pressure cookers may not provide a sufficient heat process to destroy spoilage and pathogenic microorganisms. Past research showed that smaller retorts heat up and cool more quickly than larger retorts (Taube and Sater 1948). The cooling period contributes to the overall lethality of microorganisms (Toepfer and others 1946; Esselen and Tischer 1946). Smaller retorts may require longer process times to achieve equivalent lethalities (Taube and Sater 1948; Nordsiden and others 1978; Walsh and Bates 1978). There are no published data on thermal processing in the pressure cookers that are available in today's marketplace.

The objective of this study is to compare heating and cooling characteristics, cumulative lethalities, and potential safe process times of stewed tomatoes in 6, 8, and 17 quart household pressure retorts. The hypotheses are: the rate of heating and cooling will increase as retort size decreases; cumulative lethalities will decrease as retort size decreases; potential process times will increase as retort size decreases.

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CHAPTER 2

LITERATURE REVIEW

Thermal Process Design

The purpose of thermal processing is to produce a safe and long lasting product by heating it sufficiently to destroy pathogenic and spoilage microorganisms. However, heating a product too long may adversely alter the flavor and nutritive value of the product. Thermal process design originated out of the need to preserve food safely without over-processing it. Thermal process design combines the rate a product heats and cools with the rate a microorganism population is inactivated. There are various ways to use heat penetration data and thermal death time models to calculate process recommendations but there are two main methodologies commonly used, the general method and the formula method.

Heat Penetration

Heat penetration data are needed to determine the rates at which a product heats up and cools down during and after a process. Temperature profiles are collected by thermocouples and recorded by software and computer. The thermocouples are secured at the point of slowest heating known as the cold spot. Thermocouples are attached to lead wires that pass through the retort via an insulated opening called a stuffing box. These wires transport the temperature data to a data logger. The data logger is attached to a computer with specialized software that records the temperature profiles.

The cold spot for each product in its container must be determined prior to collecting heat penetration data for process determination (IFTPS 1995). Products can be classified into three different categories based on the way they heat: conduction heating, convection heating, or broken curve heating (Teixeira 1992). Products that do not circulate during a heat process heat by conduction. The geometric center of the container is the cold spot in products that heat by conduction. Foods that heat by convection circulate during a heat process and heat more evenly and rapidly than do conduction heating products. The cold spot is usually below the geometric center of the container in products that heat by convection. Broken curve heating products are those that heat part of the process by conduction and part of the process by convection. The cold spot can be either at the geometric center or below the center of the container depending on the product.

Heat penetration data can be affected by many factors including: processing temperature, initial product temperature, size and shape of the container, headspace, fill weight, ratio of solid to liquid, and product consistency (Downing 1996).

Thermal Death Time

Thermal death time (TDT) models are used to describe the heat resistance of bacteria. Thermal death time is the time at a given temperature to destroy a proportion of bacteria. The TDT curve is a plot of time on a logarithmic scale y-axis and temperature on a linear scale x-axis.

Bacteria exhibit a logarithmic order of death when exposed to a particular lethal temperature (Stumbo 1973; Hersom and Hulland 1980; Teixeira 1992). This means that the same proportion of bacteria is inactivated per unit time. The unit of time required to destroy 90% of bacteria is called the decimal reduction time, or D value (National Canners Association 1968). The D value is determined from the logarithmic survival curve (the plot of survivors on a logarithmic scale by time at a constant temperature on a linear scale). Low acid products require a 12 D reduction in *Clostridium botulinum,* the most heat resistant pathogen, to ensure a commercially sterile product. Commercial sterility is defined as the destruction of all pathogenic organisms (National Canners Association 1968).

The z value is the temperature required for a tenfold change in time to achieve an equivalent lethal effect. The z value can be determined from either the TDT curve or the phantom TDT curve. The phantom TDT curve is the plot of the D-value (rather than time) on a logarithmic scale versus the temperature on a linear scale. The z value is the negative inverse of the slope of the line on the phantom TDT curve and the slope of the TDT curve (National Canners Association 1968). The z value for *C. botulinum* is generally accepted to be 18 °F or 10 °C (Downing 1996).

The sterilizing value (F_0) denotes the minutes it takes to destroy a specified number of spores at 121.1 °C when z is 10 °C. A F_0 of 2.5 minutes is required for a 12 D reduction in *C. botulinum* in a neutral phosphate buffer (Stumbo 1973; National Canners Association 1968). Processing to a minimum F_0 of 3 for low acid foods and a F_0 of 0.7 for acid foods is typically used in determining adequate process times (Hersom and Hulland 1980).

A variety of factors can affect the heat resistance of microorganisms. Heat resistance generally increases with: increased proximity to optimal pH, decreased moisture, presence of fat, presence of carbohydrate, presence of protein, increasing numbers of the microorganism, increasing age of the microorganism (Jay 2000). Low concentrations of salt (sodium chloride) tend to have a protective effect while large concentrations tend to have an inhibitory affect (Stumbo 1973).

General Method

The general method is a way of graphically integrating heat penetration data with TDT data. Bigelow and others first introduced the concept in 1920 (Bigelow and others 1920). A lethal rate is assigned to each temperature on the heat penetration curve. The lethal rate is obtained by taking the reciprocal of the minutes for that temperature on the TDT curve. A lethality curve is constructed by replacing the temperatures with the lethal rate values. The area under the curve is calculated. A process is considered adequate when the area under the curve is at least one.

Formula Method

Ball (1923-1924) developed a mathematical formula to directly calculate an adequate process time. This formula is based on the plot of the heating curve on semilog paper and is as follows: $B_b = f_h (\log jI - \log g)$

Where: B_b = process time in minutes

f_h = the slope of the straight line portion of the heating curve

j = heating lag factor

I = the difference between retort temperature and initial product temperature

g = the difference between retort temperature and the maximum product temperature that must be attained to achieve commercial sterility

The Ball formula has some recognized limitations, but it has nevertheless persisted over time and is probably the most widely used method for calculating canning processes. The formula has evolved through the decades as other scientists proposed corrections for the limitations of the original formula (Merson and others 1978; Stumbo 1973; Hayakawa 1970). Several different versions of the Ball formula are used today. Each version has its own set of advantages and disadvantages. The formula method continues to change, especially as computers make it easier to perform calculations (Merson and others 1978).

Inoculated Pack Studies

Inoculated pack studies can be performed to confirm that a calculated process is adequate (National Canners Association 1968). The product is inoculated with a known amount of bacterial spores and processed according to the devised process schedule. The product is then incubated for a period of time at various temperatures. Then the cans are examined for spoilage, microbial content, and/or toxin formation.

Inoculated pack studies can also be done to determine an adequate process schedule (National Canners Association 1968). The product is inoculated and processed according to various potential process schedules.

Effect of Retort Construction and Size

In the following review, household pressure retorts are as defined by Zottola and others (1978). Pressure retorts of 8 quart liquid capacity and below are referred to as pressure saucepans. Those at and above 12 quart liquid capacity are referred to as pressure canners.

The sterilizing value of a process is associated with the come-up and cooling periods as well as the actual processing time. Toepfer and others (1946) reported that the cooling curve of vegetables in pint size jars accounted for fifty percent of the sterilizing value. Esselen and Tischer (1946) found the cooling curve of vegetables in quart size jars to be about thirty percent of the sterilizing value. Since smaller canners and their contents will heat up (come-up) and cool down more quickly, it is likely that safe process times increase as size decreases.

Taube and Sater (1948) compared the sterilizing value of snap beans processed in pressure saucepans to those processed in a standard pressure canner. They studied six different pressure saucepans. The snap beans were processed in pint jars for 20 minutes at 10 pounds per square inch as measured by gauge (psig). The target sterilizing value was identified as 5.0. The mean sterilizing value of snap beans processed in a standard pressure canner was 7.1. Only one of the saucepans studied yielded a mean sterilizing value above 5.0. They concluded that process recommendations for pressure canners were not sufficient for pressure saucepans. Taube and Sater went on to investigate process times of 13 different low acid vegetables in a 4 quart pressure saucepan that could hold three pint size jars and in a 21 quart canner that could hold 16 pint size jars. They recommended a 20-minute increase in process time in the 4 quart pressure saucepan compared to the larger canner. This recommendation was not incorporated into official USDA publications.

Walsh and Bates (1978) applied Taube and Sater's recommendation to add twenty minutes to the process of green beans in saucepans. This resulted in an overly processed product with a mean sterilizing value of 10.46. They were able to replicate the results in the standard size pressure canner but not in the pressure saucepan. They recommended a nine-minute increase in the pressure saucepans they used. Walsh and Bates attributed discrepancies from earlier work to lighter saucepan construction. They failed to mention that the pressure saucepan and the pressure canner used in these studies were of different sizes than the Taube and Sater study. The pressure canner in this study was smaller having a maximum capacity of seven quart-size jars. The pressure saucepan used in this study was larger; it could hold up to five pint-size jars.

Nordsiden and others (1978) investigated canning at 15 psig in a 4 quart pressure saucepan and in a 21 quart capacity pressure canner. They studied products that heat by conduction (cream corn, fish, and beef) and products that heat by convection (asparagus, green beans, and carrots). They recommended an additional 10 minutes for convection heating products processed in a pressure saucepan. For products heating by convection, they recommended an additional 10 minutes to the process in the pressure saucepans to their recommendations for the 21 quart pressure canner. They were unable to recommend process times for the products that heated by conduction due to inconclusive results.

While most attention in the home canning literature on retort size has focused on pressure processes, Montville (1981) found a substantial difference between two sizes of boiling water bath canners in the lethality of *B. licheniformis* in canned tomatoes. The larger canner could hold 9 pint size jars. The smaller canner could hold 7 pint size jars.

Processing inoculated tomatoes according to USDA recommendations provided 2.7 decimal reductions in the smaller canner compared to 7.4 decimal reductions in the larger canner. The temperature in the jars in the larger canner at the end of process was 7 °C higher than the end temperature of the jars in the smaller canner. Montville attributed this to the longer time it took for the larger canner to come to a boil prior to the start of the process.

Effect of Process Temperature

Processing foods at higher temperatures can shorten the process time considerably. Another finding of Nordsiden and others (1978) was that products that heat by convection could be processed at 15 psig in about one third of the time than at 10 psig. Wallace and others (1978) confirmed this through inoculated pack studies. However, even though process time is shortened, the total time involved in process management from come-up through cooling, may not be any shorter.

Processing foods at higher temperatures also saves energy. Zimmerman and others (1978) studied processing tomatoes by the following methods: boiling water, 5 psig, 10 psig, and 15 psig. Processing in a boiling water canner used more kilowatt-hours than processing under pressure. They also used a sensory panel to compare the end product of the different processing methods; no difference in acceptability and quality was found. They processed tomatoes to a minimum endpoint cold spot temperature of 82 °C. They did not compare F_0 values or make any process recommendations.

Lazaridis and Sander (1988) studied the effect of a higher process temperature on the quality of low-acid foods. They processed asparagus (convection heating), peas (combined heating), and strained squash (conduction heating) at 10 psig and 15 psig.

Foods were processed to equivalent F_0 values. Texture and color were analyzed by instruments. A sensory panel also evaluated texture, color, and flavor. No differences were found in the asparagus. The peas processed at 15 psig were less soft than those processed at 10 psig. There was no difference in color or flavor. Quality differences between squash processed at 10 psig and 15 psig were significant. The squash processed at 15 psig was similar in taste, texture, and color to the unprocessed squash. These results show that quality of foods processed at 15 psig is as good if not better than when processed at 10 psig.

The pH of Tomatoes

Tomatoes are usually classified as a high acid product. However, tomatoes have been reported to have pH values above 4.6 (Powers 1976). A pH below 4.6 is required to prevent *C. botulinum* from becoming a health threat. A pH of 4.1 in canned tomatoes is sufficiently low to prevent spoilage (Powers 1976). The commercial canning industry classifies tomatoes and tomato products with an equilibrium pH of 4.7 and above in the low-acid food category (Food and Drug Administration 2002). The USDA treats all tomatoes and tomato products as potentially low-acid foods (1994).

Anderson and Mendenhall (1978) conducted a survey of fresh tomatoes and home canned tomatoes in Utah. The survey analyzed 249 fresh and 156 canned tomato samples. Tomatoes were categorized by cultivar when known. Cultivar did not seem to correlate with pH as there was more variety among samples of the same cultivar as there was among cultivar. Fresh samples ranged in pH from 3.78 to 4.55. The canned tomatoes ranged in pH from 3.81 to 4.53 with an average pH of 4.13. No tomatoes fresh or canned were found to be in the low-acid category.

Wolf and others (1979) examined the pH of 107 varieties of tomatoes from three different areas in Minnesota. They sampled underripe, ripe, and overripe tomatoes. Twelve varieties had a pH above 4.6 in the overripe stage. The pH correlated with location, cultivar, and maturity.

Gutheil and others (1980) collected 152 samples of fresh homegrown tomatoes in 19 counties of Washington State. They categorized tomatoes across five levels of maturity, from green to overripe. A pH greater than 4.6 was found in two firm, ripe tomatoes. One soft, overripe tomato had a pH of 4.74. Acidity decreased with maturity. They also found that the tomatoes from the eastern portion of the state, where the climate is warmer and drier, had a higher pH.

Combining high acid tomatoes with low acid vegetables can result in a low acid product. Sapers and others (1981) created a database of common tomato based recipes and categorized them into three groups according to pH. Stewed tomatoes, tomato-celery combinations, tomato paste and puree, and several meatless tomato sauces were classified as high acid products. Tomato-bean, tomato zucchini, spaghetti sauce with meat, and chili con carne recipes were low acid recipes. Juice blends, soups, tomato-okra, tomato-mushroom sauces, Creole sauces, and Spanish style sauces had recipes with pH values above and below 4.6. They stated that it was best to assume these products were low acid.

Metabiosis

Metabiosis is when one species changes the environment in a way that makes it possible for another to survive. If a home canned jar of an acidic food does not have a sufficient seal, the food will be exposed to oxygen. Presence of oxygen and exposure to the outside environment may be breeding ground for spoilage microorganisms. Some spoilage microorganisms may increase the pH enough to allow *Clostridium botulinum* to thrive.

Huhtanen and others (1976) investigated the effect of mold on *C. botulinum* growth in tomato juice. They adjusted the pH of commercially canned tomato juice to 4.2, 4.6, and 5.2. Samples were then inoculated with *C. botulinum.* Mold cultures of *Cladosporium* were added to samples. pH readings were taken throughout the samples and toxin production was analyzed at 6, 9, and 19 days after incubation. The pH rose rapidly beneath the mold mat in all levels of acidity. The pH also increased throughout the samples. In the presence of mold, toxin formed as rapidly in the juice with an initial pH of 4.2 as in the juice with the pH of 5.2.

Mundt (1978) investigated the effect of 58 species of mold on tomato juice. Almost all of the species tested caused a rise in pH after 35 days of being incubated at 22 °C.

Montville and Sapers (1981) studied the thermal resistance of the mold, *Bacillus licheniformis*. The pH of the tomato puree was 4.4. The average thermal resistance was 2.0 minutes at 100 ºC and 4.5 minutes at 95 ºC. Inoculated pack experiments were performed. Tomato puree was processed according to 1975 USDA raw-pack recommendations. The process provided more than a 3D reduction in *B. licheniformis.* The seals on half of the jars were purposely broken. Jars were incubated at 30 ºC for 90 days. No growth or elevation of pH was noted in the sealed jars. Mold spores did grow and raise the pH to 5.2 in the jars with broken seals.

Montville (1982) went on to study the effect of *B. licheniformis* on *C. botulinum* in tomatoes. Inoculated pack studies were performed on Roma tomatoes with a pH of 4.4. *C. botulinum* and/or *B. licheniformis* spores were inoculated into pint jars of cold packed Roma tomatoes and processed in a boiling water canner for 35 minutes. To mimic an inadequate seal, the seal was purposely broken on half of the processed jars prior to storage. Jars were incubated at 30 ºC. No toxin production was detected in any of the samples after 30 days. However, pH was elevated in the jars inoculated with *B. licheniformis*. One of the coinoculated jars with a broken seal did have a putrid odor, suggesting the presence of *C. botulinum*.

Acidulation of Tomatoes

Adding acid to tomatoes prior to canning is one way to decrease the likelihood of spoilage and/or the growth of pathogens. Sapers and others (1978) found that adding ¼ teaspoon of citric acid monohydrate or one tablepoon bottled lemon juice per pint was required to assure tomatoes do not exceed a pH of 4.6. Savani and Harris (1978) compared four different acid treatments to no acid treatment on the survival of *Clostridium sporogenes*. The order of effectiveness from most inhibitory to no inhibition of *C. sporogenes* is as follows: bottled lemon juice, cream of tarter, citric acid, citric acid with sugar, and no treatment.

One downside to adding acid to tomatoes is a change in flavor and acceptability. Skelton and Marr (1978) used a sensory panel to compare canned tomatoes with and without citric acid. One quarter teaspoon of citric acid was added to tomatoes. The citric acid condition tomatoes were canned with ¼ teaspoon per pint. The sensory panelists rated the color of the acidified tomatoes higher than the non-acidified tomatoes but rated the flavor lower. Skelton and Craig (1978) recommended adding 1/8 teaspoon of citric acid per pint, but this amount is inconsistent with recommendations for safety (Sapers and others 1978; USDA 1994).

Current USDA Recommendations for Canning Tomatoes

The USDA (1994) recommends using only disease-free, vine-ripened, firm tomatoes for canning. They recommend adding 2 tablespoons of bottled lemon juice or ½ teaspoon of citric acid per quart and 1 tablespoon of bottled lemon juice or ¼ teaspoon citric acid per pint to whole, crushed, or juiced tomatoes. Tomatoes can be processed in a boiling water bath canner or a pressure canner. Weighted gauge recommendations are for 10 psig or 15 psig depending on altitude and product. Process schedules for non-acidified tomato products are designed for the destruction of *C. botulinum* and are always canned under pressure.

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CHAPTER 3

METHODS

Materials

- Aluminum retorts

  (National Presto Industries, Inc., Eau Claire, WI)

  - 6 quart liquid capacity, Model 01264
  - 8 quart liquid capacity, Mode 01282
  - 17 quart liquid capacity, Model 01750

- CALSoft thermal processing software

  (TechniCAL, Inc., New Orleans, LA)

- Das-TC data acquisition system (cold spot studies)

  (Keathley Instruments, Inc., Cleveland, OH)

- E-Val™ Monitoring System (confirmation studies)

  (Ellab Inc., Arvada, CO)

- Ecklund needle type thermocouples and insulated copper constantan leads

  (Ecklund-Harrison Technologies, Inc., Fort Myers, FL)

- IQ 200 ph meter

  (IQ Scientific Instruments, Inc., San Diego, CA)

- SAS 8.2

  (SAS Institute Inc., Cary, NC)

- Standard household gas ranges
- Standard half pint home-canning jars

  (Alltrista Consumer Products Company, Muncie, IN)
- Standard two piece metal lids and ring bands

  (Alltrista Consumer Products Company, Muncie, IN)

Product Preparation and pH Studies

The stewed tomatoes recipe used in this investigation is as follows: 2 quarts chopped Roma tomatoes, 1/4 cup chopped celery, 1/4 cup chopped onions, 2 teaspoons celery salt, 2 teaspoons sugar, and 1/4 teaspoon canning salt. Tomatoes were blanched in boiling water and dipped in cold water in order to remove their skins before chopping. Ingredients were mixed together and cooked in a covered pot for 10 minutes on a gas stove.

The IQ200 pH meter (IQ Scientific Instruments, Inc., San Diego, CA) was used for the pH studies. The stewed tomatoes recipe was first prepared five times and cooked for 10 minutes in an open saucepan. pH readings were obtained for the individual raw ingredients as well as for each ingredient post-cooking. The recipe was then prepared six times and canned at 15 psig for 15 minutes. Individual ingredients had both raw and post-canning pH readings taken.

Each raw ingredient was pureed in a mini food processor prior to pH testing. In cooked and canned samples, the mixture was first drained through a strainer. The individual ingredients were separated, rinsed with de-ionized water, and mashed with mortar and pestle prior to pH reading. The pH of the drained liquid was also taken to represent the pH of the combined mixture, after preliminary tests showed this was true for this procedure.

Filling Procedure

Standard glass half pint canning jars were sterilized in boiling water for ten minutes. Five jars were filled per recipe, leaving 1/2 inch headspace. The fill weight of each jar was kept constant. Bubbles were removed with a plastic spatula. Jar rims were wiped with a damp paper towel. Flat metal lids with sealing compound were treated with hot water, placed on jars, and secured with screw on ring bands. Five jars were placed in the retort to be processed.

Processing Procedure

The stewed tomatoes were processed in 6 quart, 8 quart, and 17 quart liquid capacity aluminum pressure retorts. The retorts were manufactured by National Presto Industries, Incorporated (Eau Claire, Wisconsin). The retorts used are pictured in figure 3.1. The 6 quart retort (Model 01264) is marketed as a “pressure cooker” but it can hold 5 half-pint canning jars. The 8 quart retort (Model 01282) is sold as a “pressure cooker and canner” that can hold up to 7 pint jars. The 17 quart retort (Model 01750) is marketed as a “pressure cooker and canner” that can hold 24 half-pint jars, 10 pint jars, or 7 quart jars. The 6 and 8 quart capacity retorts have 15 psig weighted gauges and the 17 quart capacity retort has a dial gauge.

Figure 3.1. Retorts used in this study, from left to right: 17 qt, 8 qt, 6 qt

The amount of water used in each retort was adjusted to bring the water level to 1 7/8″ with 5 half pint jars in the retort. The water was preheated. The jars were placed in the retort and the retort lid was secured.

The burner was turned to its highest setting. Once a clear funnel of steam was visible, the retort was allowed to vent for 10 minutes. After the 10 minutes, a 15 psig calibrated weight was placed over the vent port to allow the retort to pressurize. A consistent rocking of the weight indicated the retort was at pressure. The heat was turned off after being at pressure for 25 minutes. Once the retort depressurized, the lid was removed, and the jars were lifted out of the retort to cool at room temperature.

Data Acquisition

Retort and product temperatures were measured with Ecklund thermocouple equipment (Ecklund-Harrison Technologies, Inc., Fort Myers, FL). The wall of each retort was outfitted with a stuffing box. Six insulated copper/constantan leads passed through each stuffing box. The ends of the leads on the inside of the retort were attached to jar thermocouples prior to canning (Figure 3.2). The ends of the leads on the outside of the retort were attached to a data logger. The data logger was connected to a hard drive. The Das-TC (Keathley Instruments, Inc., Cleveland, OH) data acquisition system was used for the cold spot studies. The data acquisition system was upgraded to the E-Val™ Monitoring System (Ellab, Arvada, CO) for all other data collection. The data acquisition systems recorded temperatures every minute.

Figure 3.2. Internal leads attached to jar thermocouples

<u>Cold Spot Studies</u>

The cold spot was determined by collecting heat penetration data at half-inch increments from the geometric center within the jars. The thermocouple lengths used were: center- 1 7/8″, 1/2″ below center- 2 3/8″, 1″ below center- 2 7/8″, 1 1/2″ below center- 3 3/8″ (Figure 3.3). Five jars were processed at least three times per retort size. The data taken during the process, from when the retort reached 121.1 ºC to when the heat was turned off, were imported into SAS, Version 8.2 (Carey, NC). Data were transformed by taking the log of the difference between the retort and the thermocouple temperature. The f_h values were determined for each thermocouple position. The general linear model procedure was used to compare f_h values. The thermocouple length with the largest mean f_h value was identified as being at the cold spot.

Figure 3.3. Four lengths of needle type thermocouples in half-pint jars

Confirmation Studies

Heating profiles were collected at the cold spot in 15 jars per retort size. Data were imported into CALSoft, v1.3.2 (TechniCAL, Inc, 1997). CALSoft generated heating, cooling, and total lethalities by using the general method. Potential process times and f_h values were determined using the Ball formula method. Analysis of variance (ANOVA) using the general linear model procedure (SAS Version 8.2, SAS Institute Inc., Cary, NC) was performed to compare the following across retort size: temperatures at the start of process, temperatures at the end of process, and f_h values.

CHAPTER 4

RESULTS

pH Studies

The average pH of the raw tomatoes sampled was 4.45 (Table 4.1). Five of the samples had pH readings above 4.6. The pH of the raw tomatoes increased an average of 0.09 after the 10 minute boil but decreased (from raw) an average of 0.13 after the pressure process. The pH of the liquid did not exceed 4.55 after the 10 minute boil nor the 15 minute pressure process.

Table 4.1. pH of Ingredients and Liquid

	n	**pH Mean**	**Range**	**Mean change from raw**[1]
Raw				
Tomatoes	17	4.45	4.22 – 4.77	
Celery	16	5.77	5.53 – 6.10	
Onions	17	5.36	5.19 – 5.67	
Post 10 minute boil				
Tomatoes	12	4.51	4.39 – 4.59	+0.09
Celery	12	4.59	4.49 – 4.68	- 1.30
Onions	12	4.57	4.45 – 4.64	- 0.84
Liquid	12	4.49	4.37 – 4.57	
Post pressure process[2]				
Tomatoes	18	4.38	4.24 – 4.54	- 0.13
Celery	18	4.40	4.27 – 4.57	- 1.36
Onions	18	4.41	4.32 – 4.57	- 0.19
Liquid	18	4.36	4.15 – 4.54	

[1]Post process minus raw
[2]Processed 15 minutes at 15 psig

Cold Spot Studies

The slowest heating point of this stewed tomatoes recipe in half-pint jars is the geometric center of the jar. The f_h value at the center position was significantly larger ($p < 0.001$) than the each of the positions below it (Table 4.2).

Table 4.2. Determination of the Cold Spot of Stewed Tomatoes in Half-pint Jars

		f_h	
Thermocouple placement	**n**	**Mean[1]**	**Standard deviation**
Center	15	32.5^{A}	2.0
½″ below center	15	31.5^{B}	2.0
1″ below center	13	29.0^{B}	3.3
1 ½″ below center	11	23.9^{B}	4.7

[1]Means in the same column with different letters are significantly different at $p < 0.001$

Confirmation Studies

Retort temperature was controlled at 121 °C during the process in all three sizes of retorts (Table 4.3). Retorts reached process temperature in 13 to 14 minutes from the start of the 10 minute exhaust period. The 8 quart retort took longer than the 17 quart retort to depressurize. The 6 quart retort depressurized faster than the 8 quart and 17 quart retorts due to a leak in the stuffing box.

Table 4.3. Retort Properties

	Retort size (quart)		
	6 (n = 3)	8 (n = 3)	17 (n = 3)
Retort temperature at the end of exhaust (°C)	101.4 ± 0.6[1]	102.5 ± 0.4	102.7 ± 0.1
Retort temperature during process (°C)	121.4 ± 0.1	121.2 ± 0.1	121.1 ± 0.0
Time from start of exhaust to start of process (min)	13.3 ± 0.6	13.7 ± 0.6	13.0 ± 0.0
Time from end of process to lid off (min)	13.7 ± 1.2	26.7 ± 0.6	19.7 ± 2.1

[1]Mean ± standard deviation

Jar temperature did not start to increase until the end of the 10 minute exhaust (Table 4.4). Mean jar temperatures achieved by the end of the 25 minute process were the same ($p < 0.001$) in the 6 quart and 8 quart retorts (Table 4.4).

Table 4.4. Heating Characteristics of Jars (°C)

	Retort size (quart)		
	6 (n=15)	8 (n=15)	17 (n= 15)
Initial	79.3 ± 5.8[1]	80.5 ± 2.1	76.8 ± 3.2
Start of exhaust	76.8 ± 4.4	78.3 ± 2.3	74.1 ± 2.3
End of exhaust	79.8 ± 2.9	79.4 ± 2.1	76.0 ± 1.9
Start of process	84.8 ± 2.1[A2]	85.3 ± 1.4[A]	81.2 ± 1.7[B]
End of process	113.7 ± 0.6[A]	113.0 ± 0.8[A]	112.2 ± 0.7[B]

[1]Mean ± standard deviation
[2]Values in the same row with different letters are significantly different at $p < .001$

Maximum jar temperatures were reached after the heat was turned off (Table 4.5). Maximum jar temperatures were similar regardless of retort size. Jar temperatures peaked earlier in the 6 quart retort. Jars processed in the 8 quart retort remained in a lethal range for a longer period of time. This was the retort that took longest to depressurize which means the jars were in the retort the longest (Table 4.3).

Table 4.5. Cooling Characteristics of Jars from the End of Process

	Retort size (quart)		
	6 (n = 15)	8 (n = 14)	17 (n = 15)
Maximum jar temperature (°C)	116.5 ± 0.7[1]	117.1 ± 0.5	116.2 ± 0.6
Time to maximum jar temperature (min)	3.9 ± 0.9	5.5 ± 0.7	5.3 ± 0.7
Time to jar temperature < 95 °C (min)	18.4 ± 2.7	31.3 ± 2.4	24.1 ± 3.0

[1]Mean ± standard deviation

The f_h values increased with retort size (Table 4.6). The jars processed in the 17 quart retort had a slower rate of heating ($p < 0.01$). The difference between the f_h values was not significant between the 6 quart and 8 quart retorts.

Target F_0 (3.0) was not achieved in any retort by the end of the process time; at least 80 % of the total cumulative lethality was achieved during cooling (Figure 4.1).

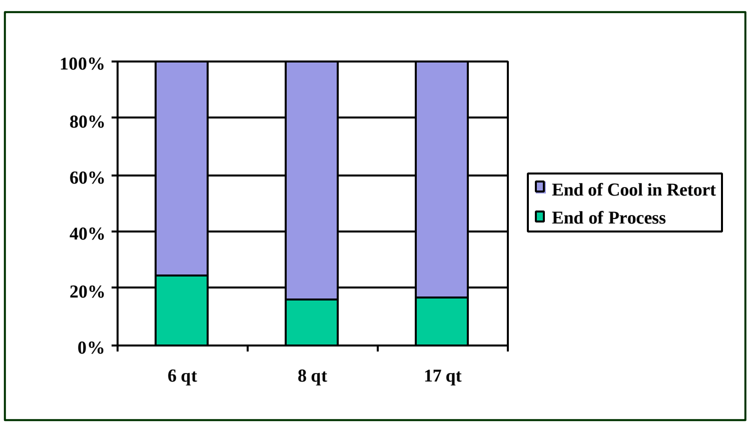

Figure 4.1. Contribution of heating and cooling to cumulative lethality

Even though the average calculated process time appears to follow the trend of f_h values, the maximum achieved in each size retort does not. In practice, home canning process times are rounded up to the next 5 minute interval. Therefore, if these results were to be used for recommending a process time, based on the worst-case jar scenario in each retort, the recommended process time for all three sizes would be 40 minutes (Table 4.6).

Table. 4.6. Effect of Retort Size on the Processing of Stewed Tomatoes

	Retort size (quart)		
	6 (n=15)	**8** (n=15)	**17** (n=15)
***f_h* (min)**	30.6 $\pm$ 1.4[A12]	31.3 $\pm$ 1.5[A]	33.1 $\pm$ 1.3[B]
Cumulative F_0 (min)			
End of process	0.9 $\pm$ 0.2	0.9 $\pm$ 0.1	0.6 + 0.1
End of cool in retort	n/a[3]	4.8 $\pm$ 0.6	3.0 $\pm$ 0.5
Calculated process times (min)			
B_b	33.6 $\pm$ 1.5	33.8 $\pm$ 0.9	36.0 $\pm$ 0.6
Maximum B_b	37.3	35.9	37.0
Potential recommendation	40[4]	40	40

[1]Mean $\pm$ standard deviation
[2]Values in the same row with different letters are significantly different at $p < .01$
[3]Cooling data not available due to equipment failure
[4]Maximum B_b rounded up to the next nearest 5 minute increment

CHAPTER 5

DISCUSSION

pH Studies

The pH of some tomato samples examined in this study was above 4.7. This exemplifies the potential for low-acid tomatoes. The stewed tomatoes recipe in this study is non-acidified; it does not contain common household acidulants such as lemon juice, citric acid, or vinegar. Non-acidified tomato products should be processed for the destruction of *C. botulinum*.

Cold Spot Studies

The geometric center of the jar was determined to be the point of slowest heating. This is typical of conduction heating products (Downing 1996). The fact the jar temperatures continued to increase after the heat was turned off supports that these stewed tomatoes are a conduction-heating product. Products that heat by conduction have a slower response to heat since heat is transferred from particle to particle.

Confirmation Studies

The jars of stewed tomatoes in the 17 quart retort had significantly higher f_h values. This means the stewed tomatoes heated more slowly in the 17 quart retort. This was not expected. Theoretically, the same product exposed to the same heat processing environment (temperature) should heat at the same rate at the cold spot. Retort temperatures were well controlled so the slower rate of heating cannot be explained by variation in process temperature. Even though the same recipe and procedure were used throughout the study, it is possible that there were variations in product consistency. Natural variation in the produce could be to blame.

Another possible cause for the slower rate of heating in the 17 quart retort may be the larger amount of space around the jars. The 17 quart retort has a considerably larger volume than the smaller retorts used in this study. The same number of jars was processed per heat penetration test in each retort. The jars in the smaller retort were placed in close proximity to each other while the jars processed in the 17 quart retort had more space around and above them. Air pockets within the retort can cause a slower rate of heating (National Canners Association 1968). Perhaps a 10-minute vent is not sufficient to evacuate all the air from a 17 quart retort containing only five half-pint jars. The fact that all retorts reached processing temperature in about the same time is an indication that the 10 minute vent was adequate. However, retort temperature was taken in the top center area in each retort by a single thermocouple and there may have been undetected air pockets in the retort with lower temperatures.

The slower rate of heating in the 17 quart retort resulted in lower temperatures, lower cumulative lethalities, and lower calculated process times. However, according to the worst-case scenario, the potential process recommendations are the same regardless of retort size. Previous research also failed to distinguish an effect of retort size on home canning process schedules for conduction heating products (Walsh and Bates 1978).

Like previous research (Esselen and Tischer 1946; Toepfer and others 1946), this study shows the significant contribution the cooling period makes toward total lethality. At least 80 % of the total lethality was accumulated after the process, while the jars were cooling.

Taube and Sater (1948) reported that smaller retorts heated up and cooled down more quickly than larger retorts. This was not the case in this study. Retorts came to pressure in three to four minutes after the exhaust, regardless of size. The cooling data were more difficult to discern. The 6 quart retort depressurized much more quickly than the other retorts as a result of an inadequate seal of the stuffing box. The 17 quart retort actually cooled faster than the 8 quart retort. This was probably due to more air circulation around the jars. Nevertheless, these results do not concur with past research or the hypothesis of the study.

The discrepancy between the current findings and past studies may be due to retort construction; yesterday's pressure saucepans are probably not the same as today's pressure cookers. Unfortunately little information on the construction and size of the pressure saucepans is presented in past research so it is not possible to describe the differences between past and present small pressure retorts.

Today's smaller pressure retorts may not heat and cool more quickly than modern larger retorts as hypothesized. Since the retorts used in this study heated at the same rate, it is likely that they also cool at the same rate when they are filled to capacity. If there is no difference in the cooling period then there may not be a difference in total lethality or recommended process schedules. The results of this study showed no difference in potential recommended process schedules among the three sizes of retorts.

Final conclusions cannot be drawn from this study but it highlights the need for further research.

Suggestions for Future Research

The effect of retort size on heat penetration could not be effectively examined due to significant differences in f_h values in this study. It is unknown why there was a difference but it could have been due to variability in the stewed tomatoes or the larger amount of open space in the 17 quart retort. Variability in product should be determined by measuring product viscosity, degrees Brix as a measurement of soluble solids, drain weights, and weights of solids. Increasing the number of jars in the 17 quart retort would help determine if there is an effect of open space within the retort on heat penetration. Placing more thermocouples at various positions within the retort would be useful to determine if air pockets are present.

Comparisons of the cooling process between the 6 quart retort and the other retorts could not be made due to a leak in the stuffing box. Because the cooling period has a significant impact on total lethality it is important that the stuffing box is airtight.

Results from the current study indicate that the number of jars within a retort may impact the cooling and total process lethality. The 8 quart retort was filled almost to capacity so it took longer to cool than did the lightly loaded 17 quart retort.

It was difficult to compare this study to studies done in the past because of lack of or inconsistent ways of presenting information on retort size and construction. Researchers should be as specific as possible when describing the retorts studied.

References

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CHAPTER 6

SUMMARY AND CONCLUSION

Most current home pressure canning recommendations were developed using standard 17 to 21 quart pressure retorts. Today's marketplace offers a variety of smaller pressure-based cookers/canners. Retort size has the potential to affect come up and cooling times, which contribute to the sterilizing value of a pressure process. As heating and cooling times are reduced so is total lethality.

The objective of this study was to compare f_h values, cumulative lethalities, and potential safe process times during pressure processing of stewed tomatoes in 6, 8, and 17 quart household pressure retorts. Stewed tomatoes were prepared and packed into 8 half-pint glass home canning jars. Jars were processed at 121.1 °C for 25 minutes in 6, 8, and 17 quart pressure retorts after a 10 minute exhaust of the retort. The cold spot was determined to be the geometric center of the jar. Continuous temperature profiles from 15 replications were collected using copper-constantan needle thermocouples connected to an electronic data logger. Potential process times and cumulative lethal rates were calculated for the destruction of *Clostridium botulinum* spores.

All three retorts came up to process temperature in the same time period so no difference in heating was noted before the process. Processing in smaller retorts resulted in lower f_h values ($p < 0.001$). Cooling data were confounded by a stuffing box leak in the 6 quart retort and possibly by more space around the jars in the 17 quart retort. The majority of lethality was accumulated in the cooling period. Calculated process times from the data collected so far were found to be equivalent, but due to the need to verify some data with additional work, a final conclusion about process schedules cannot be made at this time.

APPENDIX A

pH STUDIES

Table A.1. pH of Raw Ingredients

		pH			
Batch	**Ingredient**	**Sample 1**	**Sample 2**	**Sample 3**	**Average**
2	celery	5.76			
3	celery	5.81			
4	celery	6.10			
5	celery	5.90			
6	celery	5.87	5.88	5.89	5.88
7	celery	5.66	5.66	5.67	5.66
8	celery	5.53	5.54	5.54	5.54
10	celery	5.72			5.72
11	celery	5.88			5.88
12	celery	5.88			5.88
1	green pepper	5.15			
1	onion	5.67			
2	onion	5.62			
3	onion	5.44			
4	onion	5.26			
5	onion	5.29			
6	onion	5.42	5.42	5.43	5.42
7	onion	5.32	5.32	5.32	5.32
8	onion	5.19	5.20	5.20	5.20
10	onion	5.32			5.32
11	onion	5.35			5.35
12	onion	5.35			5.35
1	tomato	4.5			
2	tomato	4.48			
3	tomato	4.49			
4	tomato	4.40			
5	tomato	4.30			
6	tomato	4.31	4.37	4.29	4.32
7	tomato	4.66	4.64	4.63	4.64
8	tomato	4.22	4.22	4.23	4.22
10	tomato	4.31			4.31
11	tomato	4.77			4.77
12	tomato	4.77			4.77

Table A.2. pH Post 10 Minute Boil

Batch	Ingredient	pH Sample 1	Sample 2	Sample 3	Average
2	celery	4.57	4.55	4.56	4.56
3	celery	4.64	4.62	4.57	4.61
4	celery	4.68	4.68	4.68	4.68
5	celery	4.49	4.53	4.52	4.51
1	green pepper	4.65	4.6	4.62	4.62
1	liquid	4.34	4.4	4.39	4.38
2	liquid	4.47	4.48	4.51	4.49
3	liquid	4.53	4.56	4.55	4.55
4	liquid	4.50	4.57	4.56	4.54
5	liquid	4.37	4.40	4.43	4.40
1	onion	4.45	4.44	4.56	4.48
2	onion	4.56	4.60	4.59	4.58
3	onion	4.64	4.60	4.59	4.61
4	onion	4.61	4.60	4.62	4.61
5	onion	4.46	4.49	4.45	4.47
1	tomato	4.39	4.39	4.39	4.39
2	tomato	4.53	4.52	4.53	4.53
3	tomato	4.56	4.57	4.59	4.57
4	tomato	4.47	4.56	4.56	4.53
5	tomato	4.39	4.43	4.43	4.42

Table A.3. pH Post Pressure Process

		pH			
Batch	**Ingredient**	**Sample 1**	**Sample 2**	**Sample 3**	**Average**
10	celery	4.37	4.38	4.37	4.37
11	celery	4.42	4.41	4.40	4.41
12	celery	4.38	4.43	4.37	4.39
6	celery	4.32	4.41	4.42	4.38
7	celery	4.54	4.54	4.57	4.55
8	celery	4.35	4.27	4.30	4.31
10	liquid	4.35	4.36	4.36	4.36
11	liquid	4.37	4.37	4.36	4.37
12	liquid	4.37	4.40	4.37	4.38
6	liquid	4.31	4.25	4.40	4.32
7	liquid	4.50	4.52	4.54	4.52
8	liquid	4.30	4.15	4.21	4.22
10	onion	4.39	4.39	4.38	4.39
11	onion	4.44	4.43	4.40	4.42
12	onion	4.41	4.42	4.38	4.40
6	onion	4.32	4.34	4.44	4.37
7	onion	4.57	4.57	4.57	4.57
8	onion	4.34	4.33	4.32	4.33
10	tomato	4.36	4.37	4.35	4.36
11	tomato	4.37	4.37	4.37	4.37
12	tomato	4.38	4.40	4.37	4.38
6	tomato	4.30	4.33	4.40	4.34
7	tomato	4.53	4.53	4.54	4.53
8	tomato	4.38	4.25	4.24	4.29

APPENDIX B

COLD SPOT DATA AND ANALYSIS

Cold Spot SAS Syntax

```
data one;
    set one;
data one; set one;
    if Tcid=. then delete;
    drop F9;
data new; set one;
    Temp1=RetortTemp-JarTemp;
    Temp=log10(Temp1);
    output;
data new; set new;
    drop RetortTemp JarTemp Temp1;
proc print data=new;
run;
proc sort data=new;
    by TCID;
proc print data=new;
run;
proc glm data=new;
```

```
        by TCID;
        model Temp=time/solution;
        output out=glmout;
        ods output ParameterEstimates=parm;
run;
proc print;run;
proc print data=parm;
run;
data parmout; set parm;
        drop StdErr tValue Probt;
proc print data=parmout;
run;
proc sort data= parmout;
        by TCID;
proc print;
run;
data slope; set parmout;
        if int(_n_/2)= _n_/2 then output;
proc print data=slope;
run;
data slope; set slope;
        drop Dependent Parameter;
proc print data=slope;
```

```
run;
data group; set new;
	keep TCID Batch TC_ TCLength RetortSize;
proc print data=group;
run;
data all;
	merge slope group;
	by TCID;
proc print data=all;
run;
data two;set all;
	if int(_n_/25)=_n_/25 then output;
proc print data=two;
run;
data two; set two;
	fh=-1/Estimate;
proc print data=two;
run;
options formdlim=' ';
proc glm data=two;
	class Batch TC_ TCLength RetortSize;
	model fh=RetortSize TCLength TC_;
	means TCLength/tukey;
```

```
    means TCLength;
    lsmeans TCLength /out=lsout;
run;
title 'profile plot';
proc plot data=lsout vpercent=50;
    plot lsmean*TClength='L';
run;
```

Cold Spot Data File

TCID	Batch	TC#	TCLength	RetortSize	Time	RetortTemp	JarTemp
225	9	2	3.375	8	0	121.26	100.97
225	9	2	3.375	8	1	121.36	102.32
225	9	2	3.375	8	2	121.38	103.54
225	9	2	3.375	8	3	121.38	104.67
225	9	2	3.375	8	4	121.40	105.78
225	9	2	3.375	8	5	121.36	106.75
225	9	2	3.375	8	6	121.42	107.81
225	9	2	3.375	8	7	121.30	108.95
225	9	2	3.375	8	8	121.36	110.08
225	9	2	3.375	8	9	121.42	111.20
225	9	2	3.375	8	10	121.38	112.11
225	9	2	3.375	8	11	121.42	113.00
225	9	2	3.375	8	12	121.38	113.87
225	9	2	3.375	8	13	121.34	114.80
225	9	2	3.375	8	14	121.38	115.73
225	9	2	3.375	8	15	121.38	116.41
225	9	2	3.375	8	16	121.38	116.88
225	9	2	3.375	8	17	121.36	117.40
225	9	2	3.375	8	18	121.36	117.81
225	9	2	3.375	8	19	121.40	118.26
225	9	2	3.375	8	20	121.40	118.55
225	9	2	3.375	8	21	121.34	118.74
225	9	2	3.375	8	22	121.46	119.19
225	9	2	3.375	8	23	121.36	119.27
225	9	2	3.375	8	24	121.05	119.83
226	9	3	2.875	8	0	121.26	92.72

226	9	3	2.875	8	1	121.36	93.76
226	9	3	2.875	8	2	121.38	95.02
226	9	3	2.875	8	3	121.38	96.18
226	9	3	2.875	8	4	121.40	97.44
226	9	3	2.875	8	5	121.36	98.83
226	9	3	2.875	8	6	121.42	100.09
226	9	3	2.875	8	7	121.30	101.38
226	9	3	2.875	8	8	121.36	102.73
226	9	3	2.875	8	9	121.42	103.99
226	9	3	2.875	8	10	121.38	105.10
226	9	3	2.875	8	11	121.42	106.39
226	9	3	2.875	8	12	121.38	107.56
226	9	3	2.875	8	13	121.34	108.64
226	9	3	2.875	8	14	121.38	109.61
226	9	3	2.875	8	15	121.38	110.46
226	9	3	2.875	8	16	121.38	111.28
226	9	3	2.875	8	17	121.36	112.15
226	9	3	2.875	8	18	121.36	112.81
226	9	3	2.875	8	19	121.40	113.48
226	9	3	2.875	8	20	121.40	114.12
226	9	3	2.875	8	21	121.34	114.69
226	9	3	2.875	8	22	121.46	115.33
226	9	3	2.875	8	23	121.36	115.73
226	9	3	2.875	8	24	121.05	116.35
227	9	4	2.375	8	0	121.26	89.02
227	9	4	2.375	8	1	121.36	90.21
227	9	4	2.375	8	2	121.38	91.41
227	9	4	2.375	8	3	121.38	92.79
227	9	4	2.375	8	4	121.40	94.15
227	9	4	2.375	8	5	121.36	95.41
227	9	4	2.375	8	6	121.42	96.84
227	9	4	2.375	8	7	121.30	98.23
227	9	4	2.375	8	8	121.36	99.54
227	9	4	2.375	8	9	121.42	100.91
227	9	4	2.375	8	10	121.38	102.17
227	9	4	2.375	8	11	121.42	103.43
227	9	4	2.375	8	12	121.38	104.54
227	9	4	2.375	8	13	121.34	105.69
227	9	4	2.375	8	14	121.38	106.80
227	9	4	2.375	8	15	121.38	107.77
227	9	4	2.375	8	16	121.38	108.68

227	9	4	2.375	8	17	121.36	109.59
227	9	4	2.375	8	18	121.36	110.44
227	9	4	2.375	8	19	121.40	111.24
227	9	4	2.375	8	20	121.40	111.98
227	9	4	2.375	8	21	121.34	112.66
227	9	4	2.375	8	22	121.46	113.32
227	9	4	2.375	8	23	121.36	113.93
227	9	4	2.375	8	24	121.05	114.50
228	9	5	1.875	8	0	121.26	88.45
228	9	5	1.875	8	1	121.36	89.69
228	9	5	1.875	8	2	121.38	91.00
228	9	5	1.875	8	3	121.38	92.35
228	9	5	1.875	8	4	121.40	93.74
228	9	5	1.875	8	5	121.36	95.11
228	9	5	1.875	8	6	121.42	96.59
228	9	5	1.875	8	7	121.30	98.04
228	9	5	1.875	8	8	121.36	99.45
228	9	5	1.875	8	9	121.42	100.86
228	9	5	1.875	8	10	121.38	102.13
228	9	5	1.875	8	11	121.42	103.41
228	9	5	1.875	8	12	121.38	104.59
228	9	5	1.875	8	13	121.34	105.76
228	9	5	1.875	8	14	121.38	106.84
228	9	5	1.875	8	15	121.38	107.83
228	9	5	1.875	8	16	121.38	108.81
228	9	5	1.875	8	17	121.36	109.72
228	9	5	1.875	8	18	121.36	110.58
228	9	5	1.875	8	19	121.40	111.37
228	9	5	1.875	8	20	121.40	112.09
228	9	5	1.875	8	21	121.34	112.72
228	9	5	1.875	8	22	121.46	113.32
228	9	5	1.875	8	23	121.36	113.72
228	9	5	1.875	8	24	121.05	114.23
229	10	2	1.875	8	0	121.44	87.60
229	10	2	1.875	8	1	121.50	88.97
229	10	2	1.875	8	2	121.56	90.41
229	10	2	1.875	8	3	121.59	91.94
229	10	2	1.875	8	4	121.65	93.46
229	10	2	1.875	8	5	121.61	95.00
229	10	2	1.875	8	6	121.73	96.54
229	10	2	1.875	8	7	121.77	98.10

229	10	2	1.875	8	8	121.77	99.56
229	10	2	1.875	8	9	121.71	100.97
229	10	2	1.875	8	10	121.73	102.30
229	10	2	1.875	8	11	121.77	103.67
229	10	2	1.875	8	12	121.75	104.86
229	10	2	1.875	8	13	121.77	106.05
229	10	2	1.875	8	14	121.79	107.20
229	10	2	1.875	8	15	121.77	108.32
229	10	2	1.875	8	16	121.81	109.40
229	10	2	1.875	8	17	121.79	110.48
229	10	2	1.875	8	18	121.79	111.41
229	10	2	1.875	8	19	121.83	112.36
229	10	2	1.875	8	20	121.83	113.29
229	10	2	1.875	8	21	121.81	114.50
229	10	2	1.875	8	22	121.85	115.26
229	10	2	1.875	8	23	121.85	115.71
229	10	2	1.875	8	24	121.89	116.28
230	10	3	2.375	8	0	121.44	89.43
230	10	3	2.375	8	1	121.50	90.61
230	10	3	2.375	8	2	121.56	91.92
230	10	3	2.375	8	3	121.59	93.27
230	10	3	2.375	8	4	121.65	94.66
230	10	3	2.375	8	5	121.61	96.09
230	10	3	2.375	8	6	121.73	97.53
230	10	3	2.375	8	7	121.77	98.98
230	10	3	2.375	8	8	121.77	100.31
230	10	3	2.375	8	9	121.71	101.70
230	10	3	2.375	8	10	121.73	102.98
230	10	3	2.375	8	11	121.77	104.27
230	10	3	2.375	8	12	121.75	105.48
230	10	3	2.375	8	13	121.77	106.56
230	10	3	2.375	8	14	121.79	107.66
230	10	3	2.375	8	15	121.77	108.66
230	10	3	2.375	8	16	121.81	109.63
230	10	3	2.375	8	17	121.79	110.54
230	10	3	2.375	8	18	121.79	111.35
230	10	3	2.375	8	19	121.83	112.15
230	10	3	2.375	8	20	121.83	112.93
230	10	3	2.375	8	21	121.81	113.59
230	10	3	2.375	8	22	121.85	114.25
230	10	3	2.375	8	23	121.85	114.84

230	10	3	2.375	8	24	121.89	115.41
231	10	4	2.875	8	0	121.44	91.55
231	10	4	2.875	8	1	121.50	92.79
231	10	4	2.875	8	2	121.56	94.04
231	10	4	2.875	8	3	121.59	95.39
231	10	4	2.875	8	4	121.65	96.74
231	10	4	2.875	8	5	121.61	98.02
231	10	4	2.875	8	6	121.73	99.35
231	10	4	2.875	8	7	121.77	100.80
231	10	4	2.875	8	8	121.77	102.15
231	10	4	2.875	8	9	121.71	103.32
231	10	4	2.875	8	10	121.73	104.52
231	10	4	2.875	8	11	121.77	105.74
231	10	4	2.875	8	12	121.75	106.92
231	10	4	2.875	8	13	121.77	107.92
231	10	4	2.875	8	14	121.79	108.95
231	10	4	2.875	8	15	121.77	109.82
231	10	4	2.875	8	16	121.81	110.67
231	10	4	2.875	8	17	121.79	111.49
231	10	4	2.875	8	18	121.79	112.21
231	10	4	2.875	8	19	121.83	112.93
231	10	4	2.875	8	20	121.83	113.65
231	10	4	2.875	8	21	121.81	114.23
231	10	4	2.875	8	22	121.85	114.82
231	10	4	2.875	8	23	121.85	115.39
231	10	4	2.875	8	24	121.89	115.93
232	10	5	3.375	8	0	121.44	99.00
232	10	5	3.375	8	1	121.50	100.01
232	10	5	3.375	8	2	121.56	101.12
232	10	5	3.375	8	3	121.59	102.15
232	10	5	3.375	8	4	121.65	103.39
232	10	5	3.375	8	5	121.61	104.50
232	10	5	3.375	8	6	121.73	105.21
232	10	5	3.375	8	7	121.77	106.44
232	10	5	3.375	8	8	121.77	107.35
232	10	5	3.375	8	9	121.71	108.30
232	10	5	3.375	8	10	121.73	109.21
232	10	5	3.375	8	11	121.77	110.06
232	10	5	3.375	8	12	121.75	110.90
232	10	5	3.375	8	13	121.77	111.64
232	10	5	3.375	8	14	121.79	112.36

232	10	5	3.375	8	15	121.77	113.08
232	10	5	3.375	8	16	121.81	113.74
232	10	5	3.375	8	17	121.79	114.31
232	10	5	3.375	8	18	121.79	114.84
232	10	5	3.375	8	19	121.83	115.45
232	10	5	3.375	8	20	121.83	115.97
232	10	5	3.375	8	21	121.81	116.41
232	10	5	3.375	8	22	121.85	116.88
232	10	5	3.375	8	23	121.85	117.27
232	10	5	3.375	8	24	121.89	117.73
233	11	2	1.875	8	0	121.40	87.12
233	11	2	1.875	8	1	121.48	88.43
233	11	2	1.875	8	2	121.59	89.89
233	11	2	1.875	8	3	121.54	91.33
233	11	2	1.875	8	4	121.59	92.94
233	11	2	1.875	8	5	121.56	94.51
233	11	2	1.875	8	6	121.63	96.11
233	11	2	1.875	8	7	121.73	97.70
233	11	2	1.875	8	8	121.71	99.41
233	11	2	1.875	8	9	121.71	100.84
233	11	2	1.875	8	10	121.73	102.21
233	11	2	1.875	8	11	121.73	103.62
233	11	2	1.875	8	12	121.79	104.93
233	11	2	1.875	8	13	121.79	106.29
233	11	2	1.875	8	14	121.79	107.39
233	11	2	1.875	8	15	121.81	108.43
233	11	2	1.875	8	16	121.81	109.57
233	11	2	1.875	8	17	121.87	110.56
233	11	2	1.875	8	18	121.85	111.41
233	11	2	1.875	8	19	121.83	112.30
233	11	2	1.875	8	20	121.87	113.12
233	11	2	1.875	8	21	121.81	113.84
233	11	2	1.875	8	22	121.79	114.54
233	11	2	1.875	8	23	121.85	115.18
234	11	3	2.375	8	0	121.40	87.14
234	11	3	2.375	8	1	121.48	88.40
234	11	3	2.375	8	2	121.59	89.78
234	11	3	2.375	8	3	121.54	91.17
234	11	3	2.375	8	4	121.59	92.85
234	11	3	2.375	8	5	121.56	94.30
234	11	3	2.375	8	6	121.63	95.86

234	11	3	2.375	8	7	121.73	97.53
234	11	3	2.375	8	8	121.71	98.83
234	11	3	2.375	8	9	121.71	100.39
234	11	3	2.375	8	10	121.73	101.78
234	11	3	2.375	8	11	121.73	103.00
234	11	3	2.375	8	12	121.79	104.56
234	11	3	2.375	8	13	121.79	106.08
234	11	3	2.375	8	14	121.79	107.07
234	11	3	2.375	8	15	121.81	108.19
234	11	3	2.375	8	16	121.81	109.23
234	11	3	2.375	8	17	121.87	110.22
234	11	3	2.375	8	18	121.85	111.03
234	11	3	2.375	8	19	121.83	111.98
234	11	3	2.375	8	20	121.87	112.81
234	11	3	2.375	8	21	121.81	113.55
234	11	3	2.375	8	22	121.79	114.33
234	11	3	2.375	8	23	121.85	114.92
235	11	4	2.875	8	0	121.40	90.19
235	11	4	2.875	8	1	121.48	91.28
235	11	4	2.875	8	2	121.59	92.57
235	11	4	2.875	8	3	121.54	93.87
235	11	4	2.875	8	4	121.59	95.45
235	11	4	2.875	8	5	121.56	96.86
235	11	4	2.875	8	6	121.63	98.43
235	11	4	2.875	8	7	121.73	99.92
235	11	4	2.875	8	8	121.71	101.36
235	11	4	2.875	8	9	121.71	102.70
235	11	4	2.875	8	10	121.73	104.18
235	11	4	2.875	8	11	121.73	105.38
235	11	4	2.875	8	12	121.79	106.67
235	11	4	2.875	8	13	121.79	108.04
235	11	4	2.875	8	14	121.79	109.10
235	11	4	2.875	8	15	121.81	110.16
235	11	4	2.875	8	16	121.81	111.14
235	11	4	2.875	8	17	121.87	112.05
235	11	4	2.875	8	18	121.85	112.93
235	11	4	2.875	8	19	121.83	113.70
235	11	4	2.875	8	20	121.87	114.48
235	11	4	2.875	8	21	121.81	115.05
235	11	4	2.875	8	22	121.79	115.69
235	11	4	2.875	8	23	121.85	116.16

236	11	5	3.375	8	0	121.40	97.74
236	11	5	3.375	8	1	121.48	98.87
236	11	5	3.375	8	2	121.59	100.39
236	11	5	3.375	8	3	121.54	101.70
236	11	5	3.375	8	4	121.59	103.05
236	11	5	3.375	8	5	121.56	104.56
236	11	5	3.375	8	6	121.63	105.78
236	11	5	3.375	8	7	121.73	107.09
236	11	5	3.375	8	8	121.71	108.57
236	11	5	3.375	8	9	121.71	109.95
236	11	5	3.375	8	10	121.73	110.94
236	11	5	3.375	8	11	121.73	112.00
236	11	5	3.375	8	12	121.79	113.00
236	11	5	3.375	8	13	121.79	113.61
236	11	5	3.375	8	14	121.79	114.67
236	11	5	3.375	8	15	121.81	115.67
236	11	5	3.375	8	16	121.81	116.49
236	11	5	3.375	8	17	121.87	117.27
236	11	5	3.375	8	18	121.85	117.95
236	11	5	3.375	8	19	121.83	118.49
236	11	5	3.375	8	20	121.87	119.17
236	11	5	3.375	8	21	121.81	119.58
236	11	5	3.375	8	22	121.79	119.69
236	11	5	3.375	8	23	121.85	120.04
237	12	1	1.875	8	0	121.69	80.34
237	12	1	1.875	8	1	122.02	82.03
237	12	1	1.875	8	2	122.00	83.71
237	12	1	1.875	8	3	120.99	85.44
237	12	1	1.875	8	4	120.93	87.25
237	12	1	1.875	8	5	120.76	89.21
237	12	1	1.875	8	6	120.84	91.15
237	12	1	1.875	8	7	120.84	93.07
237	12	1	1.875	8	8	120.84	94.98
237	12	1	1.875	8	9	120.80	96.67
237	12	1	1.875	8	10	120.76	98.38
237	12	1	1.875	8	11	121.19	99.97
237	12	1	1.875	8	12	121.50	101.38
237	12	1	1.875	8	13	121.61	102.79
237	12	1	1.875	8	14	121.67	103.90
237	12	1	1.875	8	15	121.65	105.21
237	12	1	1.875	8	16	121.63	106.50

237	12	1	1.875	8	17	121.54	107.60
237	12	1	1.875	8	18	121.67	108.76
237	12	1	1.875	8	19	121.67	109.63
237	12	1	1.875	8	20	121.59	110.80
237	12	1	1.875	8	21	121.65	111.58
237	12	1	1.875	8	22	121.67	112.68
237	12	1	1.875	8	23	121.69	113.34
237	12	1	1.875	8	24	121.65	113.57
238	12	2	2.375	8	0	121.69	82.45
238	12	2	2.375	8	1	122.02	84.11
238	12	2	2.375	8	2	122.00	85.77
238	12	2	2.375	8	3	120.99	87.51
238	12	2	2.375	8	4	120.93	89.43
238	12	2	2.375	8	5	120.76	91.28
238	12	2	2.375	8	6	120.84	93.20
238	12	2	2.375	8	7	120.84	94.96
238	12	2	2.375	8	8	120.84	96.91
238	12	2	2.375	8	9	120.80	98.62
238	12	2	2.375	8	10	120.76	100.69
238	12	2	2.375	8	11	121.19	102.17
238	12	2	2.375	8	12	121.50	103.22
238	12	2	2.375	8	13	121.61	104.69
238	12	2	2.375	8	14	121.67	106.05
238	12	2	2.375	8	15	121.65	107.18
238	12	2	2.375	8	16	121.63	108.36
238	12	2	2.375	8	17	121.54	109.23
238	12	2	2.375	8	18	121.67	110.08
238	12	2	2.375	8	19	121.67	110.99
238	12	2	2.375	8	20	121.59	112.13
238	12	2	2.375	8	21	121.65	112.64
238	12	2	2.375	8	22	121.67	113.74
238	12	2	2.375	8	23	121.69	114.56
238	12	2	2.375	8	24	121.65	114.69
239	12	3	2.875	8	0	121.69	83.95
239	12	3	2.875	8	1	122.02	85.44
239	12	3	2.875	8	2	122.00	86.86
239	12	3	2.875	8	3	120.99	88.51
239	12	3	2.875	8	4	120.93	90.41
239	12	3	2.875	8	5	120.76	92.00
239	12	3	2.875	8	6	120.84	93.80
239	12	3	2.875	8	7	120.84	95.52

239	12	3	2.875	8	8	120.84	97.03
239	12	3	2.875	8	9	120.80	98.62
239	12	3	2.875	8	10	120.76	100.24
239	12	3	2.875	8	11	121.19	101.74
239	12	3	2.875	8	12	121.50	103.13
239	12	3	2.875	8	13	121.61	104.97
239	12	3	2.875	8	14	121.67	106.90
239	12	3	2.875	8	15	121.65	106.92
239	12	3	2.875	8	16	121.63	108.13
239	12	3	2.875	8	17	121.54	109.15
239	12	3	2.875	8	18	121.67	110.16
239	12	3	2.875	8	19	121.67	111.22
239	12	3	2.875	8	20	121.59	111.81
239	12	3	2.875	8	21	121.65	112.62
239	12	3	2.875	8	22	121.67	114.59
239	12	3	2.875	8	23	121.69	115.11
239	12	3	2.875	8	24	121.65	116.00
240	12	4	3.375	8	0	121.69	94.23
240	12	4	3.375	8	1	122.02	96.05
240	12	4	3.375	8	2	122.00	97.65
240	12	4	3.375	8	3	120.99	99.24
240	12	4	3.375	8	4	120.93	100.52
240	12	4	3.375	8	5	120.76	101.78
240	12	4	3.375	8	6	120.84	103.15
240	12	4	3.375	8	7	120.84	104.50
240	12	4	3.375	8	8	120.84	105.63
240	12	4	3.375	8	9	120.80	106.54
240	12	4	3.375	8	10	120.76	107.54
240	12	4	3.375	8	11	121.19	108.76
240	12	4	3.375	8	12	121.50	109.82
240	12	4	3.375	8	13	121.61	110.71
240	12	4	3.375	8	14	121.67	111.56
240	12	4	3.375	8	15	121.65	112.19
240	12	4	3.375	8	16	121.63	113.06
240	12	4	3.375	8	17	121.54	113.76
240	12	4	3.375	8	18	121.67	114.54
240	12	4	3.375	8	19	121.67	115.03
240	12	4	3.375	8	20	121.59	115.31
240	12	4	3.375	8	21	121.65	115.95
240	12	4	3.375	8	22	121.67	116.30
240	12	4	3.375	8	23	121.69	116.74

240	12	4	3.375	8	24	121.65	117.52
241	13	1	1.875	8	0	121.11	83.20
241	13	1	1.875	8	1	121.11	84.63
241	13	1	1.875	8	2	121.15	86.07
241	13	1	1.875	8	3	121.23	87.64
241	13	1	1.875	8	4	121.23	89.23
241	13	1	1.875	8	5	121.26	90.98
241	13	1	1.875	8	6	121.19	92.66
241	13	1	1.875	8	7	121.23	94.34
241	13	1	1.875	8	8	121.19	96.01
241	13	1	1.875	8	9	121.21	97.68
241	13	1	1.875	8	10	121.15	99.35
241	13	1	1.875	8	11	121.17	100.76
241	13	1	1.875	8	12	121.19	102.23
241	13	1	1.875	8	13	121.15	103.73
241	13	1	1.875	8	14	121.28	105.04
241	13	1	1.875	8	15	121.19	106.39
241	13	1	1.875	8	16	121.19	107.56
241	13	1	1.875	8	17	121.17	108.70
241	13	1	1.875	8	18	121.21	109.78
241	13	1	1.875	8	19	121.15	110.73
241	13	1	1.875	8	20	121.15	111.62
241	13	1	1.875	8	21	121.19	112.43
241	13	1	1.875	8	22	121.28	113.25
241	13	1	1.875	8	23	121.32	113.95
241	13	1	1.875	8	24	121.17	114.69
241	13	1	1.875	8	25	121.15	115.45
242	13	2	2.375	8	0	121.11	82.73
242	13	2	2.375	8	1	121.11	84.17
242	13	2	2.375	8	2	121.15	85.57
242	13	2	2.375	8	3	121.23	87.05
242	13	2	2.375	8	4	121.23	88.73
242	13	2	2.375	8	5	121.26	90.50
242	13	2	2.375	8	6	121.19	92.09
242	13	2	2.375	8	7	121.23	93.74
242	13	2	2.375	8	8	121.19	95.54
242	13	2	2.375	8	9	121.21	97.10
242	13	2	2.375	8	10	121.15	98.62
242	13	2	2.375	8	11	121.17	100.12
242	13	2	2.375	8	12	121.19	101.53
242	13	2	2.375	8	13	121.15	102.75

242	13	2	2.375	8	14	121.28	104.18
242	13	2	2.375	8	15	121.19	105.31
242	13	2	2.375	8	16	121.19	106.52
242	13	2	2.375	8	17	121.17	107.64
242	13	2	2.375	8	18	121.21	108.66
242	13	2	2.375	8	19	121.15	109.61
242	13	2	2.375	8	20	121.15	110.42
242	13	2	2.375	8	21	121.19	111.35
242	13	2	2.375	8	22	121.28	112.17
242	13	2	2.375	8	23	121.32	112.87
242	13	2	2.375	8	24	121.17	113.59
242	13	2	2.375	8	25	121.15	114.14
243	13	4	2.875	8	0	121.11	89.65
243	13	4	2.875	8	1	121.11	90.91
243	13	4	2.875	8	2	121.15	92.37
243	13	4	2.875	8	3	121.23	93.80
243	13	4	2.875	8	4	121.23	95.34
243	13	4	2.875	8	5	121.26	96.84
243	13	4	2.875	8	6	121.19	98.38
243	13	4	2.875	8	7	121.23	100.07
243	13	4	2.875	8	8	121.19	101.33
243	13	4	2.875	8	9	121.21	102.73
243	13	4	2.875	8	10	121.15	104.16
243	13	4	2.875	8	11	121.17	105.48
243	13	4	2.875	8	12	121.19	106.84
243	13	4	2.875	8	13	121.15	108.32
243	13	4	2.875	8	14	121.28	109.27
243	13	4	2.875	8	15	121.19	110.33
243	13	4	2.875	8	16	121.19	111.39
243	13	4	2.875	8	17	121.17	112.38
243	13	4	2.875	8	18	121.21	113.15
243	13	4	2.875	8	19	121.15	113.99
243	13	4	2.875	8	20	121.15	114.82
243	13	4	2.875	8	21	121.19	115.52
243	13	4	2.875	8	22	121.28	116.18
243	13	4	2.875	8	23	121.32	116.84
243	13	4	2.875	8	24	121.17	117.42
243	13	4	2.875	8	25	121.15	117.77
244	13	5	3.375	8	0	121.11	96.82
244	13	5	3.375	8	1	121.11	98.38
244	13	5	3.375	8	2	121.15	99.58

244	13	5	3.375	8	3	121.23	100.84
244	13	5	3.375	8	4	121.23	101.78
244	13	5	3.375	8	5	121.26	102.92
244	13	5	3.375	8	6	121.19	104.33
244	13	5	3.375	8	7	121.23	105.46
244	13	5	3.375	8	8	121.19	106.84
244	13	5	3.375	8	9	121.21	108.17
244	13	5	3.375	8	10	121.15	109.44
244	13	5	3.375	8	11	121.17	110.52
244	13	5	3.375	8	12	121.19	111.41
244	13	5	3.375	8	13	121.15	112.19
244	13	5	3.375	8	14	121.28	113.27
244	13	5	3.375	8	15	121.19	114.12
244	13	5	3.375	8	16	121.19	114.78
244	13	5	3.375	8	17	121.17	115.47
244	13	5	3.375	8	18	121.21	116.12
244	13	5	3.375	8	19	121.15	116.43
244	13	5	3.375	8	20	121.15	117.07
244	13	5	3.375	8	21	121.19	117.44
244	13	5	3.375	8	22	121.28	117.77
244	13	5	3.375	8	23	121.32	118.10
244	13	5	3.375	8	24	121.17	118.45
244	13	5	3.375	8	25	121.15	118.76
245	14	1	3.375	8	0	121.65	95.26
245	14	1	3.375	8	1	122.08	96.82
245	14	1	3.375	8	2	121.65	98.28
245	14	1	3.375	8	3	120.72	99.69
245	14	1	3.375	8	4	121.21	101.14
245	14	1	3.375	8	5	121.11	102.66
245	14	1	3.375	8	6	121.09	104.05
245	14	1	3.375	8	7	121.17	105.50
245	14	1	3.375	8	8	121.26	106.86
245	14	1	3.375	8	9	121.15	108.11
245	14	1	3.375	8	10	121.13	109.29
245	14	1	3.375	8	11	121.09	110.39
245	14	1	3.375	8	12	121.15	111.49
245	14	1	3.375	8	13	121.23	112.43
245	14	1	3.375	8	14	121.28	113.55
245	14	1	3.375	8	15	121.19	114.42
245	14	1	3.375	8	16	121.19	115.41
245	14	1	3.375	8	17	121.17	116.33

245	14	1	3.375	8	18	121.13	116.88
245	14	1	3.375	8	19	121.21	117.44
245	14	1	3.375	8	20	121.19	117.93
245	14	1	3.375	8	21	121.03	118.26
245	14	1	3.375	8	22	121.28	118.61
245	14	1	3.375	8	23	121.21	118.84
245	14	1	3.375	8	24	121.05	119.19
246	14	2	2.875	8	0	121.65	86.18
246	14	2	2.875	8	1	122.08	87.29
246	14	2	2.875	8	2	121.65	88.40
246	14	2	2.875	8	3	120.72	89.69
246	14	2	2.875	8	4	121.21	91.17
246	14	2	2.875	8	5	121.11	92.88
246	14	2	2.875	8	6	121.09	94.66
246	14	2	2.875	8	7	121.17	96.59
246	14	2	2.875	8	8	121.26	98.47
246	14	2	2.875	8	9	121.15	100.31
246	14	2	2.875	8	10	121.13	102.04
246	14	2	2.875	8	11	121.09	103.71
246	14	2	2.875	8	12	121.15	105.36
246	14	2	2.875	8	13	121.23	106.84
246	14	2	2.875	8	14	121.28	108.19
246	14	2	2.875	8	15	121.19	109.46
246	14	2	2.875	8	16	121.19	110.90
246	14	2	2.875	8	17	121.17	112.17
246	14	2	2.875	8	18	121.13	113.25
246	14	2	2.875	8	19	121.21	114.27
246	14	2	2.875	8	20	121.19	115.11
246	14	2	2.875	8	21	121.03	115.93
246	14	2	2.875	8	22	121.28	116.63
246	14	2	2.875	8	23	121.21	117.15
246	14	2	2.875	8	24	121.05	117.62
247	14	4	2.375	8	0	121.65	83.15
247	14	4	2.375	8	1	122.08	84.50
247	14	4	2.375	8	2	121.65	85.94
247	14	4	2.375	8	3	120.72	87.45
247	14	4	2.375	8	4	121.21	89.08
247	14	4	2.375	8	5	121.11	90.78
247	14	4	2.375	8	6	121.09	92.46
247	14	4	2.375	8	7	121.17	94.27
247	14	4	2.375	8	8	121.26	96.01

247	14	4	2.375	8	9	121.15	97.63
247	14	4	2.375	8	10	121.13	99.24
247	14	4	2.375	8	11	121.09	100.80
247	14	4	2.375	8	12	121.15	102.36
247	14	4	2.375	8	13	121.23	103.92
247	14	4	2.375	8	14	121.28	105.16
247	14	4	2.375	8	15	121.19	106.56
247	14	4	2.375	8	16	121.19	107.75
247	14	4	2.375	8	17	121.17	108.81
247	14	4	2.375	8	18	121.13	109.97
247	14	4	2.375	8	19	121.21	111.03
247	14	4	2.375	8	20	121.19	111.98
247	14	4	2.375	8	21	121.03	112.98
247	14	4	2.375	8	22	121.28	113.89
247	14	4	2.375	8	23	121.21	114.75
247	14	4	2.375	8	24	121.05	115.60
248	14	5	1.875	8	0	121.65	79.48
248	14	5	1.875	8	1	122.08	81.01
248	14	5	1.875	8	2	121.65	82.60
248	14	5	1.875	8	3	120.72	84.28
248	14	5	1.875	8	4	121.21	86.07
248	14	5	1.875	8	5	121.11	87.88
248	14	5	1.875	8	6	121.09	89.71
248	14	5	1.875	8	7	121.17	91.63
248	14	5	1.875	8	8	121.26	93.53
248	14	5	1.875	8	9	121.15	95.30
248	14	5	1.875	8	10	121.13	97.01
248	14	5	1.875	8	11	121.09	98.66
248	14	5	1.875	8	12	121.15	100.29
248	14	5	1.875	8	13	121.23	101.85
248	14	5	1.875	8	14	121.28	103.39
248	14	5	1.875	8	15	121.19	104.80
248	14	5	1.875	8	16	121.19	106.12
248	14	5	1.875	8	17	121.17	107.35
248	14	5	1.875	8	18	121.13	108.53
248	14	5	1.875	8	19	121.21	109.76
248	14	5	1.875	8	20	121.19	110.71
248	14	5	1.875	8	21	121.03	111.71
248	14	5	1.875	8	22	121.28	112.55
248	14	5	1.875	8	23	121.21	113.38
248	14	5	1.875	8	24	121.05	114.20

100	15	1	1.875	6	0	121.89	88.30
100	15	1	1.875	6	1	122.04	89.41
100	15	1	1.875	6	2	122.06	90.52
100	15	1	1.875	6	3	122.16	91.83
100	15	1	1.875	6	4	122.16	93.25
100	15	1	1.875	6	5	122.31	94.62
100	15	1	1.875	6	6	122.31	96.07
100	15	1	1.875	6	7	122.27	97.53
100	15	1	1.875	6	8	121.71	99.05
100	15	1	1.875	6	9	122.31	100.46
100	15	1	1.875	6	10	122.20	101.85
100	15	1	1.875	6	11	122.25	103.20
100	15	1	1.875	6	12	122.25	104.46
100	15	1	1.875	6	13	122.25	105.59
100	15	1	1.875	6	14	122.20	106.73
100	15	1	1.875	6	15	122.20	107.79
100	15	1	1.875	6	16	122.20	108.74
100	15	1	1.875	6	17	122.14	109.74
100	15	1	1.875	6	18	122.20	110.56
100	15	1	1.875	6	19	122.16	111.43
100	15	1	1.875	6	20	122.18	112.17
100	15	1	1.875	6	21	122.22	112.87
100	15	1	1.875	6	22	122.27	113.57
100	15	1	1.875	6	23	122.27	114.18
100	15	1	1.875	6	24	122.25	114.80
101	15	2	2.375	6	0	121.89	88.38
101	15	2	2.375	6	1	122.04	89.71
101	15	2	2.375	6	2	122.06	90.80
101	15	2	2.375	6	3	122.16	92.18
101	15	2	2.375	6	4	122.16	93.48
101	15	2	2.375	6	5	122.31	95.09
101	15	2	2.375	6	6	122.31	97.12
101	15	2	2.375	6	7	122.27	98.68
101	15	2	2.375	6	8	121.71	100.69
101	15	2	2.375	6	9	122.31	101.98
101	15	2	2.375	6	10	122.20	103.67
101	15	2	2.375	6	11	122.25	104.71
101	15	2	2.375	6	12	122.25	106.22
101	15	2	2.375	6	13	122.25	107.47
101	15	2	2.375	6	14	122.20	108.43
101	15	2	2.375	6	15	122.20	109.67

101	15	2	2.375	6	16	122.20	110.92
101	15	2	2.375	6	17	122.14	111.64
101	15	2	2.375	6	18	122.20	111.90
101	15	2	2.375	6	19	122.16	112.93
101	15	2	2.375	6	20	122.18	113.99
101	15	2	2.375	6	21	122.22	114.20
101	15	2	2.375	6	22	122.27	115.03
101	15	2	2.375	6	23	122.27	115.79
101	15	2	2.375	6	24	122.25	116.41
102	15	3	2.875	6	0	121.89	91.65
102	15	3	2.875	6	1	122.04	92.79
102	15	3	2.875	6	2	122.06	94.13
102	15	3	2.875	6	3	122.16	95.45
102	15	3	2.875	6	4	122.16	96.84
102	15	3	2.875	6	5	122.31	98.38
102	15	3	2.875	6	6	122.31	99.94
102	15	3	2.875	6	7	122.27	101.44
102	15	3	2.875	6	8	121.71	103.05
102	15	3	2.875	6	9	122.31	104.54
102	15	3	2.875	6	10	122.20	106.05
102	15	3	2.875	6	11	122.25	107.52
102	15	3	2.875	6	12	122.25	108.85
102	15	3	2.875	6	13	122.25	110.08
102	15	3	2.875	6	14	122.20	111.22
102	15	3	2.875	6	15	122.20	112.55
102	15	3	2.875	6	16	122.20	113.82
102	15	3	2.875	6	17	122.14	114.75
102	15	3	2.875	6	18	122.20	115.54
102	15	3	2.875	6	19	122.16	116.26
102	15	3	2.875	6	20	122.18	116.90
102	15	3	2.875	6	21	122.22	117.54
102	15	3	2.875	6	22	122.27	118.12
102	15	3	2.875	6	23	122.27	118.68
102	15	3	2.875	6	24	122.25	119.13
103	15	4	3.375	6	0	121.89	99.75
103	15	4	3.375	6	1	122.04	101.40
103	15	4	3.375	6	2	122.06	102.87
103	15	4	3.375	6	3	122.16	104.18
103	15	4	3.375	6	4	122.16	105.76
103	15	4	3.375	6	5	122.31	107.09
103	15	4	3.375	6	6	122.31	108.30

103	15	4	3.375	6	7	122.27	109.72
103	15	4	3.375	6	8	121.71	110.86
103	15	4	3.375	6	9	122.31	112.07
103	15	4	3.375	6	10	122.20	113.08
103	15	4	3.375	6	11	122.25	113.95
103	15	4	3.375	6	12	122.25	114.61
103	15	4	3.375	6	13	122.25	115.35
103	15	4	3.375	6	14	122.20	116.04
103	15	4	3.375	6	15	122.20	116.72
103	15	4	3.375	6	16	122.20	117.32
103	15	4	3.375	6	17	122.14	117.89
103	15	4	3.375	6	18	122.20	118.39
103	15	4	3.375	6	19	122.16	118.78
103	15	4	3.375	6	20	122.18	119.25
103	15	4	3.375	6	21	122.22	119.63
103	15	4	3.375	6	22	122.27	120.02
103	15	4	3.375	6	23	122.27	120.22
103	15	4	3.375	6	24	122.25	120.45
104	16	1	3.375	6	0	121.69	97.95
104	16	1	3.375	6	1	121.96	99.52
104	16	1	3.375	6	2	121.98	101.04
104	16	1	3.375	6	3	121.98	102.68
104	16	1	3.375	6	4	121.59	104.22
104	16	1	3.375	6	5	121.75	105.80
104	16	1	3.375	6	6	121.98	107.43
104	16	1	3.375	6	7	122.14	108.87
104	16	1	3.375	6	8	122.06	110.10
104	16	1	3.375	6	9	122.14	111.24
104	16	1	3.375	6	10	122.20	112.19
104	16	1	3.375	6	11	122.25	113.10
104	16	1	3.375	6	12	122.18	114.14
104	16	1	3.375	6	13	122.22	114.84
104	16	1	3.375	6	14	122.29	115.35
104	16	1	3.375	6	15	122.31	116.30
104	16	1	3.375	6	16	122.25	117.21
104	16	1	3.375	6	17	122.35	118.14
104	16	1	3.375	6	18	121.71	119.15
104	16	1	3.375	6	19	122.37	119.75
104	16	1	3.375	6	20	122.31	120.20
104	16	1	3.375	6	21	122.33	120.53
104	16	1	3.375	6	22	122.33	120.64

104	16	1	3.375	6	23	122.31	120.72
104	16	1	3.375	6	24	122.10	120.95
104	16	1	3.375	6	25	122.16	121.13
105	16	2	2.875	6	0	121.69	90.61
105	16	2	2.875	6	1	121.96	91.59
105	16	2	2.875	6	2	121.98	92.70
105	16	2	2.875	6	3	121.98	93.98
105	16	2	2.875	6	4	121.59	95.41
105	16	2	2.875	6	5	121.75	96.84
105	16	2	2.875	6	6	121.98	98.34
105	16	2	2.875	6	7	122.14	99.86
105	16	2	2.875	6	8	122.06	101.31
105	16	2	2.875	6	9	122.14	102.75
105	16	2	2.875	6	10	122.20	104.20
105	16	2	2.875	6	11	122.25	105.44
105	16	2	2.875	6	12	122.18	106.75
105	16	2	2.875	6	13	122.22	108.09
105	16	2	2.875	6	14	122.29	108.91
105	16	2	2.875	6	15	122.31	110.20
105	16	2	2.875	6	16	122.25	111.22
105	16	2	2.875	6	17	122.35	112.26
105	16	2	2.875	6	18	121.71	113.10
105	16	2	2.875	6	19	122.37	113.97
105	16	2	2.875	6	20	122.31	114.71
105	16	2	2.875	6	21	122.33	115.47
105	16	2	2.875	6	22	122.33	116.00
105	16	2	2.875	6	23	122.31	116.47
105	16	2	2.875	6	24	122.10	117.07
105	16	2	2.875	6	25	122.16	117.69
106	16	3	2.375	6	0	121.69	87.58
106	16	3	2.375	6	1	121.96	88.58
106	16	3	2.375	6	2	121.98	89.76
106	16	3	2.375	6	3	121.98	90.98
106	16	3	2.375	6	4	121.59	92.40
106	16	3	2.375	6	5	121.75	93.91
106	16	3	2.375	6	6	121.98	95.39
106	16	3	2.375	6	7	122.14	96.97
106	16	3	2.375	6	8	122.06	98.60
106	16	3	2.375	6	9	122.14	100.05
106	16	3	2.375	6	10	122.20	101.55
106	16	3	2.375	6	11	122.25	102.96

106	16	3	2.375	6	12	122.18	104.69
106	16	3	2.375	6	13	122.22	105.86
106	16	3	2.375	6	14	122.29	107.66
106	16	3	2.375	6	15	122.31	108.89
106	16	3	2.375	6	16	122.25	109.74
106	16	3	2.375	6	17	122.35	110.88
106	16	3	2.375	6	18	121.71	112.57
106	16	3	2.375	6	19	122.37	112.91
106	16	3	2.375	6	20	122.31	113.97
106	16	3	2.375	6	21	122.33	115.07
106	16	3	2.375	6	22	122.33	115.67
106	16	3	2.375	6	23	122.31	116.28
106	16	3	2.375	6	24	122.10	116.76
106	16	3	2.375	6	25	122.16	118.02
107	16	4	1.875	6	0	121.69	85.74
107	16	4	1.875	6	1	121.96	87.10
107	16	4	1.875	6	2	121.98	88.45
107	16	4	1.875	6	3	121.98	89.80
107	16	4	1.875	6	4	121.59	91.37
107	16	4	1.875	6	5	121.75	92.96
107	16	4	1.875	6	6	121.98	94.55
107	16	4	1.875	6	7	122.14	96.16
107	16	4	1.875	6	8	122.06	97.78
107	16	4	1.875	6	9	122.14	99.35
107	16	4	1.875	6	10	122.20	100.91
107	16	4	1.875	6	11	122.25	102.36
107	16	4	1.875	6	12	122.18	103.77
107	16	4	1.875	6	13	122.22	105.04
107	16	4	1.875	6	14	122.29	106.22
107	16	4	1.875	6	15	122.31	107.66
107	16	4	1.875	6	16	122.25	108.76
107	16	4	1.875	6	17	122.35	109.78
107	16	4	1.875	6	18	121.71	110.78
107	16	4	1.875	6	19	122.37	111.71
107	16	4	1.875	6	20	122.31	112.68
107	16	4	1.875	6	21	122.33	113.32
107	16	4	1.875	6	22	122.33	114.29
107	16	4	1.875	6	23	122.31	115.33
107	16	4	1.875	6	24	122.10	115.93
107	16	4	1.875	6	25	122.16	116.61
108	17	1	1.875	6	0	121.42	87.93

108	17	1	1.875	6	1	121.71	88.97
108	17	1	1.875	6	2	121.77	90.19
108	17	1	1.875	6	3	121.79	91.59
108	17	1	1.875	6	4	121.75	92.96
108	17	1	1.875	6	5	121.89	94.51
108	17	1	1.875	6	6	121.81	95.99
108	17	1	1.875	6	7	121.87	97.53
108	17	1	1.875	6	8	121.32	99.07
108	17	1	1.875	6	9	121.81	100.50
108	17	1	1.875	6	10	121.89	101.91
108	17	1	1.875	6	11	120.86	103.26
108	17	1	1.875	6	12	121.85	104.52
108	17	1	1.875	6	13	121.92	105.74
108	17	1	1.875	6	14	121.92	106.82
108	17	1	1.875	6	15	122.00	107.92
108	17	1	1.875	6	16	121.96	108.93
108	17	1	1.875	6	17	121.59	109.89
108	17	1	1.875	6	18	121.89	110.78
108	17	1	1.875	6	19	121.92	111.71
108	17	1	1.875	6	20	121.96	112.51
108	17	1	1.875	6	21	121.94	113.25
108	17	1	1.875	6	22	121.98	113.97
108	17	1	1.875	6	23	122.12	114.73
108	17	1	1.875	6	24	121.83	115.41
109	17	2	2.375	6	0	121.42	89.65
109	17	2	2.375	6	1	121.71	90.56
109	17	2	2.375	6	2	121.77	91.78
109	17	2	2.375	6	3	121.79	93.09
109	17	2	2.375	6	4	121.75	94.27
109	17	2	2.375	6	5	121.89	95.58
109	17	2	2.375	6	6	121.81	97.23
109	17	2	2.375	6	7	121.87	98.47
109	17	2	2.375	6	8	121.32	99.86
109	17	2	2.375	6	9	121.81	101.48
109	17	2	2.375	6	10	121.89	102.83
109	17	2	2.375	6	11	120.86	104.22
109	17	2	2.375	6	12	121.85	105.36
109	17	2	2.375	6	13	121.92	106.58
109	17	2	2.375	6	14	121.92	107.60
109	17	2	2.375	6	15	122.00	108.70
109	17	2	2.375	6	16	121.96	109.76

109	17	2	2.375	6	17	121.59	110.61
109	17	2	2.375	6	18	121.89	111.56
109	17	2	2.375	6	19	121.92	112.45
109	17	2	2.375	6	20	121.96	113.17
109	17	2	2.375	6	21	121.94	113.95
109	17	2	2.375	6	22	121.98	114.52
109	17	2	2.375	6	23	122.12	115.18
109	17	2	2.375	6	24	121.83	115.73
110	17	3	2.875	6	0	121.42	92.98
110	17	3	2.875	6	1	121.71	93.63
110	17	3	2.875	6	2	121.77	94.77
110	17	3	2.875	6	3	121.79	95.73
110	17	3	2.875	6	4	121.75	96.99
110	17	3	2.875	6	5	121.89	98.32
110	17	3	2.875	6	6	121.81	99.45
110	17	3	2.875	6	7	121.87	101.01
110	17	3	2.875	6	8	121.32	102.30
110	17	3	2.875	6	9	121.81	103.64
110	17	3	2.875	6	10	121.89	105.01
110	17	3	2.875	6	11	120.86	106.14
110	17	3	2.875	6	12	121.85	107.16
110	17	3	2.875	6	13	121.92	108.28
110	17	3	2.875	6	14	121.92	109.44
110	17	3	2.875	6	15	122.00	110.39
110	17	3	2.875	6	16	121.96	111.26
110	17	3	2.875	6	17	121.59	112.07
110	17	3	2.875	6	18	121.89	112.81
110	17	3	2.875	6	19	121.92	113.48
110	17	3	2.875	6	20	121.96	114.23
110	17	3	2.875	6	21	121.94	114.75
110	17	3	2.875	6	22	121.98	115.35
110	17	3	2.875	6	23	122.12	115.91
110	17	3	2.875	6	24	121.83	116.57
111	17	4	3.375	6	0	121.42	98.13
111	17	4	3.375	6	1	121.71	99.71
111	17	4	3.375	6	2	121.77	101.21
111	17	4	3.375	6	3	121.79	102.60
111	17	4	3.375	6	4	121.75	103.71
111	17	4	3.375	6	5	121.89	105.01
111	17	4	3.375	6	6	121.81	106.22
111	17	4	3.375	6	7	121.87	107.43

111	17	4	3.375	6	8	121.32	108.62
111	17	4	3.375	6	9	121.81	109.84
111	17	4	3.375	6	10	121.89	111.03
111	17	4	3.375	6	11	120.86	112.13
111	17	4	3.375	6	12	121.85	113.10
111	17	4	3.375	6	13	121.92	114.08
111	17	4	3.375	6	14	121.92	114.88
111	17	4	3.375	6	15	122.00	115.67
111	17	4	3.375	6	16	121.96	116.43
111	17	4	3.375	6	17	121.59	116.99
111	17	4	3.375	6	18	121.89	117.69
111	17	4	3.375	6	19	121.92	118.16
111	17	4	3.375	6	20	121.96	118.80
111	17	4	3.375	6	21	121.94	119.17
111	17	4	3.375	6	22	121.98	119.48
111	17	4	3.375	6	23	122.12	119.96
111	17	4	3.375	6	24	121.83	120.20
112	18	1	3.375	6	0	121.50	98.02
112	18	1	3.375	6	1	121.61	99.17
112	18	1	3.375	6	2	121.67	100.41
112	18	1	3.375	6	3	121.52	101.66
112	18	1	3.375	6	4	121.87	102.94
112	18	1	3.375	6	5	121.92	104.20
112	18	1	3.375	6	6	121.83	105.40
112	18	1	3.375	6	7	121.96	106.50
112	18	1	3.375	6	8	121.89	107.60
112	18	1	3.375	6	9	121.87	108.64
112	18	1	3.375	6	10	121.94	109.57
112	18	1	3.375	6	11	121.92	110.46
112	18	1	3.375	6	12	122.00	111.26
112	18	1	3.375	6	13	121.94	112.15
112	18	1	3.375	6	14	121.96	112.89
112	18	1	3.375	6	15	122.06	113.70
112	18	1	3.375	6	16	121.94	114.31
112	18	1	3.375	6	17	122.25	115.01
112	18	1	3.375	6	18	122.31	115.75
112	18	1	3.375	6	19	122.29	116.41
112	18	1	3.375	6	20	122.20	116.94
112	18	1	3.375	6	21	122.22	117.50
112	18	1	3.375	6	22	122.25	117.93
112	18	1	3.375	6	23	122.04	118.45

112	18	1	3.375	6	24	122.25	118.90
113	18	2	2.875	6	0	121.50	92.55
113	18	2	2.875	6	1	121.61	93.53
113	18	2	2.875	6	2	121.67	94.23
113	18	2	2.875	6	3	121.52	95.67
113	18	2	2.875	6	4	121.87	96.76
113	18	2	2.875	6	5	121.92	98.17
113	18	2	2.875	6	6	121.83	99.24
113	18	2	2.875	6	7	121.96	100.65
113	18	2	2.875	6	8	121.89	101.95
113	18	2	2.875	6	9	121.87	103.02
113	18	2	2.875	6	10	121.94	104.33
113	18	2	2.875	6	11	121.92	105.55
113	18	2	2.875	6	12	122.00	107.01
113	18	2	2.875	6	13	121.94	107.68
113	18	2	2.875	6	14	121.96	109.06
113	18	2	2.875	6	15	122.06	109.72
113	18	2	2.875	6	16	121.94	110.84
113	18	2	2.875	6	17	122.25	111.45
113	18	2	2.875	6	18	122.31	112.34
113	18	2	2.875	6	19	122.29	113.55
113	18	2	2.875	6	20	122.20	114.25
113	18	2	2.875	6	21	122.22	115.11
113	18	2	2.875	6	22	122.25	115.60
113	18	2	2.875	6	23	122.04	116.10
113	18	2	2.875	6	24	122.25	117.15
114	18	3	2.375	6	0	121.50	90.21
114	18	3	2.375	6	1	121.61	91.26
114	18	3	2.375	6	2	121.67	92.29
114	18	3	2.375	6	3	121.52	93.59
114	18	3	2.375	6	4	121.87	94.96
114	18	3	2.375	6	5	121.92	96.37
114	18	3	2.375	6	6	121.83	97.78
114	18	3	2.375	6	7	121.96	99.28
114	18	3	2.375	6	8	121.89	100.76
114	18	3	2.375	6	9	121.87	102.10
114	18	3	2.375	6	10	121.94	103.45
114	18	3	2.375	6	11	121.92	104.78
114	18	3	2.375	6	12	122.00	105.95
114	18	3	2.375	6	13	121.94	107.16
114	18	3	2.375	6	14	121.96	108.21

114	18	3	2.375	6	15	122.06	109.40
114	18	3	2.375	6	16	121.94	110.29
114	18	3	2.375	6	17	122.25	111.24
114	18	3	2.375	6	18	122.31	112.19
114	18	3	2.375	6	19	122.29	113.08
114	18	3	2.375	6	20	122.20	113.91
114	18	3	2.375	6	21	122.22	115.01
114	18	3	2.375	6	22	122.25	115.97
114	18	3	2.375	6	23	122.04	117.17
114	18	3	2.375	6	24	122.25	117.62
115	18	4	1.875	6	0	121.50	86.59
115	18	4	1.875	6	1	121.61	87.71
115	18	4	1.875	6	2	121.67	88.86
115	18	4	1.875	6	3	121.52	90.13
115	18	4	1.875	6	4	121.87	91.57
115	18	4	1.875	6	5	121.92	93.01
115	18	4	1.875	6	6	121.83	94.47
115	18	4	1.875	6	7	121.96	95.99
115	18	4	1.875	6	8	121.89	97.53
115	18	4	1.875	6	9	121.87	99.00
115	18	4	1.875	6	10	121.94	100.41
115	18	4	1.875	6	11	121.92	101.78
115	18	4	1.875	6	12	122.00	103.05
115	18	4	1.875	6	13	121.94	104.37
115	18	4	1.875	6	14	121.96	105.55
115	18	4	1.875	6	15	122.06	106.71
115	18	4	1.875	6	16	121.94	107.75
115	18	4	1.875	6	17	122.25	108.76
115	18	4	1.875	6	18	122.31	109.97
115	18	4	1.875	6	19	122.29	110.73
115	18	4	1.875	6	20	122.20	111.62
115	18	4	1.875	6	21	122.22	112.43
115	18	4	1.875	6	22	122.25	113.36
115	18	4	1.875	6	23	122.04	113.97
115	18	4	1.875	6	24	122.25	114.63
116	19	1	1.875	6	0	121.48	89.65
116	19	1	1.875	6	1	121.77	90.63
116	19	1	1.875	6	2	121.75	91.74
116	19	1	1.875	6	3	121.92	92.92
116	19	1	1.875	6	4	121.75	94.19
116	19	1	1.875	6	5	121.85	95.54

116	19	1	1.875	6	6	121.96	96.88
116	19	1	1.875	6	7	122.02	98.30
116	19	1	1.875	6	8	122.00	99.67
116	19	1	1.875	6	9	122.06	101.04
116	19	1	1.875	6	10	122.04	102.36
116	19	1	1.875	6	11	122.08	103.64
116	19	1	1.875	6	12	121.98	104.89
116	19	1	1.875	6	13	122.06	105.99
116	19	1	1.875	6	14	122.02	107.03
116	19	1	1.875	6	15	122.14	108.17
116	19	1	1.875	6	16	121.36	109.10
116	19	1	1.875	6	17	122.12	110.06
116	19	1	1.875	6	18	122.10	110.80
116	19	1	1.875	6	19	122.25	111.71
116	19	1	1.875	6	20	122.00	112.34
116	19	1	1.875	6	21	122.27	113.06
116	19	1	1.875	6	22	122.18	113.80
116	19	1	1.875	6	23	121.81	114.44
116	19	1	1.875	6	24	122.43	115.07
117	19	2	2.375	6	0	121.48	90.32
117	19	2	2.375	6	1	121.77	91.28
117	19	2	2.375	6	2	121.75	92.37
117	19	2	2.375	6	3	121.92	93.55
117	19	2	2.375	6	4	121.75	94.81
117	19	2	2.375	6	5	121.85	96.11
117	19	2	2.375	6	6	121.96	97.44
117	19	2	2.375	6	7	122.02	98.85
117	19	2	2.375	6	8	122.00	100.20
117	19	2	2.375	6	9	122.06	101.55
117	19	2	2.375	6	10	122.04	102.85
117	19	2	2.375	6	11	122.08	104.16
117	19	2	2.375	6	12	121.98	105.44
117	19	2	2.375	6	13	122.06	106.58
117	19	2	2.375	6	14	122.02	107.71
117	19	2	2.375	6	15	122.14	108.91
117	19	2	2.375	6	16	121.36	109.95
117	19	2	2.375	6	17	122.12	111.01
117	19	2	2.375	6	18	122.10	111.96
117	19	2	2.375	6	19	122.25	112.93
117	19	2	2.375	6	20	122.00	113.87
117	19	2	2.375	6	21	122.27	114.71

117	19	2	2.375	6	22	122.18	115.56
117	19	2	2.375	6	23	121.81	116.26
117	19	2	2.375	6	24	122.43	117.01
118	19	3	2.875	6	0	121.48	92.68
118	19	3	2.875	6	1	121.77	93.63
118	19	3	2.875	6	2	121.75	94.70
118	19	3	2.875	6	3	121.92	95.86
118	19	3	2.875	6	4	121.75	97.06
118	19	3	2.875	6	5	121.85	98.30
118	19	3	2.875	6	6	121.96	99.62
118	19	3	2.875	6	7	122.02	100.99
118	19	3	2.875	6	8	122.00	102.34
118	19	3	2.875	6	9	122.06	103.67
118	19	3	2.875	6	10	122.04	104.91
118	19	3	2.875	6	11	122.08	106.12
118	19	3	2.875	6	12	121.98	107.28
118	19	3	2.875	6	13	122.06	108.40
118	19	3	2.875	6	14	122.02	109.44
118	19	3	2.875	6	15	122.14	110.58
118	19	3	2.875	6	16	121.36	111.52
118	19	3	2.875	6	17	122.12	112.45
118	19	3	2.875	6	18	122.10	113.19
118	19	3	2.875	6	19	122.25	114.06
118	19	3	2.875	6	20	122.00	114.75
118	19	3	2.875	6	21	122.27	115.39
118	19	3	2.875	6	22	122.18	116.08
118	19	3	2.875	6	23	121.81	116.59
118	19	3	2.875	6	24	122.43	117.15
119	19	4	3.375	6	0	121.48	99.11
119	19	4	3.375	6	1	121.77	100.71
119	19	4	3.375	6	2	121.75	102.28
119	19	4	3.375	6	3	121.92	103.79
119	19	4	3.375	6	4	121.75	105.23
119	19	4	3.375	6	5	121.85	106.63
119	19	4	3.375	6	6	121.96	107.92
119	19	4	3.375	6	7	122.02	109.15
119	19	4	3.375	6	8	122.00	110.27
119	19	4	3.375	6	9	122.06	111.35
119	19	4	3.375	6	10	122.04	112.24
119	19	4	3.375	6	11	122.08	113.08
119	19	4	3.375	6	12	121.98	113.97

119	19	4	3.375	6	13	122.06	114.69
119	19	4	3.375	6	14	122.02	115.33
119	19	4	3.375	6	15	122.14	116.06
119	19	4	3.375	6	16	121.36	116.59
119	19	4	3.375	6	17	122.12	117.15
119	19	4	3.375	6	18	122.10	117.62
119	19	4	3.375	6	19	122.25	118.22
119	19	4	3.375	6	20	122.00	118.76
119	19	4	3.375	6	21	122.27	119.17
119	19	4	3.375	6	22	122.18	119.52
119	19	4	3.375	6	23	121.81	119.87
119	19	4	3.375	6	24	122.43	120.18
316	20	1	1.875	17	0	121.26	87.97
316	20	1	1.875	17	1	121.19	89.36
316	20	1	1.875	17	2	121.21	90.76
316	20	1	1.875	17	3	121.23	92.22
316	20	1	1.875	17	4	121.11	93.68
316	20	1	1.875	17	5	121.21	95.24
316	20	1	1.875	17	6	121.26	96.74
316	20	1	1.875	17	7	121.21	98.25
316	20	1	1.875	17	8	121.17	99.62
316	20	1	1.875	17	9	121.07	100.99
316	20	1	1.875	17	10	121.21	102.38
316	20	1	1.875	17	11	121.23	103.71
316	20	1	1.875	17	12	121.19	104.97
316	20	1	1.875	17	13	121.11	106.10
316	20	1	1.875	17	14	121.09	107.20
316	20	1	1.875	17	15	121.13	108.15
316	20	1	1.875	17	16	121.17	109.12
316	20	1	1.875	17	17	121.15	110.03
316	20	1	1.875	17	18	121.13	110.92
316	20	1	1.875	17	19	121.13	111.75
316	20	1	1.875	17	20	121.09	112.51
316	20	1	1.875	17	21	121.17	113.29
316	20	1	1.875	17	22	121.13	113.82
316	20	1	1.875	17	23	121.13	114.50
316	20	1	1.875	17	24	121.13	115.01
317	20	2	1.875	17	0	121.26	86.22
317	20	2	1.875	17	1	121.19	87.58
317	20	2	1.875	17	2	121.21	89.02
317	20	2	1.875	17	3	121.23	90.54

317	20	2	1.875	17	4	121.11	92.05
317	20	2	1.875	17	5	121.21	93.61
317	20	2	1.875	17	6	121.26	95.13
317	20	2	1.875	17	7	121.21	96.63
317	20	2	1.875	17	8	121.17	98.17
317	20	2	1.875	17	9	121.07	99.56
317	20	2	1.875	17	10	121.21	100.95
317	20	2	1.875	17	11	121.23	102.30
317	20	2	1.875	17	12	121.19	103.60
317	20	2	1.875	17	13	121.11	104.82
317	20	2	1.875	17	14	121.09	105.99
317	20	2	1.875	17	15	121.13	106.96
317	20	2	1.875	17	16	121.17	107.94
317	20	2	1.875	17	17	121.15	108.81
317	20	2	1.875	17	18	121.13	109.76
317	20	2	1.875	17	19	121.13	110.48
317	20	2	1.875	17	20	121.09	111.49
317	20	2	1.875	17	21	121.17	112.41
317	20	2	1.875	17	22	121.13	113.15
317	20	2	1.875	17	23	121.13	113.87
317	20	2	1.875	17	24	121.13	114.65
318	20	3	2.375	17	0	121.26	87.71
318	20	3	2.375	17	1	121.19	88.97
318	20	3	2.375	17	2	121.21	90.28
318	20	3	2.375	17	3	121.23	91.72
318	20	3	2.375	17	4	121.11	93.12
318	20	3	2.375	17	5	121.21	94.64
318	20	3	2.375	17	6	121.26	96.14
318	20	3	2.375	17	7	121.21	97.65
318	20	3	2.375	17	8	121.17	99.07
318	20	3	2.375	17	9	121.07	100.48
318	20	3	2.375	17	10	121.21	101.91
318	20	3	2.375	17	11	121.23	103.28
318	20	3	2.375	17	12	121.19	104.59
318	20	3	2.375	17	13	121.11	105.80
318	20	3	2.375	17	14	121.09	106.96
318	20	3	2.375	17	15	121.13	108.02
318	20	3	2.375	17	16	121.17	109.04
318	20	3	2.375	17	17	121.15	110.61
318	20	3	2.375	17	18	121.13	111.83
318	20	3	2.375	17	19	121.13	112.43

318	20	3	2.375	17	20	121.09	113.38
318	20	3	2.375	17	21	121.17	113.84
318	20	3	2.375	17	22	121.13	114.88
318	20	3	2.375	17	23	121.13	115.22
318	20	3	2.375	17	24	121.13	115.85
319	20	4	2.375	17	0	121.26	89.34
319	20	4	2.375	17	1	121.19	90.54
319	20	4	2.375	17	2	121.21	91.81
319	20	4	2.375	17	3	121.23	93.18
319	20	4	2.375	17	4	121.11	94.55
319	20	4	2.375	17	5	121.21	95.99
319	20	4	2.375	17	6	121.26	97.48
319	20	4	2.375	17	7	121.21	98.94
319	20	4	2.375	17	8	121.17	100.26
319	20	4	2.375	17	9	121.07	101.59
319	20	4	2.375	17	10	121.21	102.98
319	20	4	2.375	17	11	121.23	104.31
319	20	4	2.375	17	12	121.19	105.57
319	20	4	2.375	17	13	121.11	106.77
319	20	4	2.375	17	14	121.09	107.92
319	20	4	2.375	17	15	121.13	108.89
319	20	4	2.375	17	16	121.17	109.95
319	20	4	2.375	17	17	121.15	110.82
319	20	4	2.375	17	18	121.13	111.69
319	20	4	2.375	17	19	121.13	112.45
319	20	4	2.375	17	20	121.09	113.23
319	20	4	2.375	17	21	121.17	113.95
319	20	4	2.375	17	22	121.13	114.67
319	20	4	2.375	17	23	121.13	115.33
319	20	4	2.375	17	24	121.13	115.77
320	20	5	2.875	17	0	121.26	92.00
320	20	5	2.875	17	1	121.19	93.20
320	20	5	2.875	17	2	121.21	94.38
320	20	5	2.875	17	3	121.23	95.79
320	20	5	2.875	17	4	121.11	97.21
320	20	5	2.875	17	5	121.21	98.66
320	20	5	2.875	17	6	121.26	100.18
320	20	5	2.875	17	7	121.21	101.66
320	20	5	2.875	17	8	121.17	103.07
320	20	5	2.875	17	9	121.07	104.37
320	20	5	2.875	17	10	121.21	105.76

320	20	5	2.875	17	11	121.23	107.03
320	20	5	2.875	17	12	121.19	107.88
320	20	5	2.875	17	13	121.11	109.38
320	20	5	2.875	17	14	121.09	110.44
320	20	5	2.875	17	15	121.13	111.33
320	20	5	2.875	17	16	121.17	112.24
320	20	5	2.875	17	17	121.15	112.89
320	20	5	2.875	17	18	121.13	113.00
320	20	5	2.875	17	19	121.13	114.63
320	20	5	2.875	17	20	121.09	114.78
320	20	5	2.875	17	21	121.17	115.87
320	20	5	2.875	17	22	121.13	116.20
320	20	5	2.875	17	23	121.13	117.03
320	20	5	2.875	17	24	121.13	117.62
321	21	1	2.375	17	0	121.23	83.80
321	21	1	2.375	17	1	121.17	85.16
321	21	1	2.375	17	2	121.17	86.68
321	21	1	2.375	17	3	121.13	88.16
321	21	1	2.375	17	4	121.17	89.82
321	21	1	2.375	17	5	121.21	91.52
321	21	1	2.375	17	6	121.11	93.07
321	21	1	2.375	17	7	121.17	94.81
321	21	1	2.375	17	8	121.17	96.39
321	21	1	2.375	17	9	121.11	97.93
321	21	1	2.375	17	10	121.09	99.45
321	21	1	2.375	17	11	121.13	100.91
321	21	1	2.375	17	12	121.28	102.28
321	21	1	2.375	17	13	121.28	103.62
321	21	1	2.375	17	14	121.19	104.82
321	21	1	2.375	17	15	121.11	105.74
321	21	1	2.375	17	16	121.15	106.88
321	21	1	2.375	17	17	121.15	107.90
321	21	1	2.375	17	18	121.17	108.95
321	21	1	2.375	17	19	121.21	109.95
321	21	1	2.375	17	20	121.13	110.75
321	21	1	2.375	17	21	121.21	111.64
321	21	1	2.375	17	22	121.13	112.43
321	21	1	2.375	17	23	121.05	113.15
321	21	1	2.375	17	24	121.17	113.80
322	21	2	1.875	17	0	121.23	87.14
322	21	2	1.875	17	1	121.17	88.58

322	21	2	1.875	17	2	121.17	89.67
322	21	2	1.875	17	3	121.13	91.57
322	21	2	1.875	17	4	121.17	92.96
322	21	2	1.875	17	5	121.21	94.70
322	21	2	1.875	17	6	121.11	96.22
322	21	2	1.875	17	7	121.17	97.74
322	21	2	1.875	17	8	121.17	98.96
322	21	2	1.875	17	9	121.11	100.54
322	21	2	1.875	17	10	121.09	102.02
322	21	2	1.875	17	11	121.13	103.32
322	21	2	1.875	17	12	121.28	104.65
322	21	2	1.875	17	13	121.28	105.65
322	21	2	1.875	17	14	121.19	106.96
322	21	2	1.875	17	15	121.11	107.92
322	21	2	1.875	17	16	121.15	109.04
322	21	2	1.875	17	17	121.15	109.99
322	21	2	1.875	17	18	121.17	110.80
322	21	2	1.875	17	19	121.21	111.62
322	21	2	1.875	17	20	121.13	112.32
322	21	2	1.875	17	21	121.21	113.17
322	21	2	1.875	17	22	121.13	113.68
322	21	2	1.875	17	23	121.05	114.42
322	21	2	1.875	17	24	121.17	115.22
323	21	3	2.875	17	0	121.23	90.35
323	21	3	2.875	17	1	121.17	91.52
323	21	3	2.875	17	2	121.17	92.83
323	21	3	2.875	17	3	121.13	94.23
323	21	3	2.875	17	4	121.17	95.62
323	21	3	2.875	17	5	121.21	97.68
323	21	3	2.875	17	6	121.11	99.39
323	21	3	2.875	17	7	121.17	100.89
323	21	3	2.875	17	8	121.17	102.13
323	21	3	2.875	17	9	121.11	103.45
323	21	3	2.875	17	10	121.09	104.95
323	21	3	2.875	17	11	121.13	105.67
323	21	3	2.875	17	12	121.28	106.92
323	21	3	2.875	17	13	121.28	108.17
323	21	3	2.875	17	14	121.19	109.12
323	21	3	2.875	17	15	121.11	110.16
323	21	3	2.875	17	16	121.15	111.05
323	21	3	2.875	17	17	121.15	111.92

323	21	3	2.875	17	18	121.17	112.66
323	21	3	2.875	17	19	121.21	113.57
323	21	3	2.875	17	20	121.13	114.29
323	21	3	2.875	17	21	121.21	115.09
323	21	3	2.875	17	22	121.13	115.71
323	21	3	2.875	17	23	121.05	116.18
323	21	3	2.875	17	24	121.17	116.86
324	21	4	2.375	17	0	121.23	85.05
324	21	4	2.375	17	1	121.17	86.33
324	21	4	2.375	17	2	121.17	87.75
324	21	4	2.375	17	3	121.13	89.21
324	21	4	2.375	17	4	121.17	90.83
324	21	4	2.375	17	5	121.21	92.44
324	21	4	2.375	17	6	121.11	93.95
324	21	4	2.375	17	7	121.17	95.60
324	21	4	2.375	17	8	121.17	97.16
324	21	4	2.375	17	9	121.11	98.64
324	21	4	2.375	17	10	121.09	100.07
324	21	4	2.375	17	11	121.13	101.55
324	21	4	2.375	17	12	121.28	102.94
324	21	4	2.375	17	13	121.28	104.31
324	21	4	2.375	17	14	121.19	105.53
324	21	4	2.375	17	15	121.11	106.67
324	21	4	2.375	17	16	121.15	107.85
324	21	4	2.375	17	17	121.15	108.93
324	21	4	2.375	17	18	121.17	109.67
324	21	4	2.375	17	19	121.21	110.56
324	21	4	2.375	17	20	121.13	111.41
324	21	4	2.375	17	21	121.21	112.02
324	21	4	2.375	17	22	121.13	112.76
324	21	4	2.375	17	23	121.05	113.42
324	21	4	2.375	17	24	121.17	114.50
325	21	5	1.875	17	0	121.23	86.09
325	21	5	1.875	17	1	121.17	87.66
325	21	5	1.875	17	2	121.17	89.87
325	21	5	1.875	17	3	121.13	90.76
325	21	5	1.875	17	4	121.17	92.29
325	21	5	1.875	17	5	121.21	94.00
325	21	5	1.875	17	6	121.11	95.32
325	21	5	1.875	17	7	121.17	96.69
325	21	5	1.875	17	8	121.17	98.55

325	21	5	1.875	17	9	121.11	99.79
325	21	5	1.875	17	10	121.09	101.18
325	21	5	1.875	17	11	121.13	102.58
325	21	5	1.875	17	12	121.28	103.94
325	21	5	1.875	17	13	121.28	105.36
325	21	5	1.875	17	14	121.19	106.84
325	21	5	1.875	17	15	121.11	107.79
325	21	5	1.875	17	16	121.15	108.93
325	21	5	1.875	17	17	121.15	110.03
325	21	5	1.875	17	18	121.17	111.09
325	21	5	1.875	17	19	121.21	112.13
325	21	5	1.875	17	20	121.13	112.64
325	21	5	1.875	17	21	121.21	113.57
325	21	5	1.875	17	22	121.13	114.75
325	21	5	1.875	17	23	121.05	115.26
325	21	5	1.875	17	24	121.17	115.64

APPENDIX C

CONFIRMATION DATA AND ANALYSIS

Temperature Profiles in the 6 Quart Retort

Table C.1. Batch 23 Temperature Profiles (º C)

Time	Retort	TC505	TC506	TC507	TC508	TC509
0	73.61	86.18	84.84	87.68	86.52	83.86
1	29.08	85.33	84.16	87.00	85.65	83.14
2	51.52	84.36	83.39	86.19	84.79	82.54
3	71.71	83.42	82.67	85.40	83.87	81.93
4	95.18	82.43	81.72	84.44	82.78	81.22
Start of Exhaust						
5	99.95	81.62	81.02	83.45	81.74	80.58
6	100.95	80.84	80.38	82.73	81.06	79.81
7	101.25	80.27	79.87	82.13	80.42	79.30
8	101.40	79.89	79.60	81.76	80.02	78.99
9	101.50	79.87	79.62	81.63	79.87	78.99
10	101.57	80.14	79.98	81.82	80.07	79.35
11	101.61	80.64	80.60	82.26	80.55	79.88
12	101.63	81.40	81.32	82.88	81.17	80.65
13	101.74	82.25	82.25	83.63	81.94	81.55
14	101.80	83.20	83.19	84.44	82.84	82.54
End of Exhaust						
15	105.55	84.28	84.18	85.36	83.90	83.51
16	112.11	85.31	85.23	86.23	84.95	84.65
17	117.30	86.27	86.28	87.13	85.91	85.70
Start of Process						
18	121.66	87.25	87.24	87.98	86.89	86.79
19	121.57	88.32	88.20	88.85	87.79	87.82
20	121.60	89.50	89.25	89.87	88.81	88.95
21	121.45	90.67	90.38	90.90	89.90	90.10
22	121.37	92.04	91.68	92.13	91.09	91.51
23	121.35	93.57	93.08	93.49	92.39	92.94
24	121.04	95.02	94.57	94.94	93.82	94.45
25	121.57	96.63	96.08	96.38	95.28	96.02
26	121.41	98.12	97.63	97.84	96.70	97.63

27	121.43	99.55	99.10	99.26	98.12	99.20
28	121.02	101.05	100.52	100.67	99.55	100.82
29	121.47	102.46	101.88	102.01	100.90	102.36
30	121.43	103.73	103.16	103.31	102.16	103.61
31	121.51	104.99	104.39	104.54	103.46	104.91
32	121.49	106.15	105.54	105.69	104.62	106.03
33	121.55	107.34	106.66	106.79	105.77	107.09
34	121.02	108.42	107.67	107.80	106.78	108.08
35	121.28	109.32	108.60	108.75	107.71	109.05
36	121.41	110.33	109.53	109.66	108.68	109.94
37	121.20	111.20	110.35	110.48	109.53	110.71
38	121.37	111.97	111.13	111.26	110.35	111.47
39	121.31	112.75	111.88	111.97	111.08	112.16
40	121.57	113.40	112.53	112.62	111.80	112.90
41	121.31	114.13	113.22	113.29	112.49	113.59
42	121.41	114.70	113.77	113.88	113.10	114.22
Heat Off						
43	121.24	115.30	114.38	114.40	113.68	114.80
44	119.65	116.06	114.88	114.91	114.29	115.62
45	118.54	117.10	115.42	115.49	114.90	116.45
46	117.69	117.60	116.13	116.03	115.52	117.16
47	116.42	117.24	116.57	116.56	116.17	117.31
48	115.13	115.68	115.52	115.43	116.17	116.72
49	112.93	113.76	113.39	113.29	114.10	114.47
50	110.93	111.62	111.34	111.24	112.07	112.21
51	108.91	109.79	109.42	109.30	110.20	110.21
52	107.22	107.82	107.57	107.44	108.16	108.21
53	105.48	106.19	105.83	105.84	106.47	106.41
54	104.00	104.73	104.35	104.18	105.01	104.82
55	102.68	103.37	102.99	102.88	103.73	103.25
56	101.53	102.18	101.80	101.76	102.52	102.08
57	100.37	101.03	100.71	100.58	101.39	100.99
Lid Off						
58	46.98	99.25	99.21	99.41	99.36	99.58
59	29.40	96.01	96.87	97.43	96.34	99.11
60	23.60	93.59	94.92	95.82	94.21	98.71
61	21.79	91.69	93.13	94.23	92.43	98.23
62	21.37	89.91	91.50	92.80	90.75	97.72
63	21.47	88.28	89.92	91.24	89.18	96.97
64	21.89	86.79	88.46	89.87	87.70	96.26

65	22.36	85.31	86.96	88.50	86.28	95.42
66	22.46	83.79	85.56	87.20	84.86	94.58
67	22.51	82.45	84.16	85.91	83.52	93.70
68	22.51	81.13	82.82	84.66	82.23	92.62
69	22.46	79.83	81.50	83.43	80.95	91.69
70	22.46	78.59	80.22	82.22	79.74	90.65
71	22.41	77.32	78.98	81.05	78.54	89.62
72	22.36	76.15	77.79	79.97	77.41	88.60
73	22.31	75.03	76.61	78.91	76.30	87.58
74	22.31	73.94	75.46	77.89	75.21	86.51
75	22.19	72.84	74.39	76.89	74.16	85.46
76	22.12	71.79	73.32	75.96	73.11	84.36
77	22.07	70.78	72.22	74.98	72.11	83.29
78	22.04	69.79	71.21	73.97	71.12	82.30
79	21.87	68.82	70.20	73.10	70.20	81.33

Table C.2 Batch 24 Temperature Profiles

Time	Retort	TC510	TC511	TC512	TC513	TC514
0	50.03	83.95	72.94	76.51	77.85	78.79
1	57.42	82.80	72.96	75.82	77.30	78.28
2	73.03	81.68	72.85	75.09	76.75	77.80
Start of Exhaust						
3	95.14	80.60	72.49	74.35	76.19	77.02
4	100.61	79.61	72.04	73.71	75.81	76.42
5	101.16	78.83	71.75	73.30	75.48	76.04
6	101.36	78.23	71.66	73.08	75.39	75.73
7	101.48	77.90	71.82	73.19	75.50	75.69
8	101.59	77.95	72.35	73.60	75.95	75.93
9	101.59	78.26	73.07	74.31	76.66	76.46
10	101.63	78.83	74.03	75.20	77.54	77.24
11	101.70	79.61	75.19	76.36	78.59	78.17
12	101.72	80.56	76.41	77.60	79.76	79.30
End of Exhaust						
13	101.76	81.57	77.70	78.82	80.99	80.43
14	108.64	82.65	79.05	79.93	82.27	81.62
15	113.93	83.64	80.35	81.30	83.48	82.70
Start of Process						
16	118.79	84.69	81.65	82.66	84.62	83.93
17	120.95	85.74	82.93	84.04	85.69	85.02
18	121.31	86.84	84.23	85.23	86.85	86.18
19	121.33	88.04	85.56	86.58	88.07	87.49
20	121.51	89.26	86.98	88.05	89.40	88.93
21	121.47	90.63	88.53	89.59	90.85	90.43
22	121.43	92.10	90.14	91.22	92.37	91.97
23	121.47	93.57	91.81	92.91	93.99	93.59
24	121.43	95.02	93.47	94.59	95.58	95.18
25	121.41	96.53	95.13	96.29	97.18	96.84
26	121.45	98.01	96.77	97.95	98.74	98.38
27	121.45	99.42	98.33	99.30	100.17	99.93
28	121.41	100.83	99.83	101.46	101.62	101.33
29	121.31	102.14	101.28	102.78	102.99	102.74
30	121.33	103.37	102.67	103.93	104.24	104.02
31	121.43	104.63	103.97	105.35	105.49	105.23
32	121.43	105.77	105.26	106.34	106.64	106.39
33	121.45	106.91	106.42	107.68	107.74	107.45

34	121.41	107.93	107.57	108.73	108.75	108.44
35	121.45	108.96	108.64	109.74	109.70	109.35
36	121.47	109.98	109.70	110.84	110.58	110.21
37	121.45	110.88	110.66	111.53	111.40	111.01
38	121.45	111.78	111.57	112.56	112.20	111.79
39	121.47	112.60	112.45	113.42	112.95	112.48
40	121.51	113.42	113.27	114.38	113.64	113.13
Heat Off						
41	121.39	114.17	114.06	115.16	114.31	113.78
42	119.92	114.82	114.79	116.14	115.04	114.74
43	117.09	115.81	115.90	116.89	115.77	115.89
44	114.77	116.37	115.59	117.01	115.17	115.05
45	112.76	114.64	113.60	115.34	113.41	113.07
46	110.85	112.73	111.67	113.53	111.36	111.14
47	108.99	110.96	109.82	111.64	109.51	109.37
48	107.30	109.43	108.14	109.96	107.88	107.62
49	105.80	107.82	106.59	108.33	106.45	106.12
50	104.36	106.26	105.15	106.85	105.09	104.72
51	103.00	104.77	103.77	105.71	103.75	103.29
52	101.80	103.46	102.58	104.44	102.48	102.08
53	100.65	102.29	101.43	103.33	101.33	100.89
Lid Off						
54	60.08	100.77	100.07	102.10	99.98	99.80
55	32.11	97.86	98.42	99.32	99.17	97.57
56	27.20	94.98	96.47	98.87	98.46	95.03
57	26.03	92.82	94.64	98.31	97.60	93.09
58	25.46	91.00	92.89	97.69	96.81	91.27
59	25.12	89.26	91.29	97.05	95.99	89.56
60	24.92	87.65	89.75	96.32	95.18	87.95
61	24.68	86.09	88.29	95.46	94.36	86.44
62	24.53	84.61	86.87	94.57	93.52	84.91
63	24.33	83.18	85.47	93.62	92.65	83.49
64	24.16	81.81	84.09	92.67	91.68	82.10
65	24.06	80.45	82.84	91.63	90.68	80.76
66	23.92	79.14	81.57	90.59	89.66	79.46
67	23.79	77.97	80.38	89.57	88.64	78.24
68	23.67	76.68	79.20	88.44	87.61	77.04
69	23.52	75.57	78.03	87.41	86.54	75.84
70	23.47	74.43	76.92	86.34	85.47	74.75
71	23.32	73.34	75.83	85.32	84.44	73.68
72	23.23	72.26	74.77	84.24	83.37	72.56

73	23.13	71.21	73.76	83.19	82.31	71.56
74	23.05	70.20	72.78	82.18	81.28	70.57
75	23.00	69.25	71.86	81.16	80.29	69.65
76	22.81	68.28	70.87	80.15	79.23	68.77
77	22.31	67.36	70.00	79.15	78.32	67.85
78	22.17	66.43	69.10	77.38	74.61	66.60
79	25.41	65.36	68.02	76.23	73.20	65.58

Table C.3. Batch 25 Temperature Profiles

Time	Retort	TC515	TC516	TC517	TC518	TC519
0	42.83	76.23	73.69	72.05	70.40	77.77
1	62.48	75.72	73.36	72.01	70.22	77.51
2	72.20	75.23	72.94	71.85	70.07	77.06
3	84.42	74.70	72.58	71.63	69.86	76.40
Start of Exhaust						
4	94.92	74.14	72.22	71.33	69.66	75.71
5	99.67	73.74	71.95	71.09	69.55	75.13
6	99.95	73.58	71.75	71.04	69.59	74.77
7	100.07	73.67	71.84	71.13	69.80	74.57
8	100.12	74.01	72.06	71.56	70.20	74.73
9	100.37	74.59	72.64	72.23	70.76	75.15
10	100.59	75.43	73.49	73.10	71.61	75.82
11	100.63	76.44	74.50	74.15	72.71	76.64
12	100.69	77.59	75.70	75.38	74.03	77.66
13	100.67	78.85	76.99	76.63	75.37	78.75
End of Exhaust						
14	100.63	80.05	78.28	77.96	76.81	79.92
15	104.36	81.33	79.65	79.26	78.23	81.11
16	109.84	82.63	81.02	80.61	79.65	82.32
17	114.98	83.75	82.36	81.87	80.95	83.42
Start of Process						
18	120.27	84.93	83.57	83.10	82.27	84.45
19	121.51	86.07	84.79	84.31	83.54	85.55
20	121.62	87.27	86.09	85.53	84.84	86.73
21	121.51	88.54	87.46	86.85	86.20	87.95
22	121.60	89.91	88.96	88.24	87.66	89.32
23	121.62	91.37	90.53	89.79	89.18	90.80
24	121.57	92.92	92.20	91.33	90.79	92.31
25	121.53	94.48	93.90	93.00	92.48	93.91
26	121.60	96.10	95.61	94.66	94.36	95.53
27	121.31	97.67	97.30	96.23	96.01	97.08
28	121.33	99.14	98.91	97.82	97.60	98.62
29	121.43	100.62	100.45	99.34	99.17	100.12
30	121.45	101.97	101.90	100.77	100.62	101.53
31	121.47	103.33	103.31	102.16	102.01	102.91
32	121.45	104.58	104.56	103.46	103.29	104.25
33	121.55	105.79	105.77	104.73	104.54	105.48

34	121.55	106.85	106.87	105.94	105.73	106.67
35	121.53	107.91	107.93	107.06	106.85	107.83
36	121.55	108.88	108.92	108.12	107.88	108.95
37	121.55	109.81	109.82	109.09	108.87	109.96
38	121.55	110.69	110.66	110.06	109.78	111.01
39	121.55	111.47	111.46	110.96	110.66	112.00
40	121.53	112.23	112.22	111.81	111.50	113.00
41	121.55	112.96	112.91	112.62	112.26	113.84
42	121.55	113.67	113.62	113.46	112.95	114.70
Heat Off						
43	121.57	114.28	114.21	114.32	113.62	115.47
44	119.44	114.93	114.88	115.16	115.23	117.85
45	116.40	115.95	115.67	116.81	115.71	117.51
46	114.10	116.60	115.32	115.66	116.63	115.39
47	112.11	114.74	113.64	113.46	115.36	113.28
48	110.24	113.04	111.88	111.53	113.29	111.30
49	108.51	111.49	110.33	109.68	111.17	109.45
50	106.92	109.87	108.77	108.14	109.25	107.79
51	105.38	108.33	107.14	106.47	107.74	106.22
52	103.95	106.87	105.60	104.99	106.36	104.72
53	102.74	105.52	104.22	103.67	105.03	103.49
54	101.61	104.29	103.07	102.54	103.84	102.32
55	100.59	103.16	102.03	101.44	102.75	101.23
Lid Off						
56	55.44	101.24	100.15	99.98	101.37	99.24
57	35.99	98.16	97.73	97.48	99.19	96.35
58	30.78	95.97	97.56	95.15	97.05	93.89
59	28.64	94.07	97.43	93.26	95.15	91.64
60	26.98	92.25	97.22	91.52	93.34	89.67
61	26.74	90.54	96.94	89.83	91.66	87.77
62	26.44	88.93	96.51	88.29	90.05	86.07
63	25.86	87.41	95.93	86.69	88.46	84.41
64	25.46	85.96	95.22	85.25	86.98	82.85
65	25.05	84.61	94.42	83.89	85.60	81.35
66	25.02	83.22	93.52	82.55	84.31	79.94
67	24.78	81.99	92.52	81.21	82.97	78.55
68	24.65	80.73	91.48	79.97	81.74	77.20
69	24.48	79.54	90.44	78.78	80.51	75.91
70	24.24	78.41	89.38	77.62	79.36	74.68
71	24.16	77.32	88.31	76.45	78.23	73.50
72	24.06	76.26	87.22	75.33	77.10	72.32

73	23.99	75.14	86.15	74.26	76.03	71.22
74	23.92	74.14	85.10	73.22	74.94	70.14
75	23.79	73.11	84.03	72.16	73.96	69.06
76	23.74	72.15	82.97	71.15	72.89	68.03
77	23.65	71.21	81.98	70.14	71.91	67.05
78	23.99	70.31	80.99	69.27	70.94	66.06
79	24.36	69.41	79.98	68.32	69.95	65.09

Temperature Profiles in the 8 Quart Retort

Table C.4. Batch 27 Temperature Profiles

Time	Retort	TC606	TC607	TC608	TC609	TC610
0	53.29	77.01	80.62	85.07	81.90	80.27
1	67.59	76.59	80.09	84.42	81.26	80.12
2	77.55	76.06	79.60	83.74	80.62	79.90
Start of Exhaust						
3	91.24	75.43	78.98	82.90	79.93	79.46
4	100.18	74.88	78.41	82.07	79.23	78.88
5	100.91	74.54	78.03	81.47	78.74	78.55
6	101.18	74.25	77.72	80.96	78.34	78.24
7	102.23	74.18	77.59	80.61	78.08	78.17
8	102.49	74.36	77.74	80.52	78.16	78.33
9	102.57	74.85	78.19	80.72	78.45	78.70
10	102.70	75.63	78.85	81.25	79.07	79.30
11	102.76	76.61	79.65	81.91	79.91	80.07
12	102.83	77.72	80.68	82.73	80.82	81.02
End of Exhaust						
13	102.85	78.90	81.79	83.65	81.92	82.01
14	105.27	80.11	82.84	84.61	83.04	83.07
15	111.56	81.44	83.96	85.67	84.20	84.10
16	117.25	82.72	85.10	86.67	85.39	85.20
Start of Process						
17	121.06	83.95	86.28	87.68	86.44	86.23
18	121.39	85.20	87.40	88.74	87.53	87.27
19	121.22	86.49	88.57	89.74	88.64	88.38
20	121.20	87.82	89.86	90.92	89.83	89.54
21	121.14	89.26	91.20	92.22	91.18	90.86
22	121.14	90.78	92.72	93.62	92.61	92.23
23	121.18	92.36	94.21	95.05	94.08	93.67
24	121.16	93.94	95.74	96.53	95.58	95.16
25	121.20	95.60	97.28	97.99	97.09	96.67
26	121.24	97.17	98.78	99.43	98.55	98.17
27	121.26	98.69	100.19	100.84	99.98	99.58
28	121.22	100.21	101.58	102.16	101.43	100.97
29	121.20	101.65	102.90	103.42	102.71	102.27
30	121.18	103.03	104.09	104.56	103.97	103.49
31	121.24	104.37	105.30	105.71	105.20	104.63
32	121.22	105.62	106.42	106.75	106.32	105.76
33	121.20	106.77	107.50	107.74	107.40	106.77

34	121.24	107.87	108.47	108.67	108.39	107.74
35	121.20	108.84	109.40	109.51	109.34	108.65
36	121.20	109.79	110.26	110.36	110.22	109.49
37	121.20	110.67	111.11	111.11	111.04	110.32
38	121.16	111.43	111.88	111.87	111.80	111.05
39	121.18	112.16	112.62	112.54	112.55	111.77
40	121.18	112.88	113.29	113.23	113.22	112.48
41	121.22	113.50	113.91	113.88	113.89	113.09
Heat off						
42	121.22	114.13	114.52	114.47	114.48	113.69
43	120.14	114.70	115.09	115.11	115.19	114.26
44	119.15	115.35	115.67	115.72	115.88	114.91
45	118.13	115.87	116.30	116.58	116.69	116.35
46	117.19	116.49	116.75	117.20	116.96	116.89
47	116.34	117.02	116.50	117.26	116.46	116.45
48	115.48	117.29	115.71	116.66	115.59	115.66
49	114.67	117.14	114.96	115.85	114.81	114.86
50	113.77	116.62	114.10	114.99	113.91	113.99
51	112.93	115.93	113.25	114.11	113.12	113.21
52	112.19	115.14	112.51	113.27	112.34	112.44
53	111.39	114.11	111.67	112.44	111.57	111.62
54	110.64	113.11	110.92	111.66	110.77	110.84
55	109.79	112.23	110.10	110.86	109.99	110.02
56	109.01	111.36	109.30	110.12	109.23	109.24
57	108.30	110.59	108.56	109.32	108.45	108.46
58	107.43	109.76	107.71	108.52	107.63	107.64
59	106.73	109.03	107.02	107.78	106.91	106.94
60	105.97	108.33	106.23	107.06	106.17	106.14
61	105.25	107.72	105.54	106.32	105.47	105.50
62	104.57	107.15	104.81	105.62	104.77	104.72
63	103.87	106.51	104.14	104.95	104.09	104.02
64	103.17	105.88	103.41	104.29	103.37	103.34
65	102.46	105.22	102.71	103.59	102.67	102.68
66	101.76	104.54	101.97	102.88	101.97	101.95
67	101.16	103.95	101.37	102.27	101.37	101.29
68	100.50	103.29	100.75	101.65	100.73	100.72
Lid Off						
69	51.54	102.16	99.62	100.26	99.34	99.52
70	44.84	100.21	97.18	97.50	96.27	96.41
71	54.95	98.35	95.13	95.56	94.14	94.24
72	57.47	96.72	93.45	93.92	92.56	92.31

73	57.12	95.15	91.85	92.35	90.98	90.54
74	55.99	93.72	90.38	90.87	89.55	88.84
75	54.49	92.34	88.96	89.40	88.20	87.36
76	53.42	90.95	87.53	88.00	86.83	85.88
77	52.12	89.61	86.24	86.63	85.54	84.50
78	50.94	88.32	84.90	85.29	84.23	83.18
79	50.05	87.08	83.68	83.98	83.02	81.88
80	49.02	85.85	82.47	82.73	81.83	80.69
81	48.16	84.69	81.32	81.52	80.68	79.50
82	47.38	83.53	80.15	80.26	79.49	78.35
83	46.65	82.41	79.07	79.15	78.34	77.24
84	45.78	81.33	78.01	78.02	77.26	76.18
85	44.96	80.27	76.99	76.91	76.19	75.15
86	44.30	79.27	75.97	75.82	75.17	74.17
87	43.80	78.26	75.01	74.80	74.14	73.21
88	43.09	77.28	74.05	73.80	73.18	72.27
89	42.57	76.30	73.18	72.77	72.22	71.40
90	41.91	75.34	72.17	71.85	71.30	70.57
91	41.27	74.47	71.35	70.91	70.38	69.69
92	40.89	73.60	70.47	70.03	69.53	68.84

Table C.5. Batch 28 Temperature Profiles

Time	Retort	TC611	TC612	TC613	TC614	TC615
0	31.99	81.95	80.09	80.52	81.24	82.74
1	61.34	81.35	79.54	80.06	80.66	82.12
2	73.95	80.64	78.98	79.46	80.11	81.42
Start of Exhaust						
3	85.91	79.96	78.19	78.80	79.54	80.69
4	99.75	79.21	77.21	78.05	78.94	79.94
5	100.93	78.74	76.68	77.71	78.56	79.32
6	101.68	78.32	76.28	77.36	78.23	78.81
7	102.25	78.17	76.12	77.27	78.12	78.50
8	102.46	78.26	76.21	77.36	78.21	78.46
9	102.57	78.59	76.66	77.78	78.65	78.68
10	102.63	79.25	77.30	78.42	79.32	79.23
11	102.68	80.03	78.19	79.22	80.18	79.94
12	102.74	81.00	79.25	80.21	81.30	80.85
End of Exhaust						
13	102.74	82.03	80.38	81.34	82.38	81.88
14	106.31	83.13	81.57	82.46	83.41	82.96
15	112.00	84.25	82.71	83.65	84.49	84.04
16	117.30	85.35	83.85	84.81	85.63	85.18
Start of Process						
17	121.55	86.42	85.01	85.93	86.68	86.23
18	121.18	87.56	86.20	87.06	87.72	87.29
19	121.20	88.67	87.35	88.18	88.79	88.45
20	121.26	89.93	88.70	89.46	90.12	89.71
21	121.24	91.28	90.12	90.81	91.44	91.06
22	121.16	92.62	91.57	92.22	92.87	92.49
23	121.16	94.09	93.19	93.75	94.40	94.00
24	121.12	95.62	94.74	95.24	95.91	95.53
25	121.16	97.11	96.34	96.77	97.48	97.05
26	121.16	98.57	97.88	98.23	99.15	98.56
27	121.12	99.96	99.38	99.68	100.60	100.03
28	121.12	101.30	100.75	101.05	102.20	101.42
29	121.18	102.60	102.14	102.39	103.56	102.74
30	121.14	103.86	103.41	103.61	104.84	103.97
31	121.16	105.01	104.62	104.86	105.98	105.14
32	121.18	106.15	105.79	105.96	107.14	106.22
33	121.18	107.23	106.87	107.04	108.28	107.28

34	121.22	108.27	107.86	108.08	109.04	108.27
35	121.20	109.24	108.85	109.05	109.91	109.18
36	121.20	110.12	109.78	109.98	110.73	110.04
37	121.28	111.03	110.68	110.86	111.80	110.90
38	121.20	111.83	111.50	111.70	112.28	111.64
39	121.20	112.65	112.26	112.52	113.01	112.35
40	121.20	113.42	112.97	113.27	113.60	113.00
41	121.16	114.22	113.68	114.01	114.38	113.67
Heat off						
42	120.48	115.22	114.38	114.72	115.04	114.32
43	119.52	116.26	115.04	115.49	115.52	114.93
44	118.54	117.10	115.80	116.26	116.38	115.58
45	117.48	117.72	116.50	116.97	117.00	116.37
46	116.57	117.85	116.92	117.33	117.30	116.45
47	115.65	117.35	117.07	117.03	117.19	115.74
48	114.81	116.72	116.69	116.47	116.50	114.95
49	113.93	115.87	116.05	115.51	115.55	114.07
50	113.20	114.97	115.32	114.53	114.63	113.32
51	112.30	114.15	114.58	113.61	113.81	112.48
52	111.58	113.34	113.50	112.77	112.89	111.72
53	110.76	112.52	112.51	111.97	112.07	110.90
54	110.03	111.76	111.57	111.18	111.21	110.17
55	109.16	110.99	110.77	110.42	110.35	109.33
56	108.42	110.21	109.91	109.66	109.68	108.57
57	107.62	109.45	109.13	108.90	108.77	107.72
58	106.92	108.67	108.30	108.21	108.07	107.00
59	106.08	107.95	107.61	107.47	107.14	106.24
60	105.36	107.19	106.85	106.70	106.36	105.48
61	104.63	106.47	106.13	106.03	105.62	104.76
62	103.93	105.77	105.41	105.29	104.88	104.12
63	103.25	105.05	104.75	104.61	104.22	103.40
64	102.53	104.39	104.01	103.86	103.48	102.70
65	101.87	103.69	103.35	103.22	102.80	102.04
66	101.23	103.07	102.69	102.54	102.16	101.36
67	100.61	102.39	102.01	101.88	101.50	100.74
Lid Off						
68	75.51	101.50	101.20	101.14	101.16	99.86
69	46.00	99.44	98.25	98.46	99.28	96.63
70	50.82	97.49	96.21	96.53	98.74	93.76
71	50.77	95.60	94.36	94.77	98.27	91.69
72	50.84	93.81	92.65	93.10	97.75	90.02

73	50.19	92.17	91.11	91.48	97.24	88.47
74	49.28	90.52	89.57	89.90	96.55	86.97
75	47.85	88.98	88.14	88.42	95.84	85.53
76	46.28	87.45	86.74	86.96	95.00	84.12
77	45.34	85.99	85.39	85.53	94.16	82.83
78	45.24	84.58	84.07	84.18	93.26	81.53
79	43.73	83.24	82.82	82.90	92.33	80.30
80	43.19	81.92	81.63	81.63	91.31	79.06
81	43.02	80.98	80.42	80.39	90.33	77.91
82	41.89	80.00	79.29	79.24	89.33	76.78
83	41.48	79.69	78.14	78.07	88.29	75.66
84	40.87	79.61	77.06	76.98	87.24	74.64
85	40.46	79.41	75.99	75.87	86.24	73.59
86	40.49	79.23	74.99	74.80	85.28	72.56
87	40.58	78.94	73.98	73.75	84.29	71.62
88	40.15	78.54	73.00	72.79	83.22	70.68
89	39.46	78.12	72.06	71.78	82.25	69.69
90	39.32	77.57	71.14	70.89	81.32	68.81
91	38.77	77.01	70.22	69.96	80.38	68.00
92	38.27	76.44	69.37	69.06	79.49	67.08

Table C.6. Batch 29 Temperature Profiles

Time	Retort	TC616	TC617	TC618	TC619	TC620
0	57.58	77.68	78.34	80.35	78.36	81.82
1	63.62	76.92	77.57	79.57	77.57	80.65
2	74.64	76.19	76.83	78.69	76.81	79.52
Start of Exhaust						
3	87.02	75.57	76.08	77.78	76.06	78.46
4	98.75	75.03	75.39	76.83	75.34	77.46
5	100.42	74.61	75.01	76.25	74.90	76.71
6	101.08	74.34	74.77	75.82	74.54	76.13
7	101.65	74.27	74.68	75.60	74.32	75.82
8	101.82	74.45	74.85	75.60	74.36	75.89
9	101.89	74.92	75.28	75.85	74.79	76.18
10	101.93	75.72	76.01	76.38	75.39	76.75
11	102.06	76.66	76.90	77.14	76.19	77.57
12	102.12	77.75	77.92	78.09	77.17	78.55
End of Exhaust						
13	102.10	78.96	79.09	79.09	78.28	79.61
14	106.84	80.18	80.31	80.21	79.51	80.76
15	112.30	81.44	81.54	81.32	80.73	81.95
16	117.36	82.69	82.64	82.42	81.90	83.09
Start of Process						
17	121.28	83.97	83.83	83.56	83.08	84.23
18	120.87	85.28	84.95	84.68	84.25	85.42
19	120.81	86.62	86.22	85.86	85.45	86.64
20	120.97	88.04	87.55	87.11	86.72	87.93
21	121.18	89.58	88.99	88.48	88.12	89.30
22	121.16	91.15	90.44	89.94	89.62	90.80
23	121.02	92.82	91.96	91.46	91.20	92.38
24	121.14	94.48	93.56	93.02	92.76	93.91
25	121.18	96.12	95.09	94.53	94.31	95.46
26	121.14	97.77	96.64	96.06	95.84	96.99
27	121.14	99.49	98.12	97.54	97.35	98.47
28	121.14	101.50	99.51	98.93	98.74	99.86
29	121.16	103.26	100.88	100.33	100.11	101.21
30	121.12	103.97	102.14	101.63	101.39	102.51
31	121.12	104.92	103.35	102.84	102.58	103.70
32	121.14	105.98	104.50	104.03	103.77	104.84
33	121.14	106.94	105.58	105.12	104.84	105.95

34	121.14	108.37	106.59	106.15	105.94	106.98
35	121.18	109.36	107.59	107.19	106.89	108.00
36	121.16	109.93	108.45	108.08	107.88	108.88
37	121.16	110.88	109.32	108.96	108.79	109.81
38	121.12	112.08	110.14	109.79	109.59	110.61
39	121.10	112.81	110.92	110.59	110.41	111.39
40	121.10	113.32	111.65	111.34	111.21	112.12
41	121.18	113.86	112.34	112.06	111.95	112.79
Heat off						
42	121.24	114.84	112.99	112.73	112.64	113.46
43	119.87	115.30	113.60	113.46	113.39	114.70
44	118.88	116.39	114.33	114.28	114.25	116.28
45	117.96	117.49	115.09	115.22	115.17	117.08
46	117.07	118.04	115.98	116.03	116.30	117.24
47	116.17	118.39	116.30	116.41	116.46	116.85
48	115.35	118.04	117.96	115.95	115.84	116.16
49	114.62	117.35		115.26	115.09	115.37
50	113.87	116.51	128.74	114.53	114.33	114.68
51	113.05	115.39		113.73	113.56	113.86
52	112.34	114.51		113.04	112.83	113.13
53	111.60	113.67	189.79	112.27	112.07	112.48
54	110.89	112.85	147.39	111.55	111.36	111.70
55	110.13	111.95		110.80	110.58	111.01
56	109.39	111.01		110.08	109.78	110.29
57	108.64	110.33		109.37	109.09	109.62
58	107.92	109.58		108.63	108.35	108.80
59	107.26	108.88		107.95	107.63	108.12
60	106.56	108.16		107.28	106.95	107.43
61	105.91	107.44		106.58	106.30	106.75
62	105.16	106.64		105.94	105.62	106.14
63	104.46	106.00		105.16	104.88	105.33
64	103.78	105.33		104.50	104.18	104.67
65	103.19	104.71		103.91	103.58	104.04
66	102.57	104.07		103.27	102.97	103.42
67	101.97	103.41		102.69	102.37	102.83
68	99.35	101.92		100.92	100.24	100.40
Lid Off						
69	47.90	100.17	98.59	99.11	98.59	98.43
70	28.67	99.14	95.91	95.80	95.76	95.55
71	27.62	98.82	93.93	93.08	93.62	93.05
72	27.06	98.44	92.09	91.22	91.85	91.17

73	26.69	97.99	90.35	89.55	90.14	89.43
74	26.37	97.43	88.70	88.00	88.59	87.82
75	26.54	96.81	87.16	86.50	87.05	86.18
76	26.49	96.07	85.65	85.07	85.60	84.67
77	26.52	95.26	84.20	83.67	84.14	83.29
78	26.64	94.35	82.78	82.35	82.78	81.86
79	26.66	93.47	81.43	81.12	81.48	80.56
80	26.62	92.49	80.04	79.79	80.15	79.23
81	26.54	91.50	78.74	78.58	78.92	77.95
82	26.42	90.50	77.52	77.34	77.70	76.73
83	26.35	89.52	76.28	76.16	76.57	75.53
84	26.22	88.45	75.14	75.07	75.41	74.35
85	26.10	87.43	74.05	73.95	74.41	73.26
86	26.08	86.42	72.98	72.92	73.36	72.20

Temperature Profiles in the 17 Quart Retort

Table C.7. Batch 30 Temperature Profiles

Time	Retort	TC700	TC701	TC702	TC703	TC704
0	41.93	72.19	72.35	80.77	73.25	70.52
1	60.95	71.66	72.09	80.06	73.45	70.75
2	69.71	71.14	71.64	79.37	73.58	70.82
3	80.26	70.62	71.05	78.56	73.49	70.73
Start of Exhaust						
4	91.03	70.26	70.34	77.74	73.29	70.55
5	98.06	69.61	69.66	76.98	72.85	70.21
6	100.61	69.25	69.10	76.47	72.47	69.92
7	101.46	68.82	68.76	75.98	72.22	69.69
8	101.93	68.69	68.67	75.71	72.13	69.62
9	102.25	68.80	68.87	75.78	72.31	69.85
10	102.38	69.25	69.44	76.14	72.78	70.41
11	102.63	70.04	70.22	76.78	73.49	71.20
12	102.78	71.10	71.28	77.60	74.41	73.10
13	102.89	72.40	72.51	78.60	75.52	73.46
End of Exhaust						
14	102.93	73.78	73.85	79.77	76.70	74.77
15	106.58	75.21	75.34	81.05	77.99	76.15
16	113.07	76.84	76.88	82.31	79.36	77.55
Starrt of Process						
17	119.27	78.30	78.28	83.63	80.55	78.97
18	121.62	79.72	79.58	84.77	81.85	80.36
19	121.04	81.20	80.99	85.97	83.17	81.79
20	121.20	82.76	82.47	87.30	84.49	83.22
21	121.16	84.34	84.05	88.68	85.89	84.74
22	121.12	86.09	85.67	90.22	87.42	86.33
23	121.22	87.84	87.42	91.78	88.96	87.99
24	121.16	89.69	89.18	93.43	90.64	89.69
25	121.16	91.47	90.98	95.07	92.28	91.40
26	121.12	93.27	92.78	96.70	93.90	93.11
27	121.14	95.04	94.51	98.36	95.50	94.80
28	121.16	96.72	96.27	100.33	97.02	96.45
29	121.16	98.35	97.88	101.88	98.53	98.06
30	121.18	99.87	99.45	103.52	99.94	99.63
31	121.16	101.37	100.96	104.86	101.33	101.21

32	121.16	102.78	102.35	105.71	102.58	102.72
33	121.18	104.12	103.73	107.19	103.84	104.36
34	121.12	105.35	105.01	108.25	105.05	105.99
35	121.12	106.58	106.15	109.13	106.17	107.55
36	121.20	107.76	107.29	110.25	107.25	108.86
37	121.14	108.86	108.33	110.80	108.30	109.49
38	121.12	109.91	109.30	111.85	109.27	109.85
39	121.20	110.88	110.24	112.23	110.22	110.63
40	121.10	111.81	111.06	113.09	111.04	111.41
41	121.20	112.67	111.86	113.92	111.80	112.14
Heat Off						
42	121.12	113.55	112.60	114.51	112.57	112.88
43	119.69	114.43	113.29	115.16	113.37	113.63
44	118.09	115.41	114.12	116.12	114.21	114.49
45	116.48	116.35	115.17	117.08	115.82	115.60
46	115.04	116.62	116.07	117.89	115.61	115.45
47	113.72	115.35	116.09	117.85	114.56	114.15
48	112.44	113.97	115.17	116.70	113.29	112.92
49	111.14	112.65	114.04	115.32	112.05	111.81
50	109.98	111.41	112.81	113.92	110.83	110.29
51	108.80	110.27	111.46	112.46	109.72	109.05
52	107.68	109.11	110.10	110.96	108.60	107.91
53	106.58	107.95	108.81	109.64	107.54	106.86
54	105.50	106.81	107.63	108.50	106.49	105.80
55	104.29	105.60	106.51	107.44	105.34	104.63
56	103.27	104.56	105.54	106.18	104.16	103.55
57	102.17	103.52	104.43	104.88	103.09	102.46
58	101.16	102.56	103.46	103.76	102.16	101.46
59	100.09	101.60	102.50	102.76	101.18	100.52
60	99.20	100.66	101.65	101.78	100.26	99.60
Lid Off						
61	29.06	98.76	100.02	99.83	98.38	97.93
62	27.91	95.32	97.80	97.91	95.28	95.29
63	27.59	92.36	95.74	97.41	92.76	92.66
64	27.40	90.28	93.69	96.85	90.92	90.71
65	26.42	88.63	91.81	96.12	89.23	88.89
66	25.93	87.14	90.05	95.41	87.61	87.12
67	25.68	85.74	88.49	94.64	86.15	85.48
68	25.44	84.32	87.18	93.84	84.71	83.93
69	25.51	83.05	86.24	93.06	83.35	82.50
70	25.34	81.75	85.41	92.17	81.98	81.05

71	24.92	80.56	84.69	91.26	80.68	79.77
72	24.63	79.39	84.25	90.22	79.45	78.50
73	24.43	78.21	83.83	89.35	78.21	77.29
74	24.41	77.10	83.46	88.40	77.06	76.11
75	24.33	76.01	82.82	87.39	75.88	74.88
76	24.16	74.97	82.27	86.30	74.79	73.79
77	24.06	73.92	81.70	85.29	73.69	72.61
78	24.14	72.93	81.08	84.35	72.64	71.56
79	24.41	71.88	80.46	83.23	71.61	70.55
80	24.14	70.96	79.78	82.29	70.63	69.58
81	23.79	70.02	78.98	81.32	69.71	68.61
82	23.74	69.14	78.30	80.26	68.74	67.69

Table C.8. Batch 31 Temperature Profiles

Time	Retort	TC705	TC706	TC707	TC708	TC709
0	33.44	76.77	78.74	79.75	76.46	78.24
1	58.48	76.10	78.05	79.09	76.03	77.75
2	66.19	75.34	77.32	78.36	75.50	77.29
3	74.66	74.61	76.57	77.51	74.83	76.60
4	84.15	73.89	75.86	76.76	74.14	75.89
Start of Exhaust						
5	93.78	73.29	75.17	75.85	73.34	74.91
6	99.35	72.64	74.52	74.98	72.78	74.19
7	100.91	72.24	73.96	74.24	72.22	73.57
8	101.44	72.02	73.61	73.84	71.84	73.19
9	101.72	72.08	73.56	73.60	71.82	73.03
10	102.06	72.40	73.69	73.68	71.95	73.14
11	102.32	73.05	74.16	74.11	72.51	73.55
12	102.44	73.92	74.90	74.78	73.27	74.22
13	102.57	74.94	75.79	75.62	74.30	75.15
14	102.74	76.15	76.86	76.71	75.41	76.18
End of Exhaust						
15	103.46	77.41	78.01	77.87	76.68	77.33
16	109.42	78.68	79.40	79.13	78.14	78.57
17	114.54	80.11	80.66	80.32	79.45	79.81
Process Start						
18	119.63	81.48	81.87	81.63	80.73	81.07
19	121.04	82.78	83.06	82.79	81.96	82.30
20	121.10	84.17	84.29	84.11	83.30	83.57
21	121.04	85.55	85.58	85.47	84.66	84.89
22	121.12	87.06	86.96	86.93	86.13	86.33
23	121.18	88.65	88.40	88.53	87.66	87.84
24	121.16	90.35	89.99	90.16	89.27	89.43
25	121.14	91.99	91.61	91.81	90.92	91.04
26	121.14	93.72	93.23	93.49	92.61	92.64
27	121.18	95.39	94.85	95.20	94.27	94.24
28	121.16	96.89	96.36	96.79	95.86	95.83
29	121.18	98.44	97.90	98.27	97.43	97.36
30	121.20	99.89	99.32	99.77	98.95	98.77
31	121.22	101.22	100.75	101.18	100.45	100.18
32	121.24	102.54	102.01	102.48	101.82	101.51
33	121.22	103.73	103.29	103.67	103.14	102.78

34	121.08	104.88	104.45	104.88	104.35	103.97
35	121.14	105.98	105.60	105.96	105.51	105.08
36	121.26	107.02	106.61	107.00	106.64	106.16
37	121.10	107.95	107.57	107.99	107.65	107.17
38	121.16	108.90	108.54	108.96	108.66	108.12
39	121.20	109.70	109.40	109.85	109.57	109.05
40	121.16	110.52	110.22	110.69	110.45	109.85
41	121.14	111.30	110.98	111.49	111.29	110.67
42	121.14	111.99	111.69	112.23	112.09	111.47
Heat Off						
43	121.14	112.67	112.39	112.96	112.87	112.25
44	120.16	113.38	112.99	113.63	113.60	112.96
45	118.69	113.92	113.68	114.47	114.54	113.78
46	117.30	114.74	114.63	115.53	115.59	114.70
47	115.92	116.01	115.50	116.58	115.69	115.80
48	114.67	116.08	114.94	117.16	114.67	116.08
49	113.49	114.89	113.87	116.10	113.52	115.03
50	112.34	113.59	112.78	115.18	112.36	113.80
51	111.25	112.31	111.65	113.92	111.25	112.60
52	110.11	111.17	110.47	112.71	110.08	111.39
53	109.04	110.06	109.42	111.39	109.04	110.19
54	107.98	108.98	108.39	110.71	107.97	109.18
55	106.97	107.87	107.33	109.77	106.91	108.17
56	105.93	106.83	106.34	108.67	105.87	107.13
57	104.95	105.79	105.32	107.76	104.84	106.12
58	104.00	104.80	104.39	106.49	103.84	105.10
59	103.02	103.88	103.37	105.48	102.86	104.17
60	102.12	102.97	102.37	104.59	101.94	103.21
61	101.08	102.05	101.45	103.86	101.03	102.29
62	100.14	101.18	100.52	102.69	100.13	101.38
63	99.17	100.24	99.62	101.67	99.15	100.44
64	97.91	99.42	98.91	100.99	98.61	99.60
Lid Off						
65	25.17	98.09	97.09	98.83	96.12	98.21
66	26.49	97.82	94.79	98.51	93.62	96.28
67	27.96	97.43	92.98	97.78	91.66	94.39
68	29.62	97.00	91.37	97.37	89.96	92.62
69	27.47	96.50	89.86	96.04	88.33	90.97
70	28.93	95.88	88.33	95.63	86.70	89.26
71	25.95	95.11	86.85	94.81	85.12	87.71
72	28.37	94.26	85.47	93.92	83.59	86.16

73	26.98	93.44	84.14	92.89	82.20	84.72
74	27.40	92.51	82.84	91.91	80.93	83.36
75	28.20	91.58	81.65	90.85	79.62	82.01
76	28.06	90.61	80.44	89.77	78.36	80.65
77	27.18	89.61	79.27	88.79	77.06	79.32
78	25.54	88.61	78.12	87.63	75.83	78.06
79	26.86	87.56	76.92	86.56	74.63	76.84
80	25.76	86.51	75.86	85.47	73.54	75.62
81	24.85	85.53	74.81	84.40	72.42	74.46
82	27.18	84.50	73.72	83.34	71.35	73.35
83	25.54	83.46	72.76	82.29	70.31	72.32
84	24.87	82.54	71.82	81.27	69.32	71.26
85	25.34	81.59	70.81	80.21	68.38	70.25
86	24.90	80.64	69.86	79.26	67.41	69.24
87	25.29	79.72	68.87	78.25	66.44	68.30

Table C.9. Batch 32 Temperature Profiles

Time	Retort	TC710	TC711	TC712	TC713	TC714
0	37.24	78.32	77.99	79.68	80.46	77.15
1	58.57	77.79	77.37	79.37	79.76	76.97
2	67.18	77.26	76.72	78.87	78.92	76.62
3	75.78	76.52	75.88	78.16	77.85	75.95
4	86.08	75.77	75.01	77.49	76.86	75.04
Start of Exhaust						
5	96.17	75.03	74.25	76.74	75.92	74.30
6	100.07	74.45	73.76	76.09	74.94	73.50
7	101.12	74.01	73.27	75.58	74.30	72.85
8	101.53	73.65	72.98	75.25	73.87	72.43
9	101.76	73.63	72.94	75.16	73.72	72.29
10	102.08	73.89	73.32	75.45	73.87	72.43
11	102.14	74.47	73.94	75.98	74.41	72.92
12	102.23	75.32	74.74	76.78	75.14	73.70
13	102.32	76.35	75.79	77.80	76.08	74.66
14	102.59	77.46	76.97	78.91	77.17	75.77
End of Exhaust						
15	102.68	78.70	78.19	80.10	78.34	76.95
16	108.34	79.92	79.58	81.45	79.56	78.22
17	113.68	81.26	80.88	82.66	80.79	79.46
Process Start						
18	118.90	82.52	82.03	83.89	81.94	80.71
19	121.14	83.75	83.28	84.94	83.11	81.97
20	121.16	84.98	84.51	86.15	84.36	83.29
21	121.22	86.23	85.82	87.39	85.63	84.63
22	121.18	87.62	87.22	88.68	87.00	86.07
23	121.18	89.06	88.70	90.18	88.49	87.56
24	121.10	90.61	90.27	91.72	90.03	89.12
25	121.18	92.32	91.87	93.28	91.63	90.75
26	121.14	93.92	93.45	94.87	93.26	92.40
27	121.12	95.51	95.05	96.42	94.87	94.06
28	121.18	97.11	96.62	98.03	96.42	95.66
29	121.08	98.61	98.12	99.53	97.97	97.21
30	121.18	100.02	99.57	100.90	99.40	98.68
31	121.10	101.43	100.96	102.29	100.79	100.08
32	121.08	102.73	102.29	103.57	102.16	101.38
33	121.20	103.97	103.48	104.84	103.37	102.72

34	121.26	105.13	104.64	105.96	104.56	103.91
35	121.08	106.26	105.75	107.09	105.68	105.06
36	121.14	107.32	106.76	108.12	106.76	106.20
37	121.31	108.31	107.76	109.11	107.76	107.30
38	121.26	109.26	108.68	110.02	108.71	108.27
39	121.10	110.14	109.51	110.92	109.59	109.22
40	121.16	110.94	110.39	111.72	110.45	110.19
41	121.20	111.72	111.15	112.54	111.23	111.03
42	121.02	112.48	111.86	113.34	112.03	111.83
Heat Off						
43	121.20	113.11	112.51	114.11	112.70	112.65
44	120.29	113.71	113.16	114.78	113.52	113.28
45	118.73	114.28	113.85	115.39	114.40	114.09
46	117.21	114.97	114.50	116.01	115.34	115.09
47	115.79	115.76	115.21	116.68	116.00	116.12
48	114.43	115.83	115.88	115.89	115.09	115.43
49	113.14	114.70	115.86	114.68	113.81	114.22
50	111.96	113.48	114.83	113.32	112.57	112.96
51	110.81	112.31	113.56	112.02	111.32	111.70
52	109.65	111.11	112.41	110.86	110.18	110.57
53	108.47	110.02	111.21	109.72	109.06	109.43
54	107.33	108.69	109.95	108.54	107.93	108.21
55	106.20	107.49	108.81	107.49	106.85	107.13
56	105.16	106.39	107.74	106.41	105.77	106.07
57	104.08	105.33	106.76	105.39	104.77	104.99
58	103.02	104.31	105.62	104.27	103.63	103.93
59	102.02	103.31	104.71	103.25	102.65	102.93
60	99.99	102.22	103.77	102.18	101.37	101.83
Lid Off						
61	51.57	99.79	101.80	100.28	98.57	98.75
62	31.41	96.96	99.53	98.61	96.44	96.24
63	27.25	94.70	97.43	98.57	94.34	94.13
64	27.15	93.01	95.43	98.23	92.54	92.14
65	26.52	91.34	93.56	97.73	90.88	90.23
66	26.13	89.76	91.68	97.30	89.23	88.47
67	25.41	88.13	90.77	96.72	87.48	86.71
68	25.59	86.60	90.59	96.02	85.98	85.07
69	25.95	85.15	90.35	95.24	84.60	83.53
70	25.44	83.77	90.09	94.38	83.33	82.12
71	25.07	82.43	89.68	93.45	82.01	80.71
72	24.78	81.20	89.20	92.41	80.84	79.41

73	24.41	79.89	88.59	91.42	79.60	78.04
74	24.68	78.65	87.96	90.33	78.41	76.71
75	24.53	77.50	87.18	89.29	77.32	75.44
76	24.41	76.30	86.39	88.22	76.30	74.22
77	24.16	75.12	85.50	87.11	75.30	73.08
78	24.19	73.98	84.64	86.06	74.34	71.89
79	24.01	72.87	83.72	84.94	73.32	70.79
80	24.43	71.84	82.60	83.87	72.38	69.71
81	23.99	70.80	81.76	82.79	71.53	68.68
82	24.11	69.81	80.86	81.76	70.79	67.71
83	23.92	68.80	79.82	80.74	70.02	66.67
84	23.74	67.88	78.81	79.68	69.23	65.74
85	24.01	66.97	77.94	78.71	68.49	64.86
86	23.82	66.14	77.01	77.78	67.88	63.97
87	23.99	65.23	76.12	76.83	67.14	63.11
88	23.69	64.39	75.23	75.91	66.53	62.34
89	23.55	63.52	74.34	75.00	65.83	61.42
90	23.92	62.80	73.34	74.15	65.21	60.67
91	23.50	61.95	72.56	73.24	64.63	59.89

Confirmation Evaluation

Table C.9. Ball Formula Summary

Retort	TCID	*jh*	f_h	B_b
6	505	1.66	28.54	31.52
6	506	1.50	31.50	32.61
6	507	1.56	31.63	33.25
6	508	1.61	32.08	34.04
6	509	1.53	30.15	31.80
6	510	1.58	33.46	36.80
6	511	1.70	28.75	33.64
6	512	1.57	29.28	33.11
6	513	1.49	31.53	34.34
6	514	1.58	30.64	34.37
6	515	1.37	32.11	34.70
6	516	1.55	28.97	33.63
6	517	1.42	30.84	34.13
6	518	1.48	30.07	31.01
6	519	1.63	29.67	34.90
8	606	1.51	30.77	32.89
8	607	1.63	29.75	33.05
8	608	1.65	30.98	34.26
8	609	1.61	30.83	33.80
8	610	1.49	32.81	34.35
8	611	1.72	29.78	33.74
8	612	1.70	29.78	33.59
8	613	1.56	31.71	34.07
8	614	1.65	28.94	32.48
8	615	1.64	30.65	33.86
8	616	1.39	30.01	32.19
8	617	1.38	32.63	34.21
8	618	1.40	33.54	35.14
8	619	1.40	33.20	34.87
8	620	1.35	33.55	34.62
17	700	1.55	30.46	35.01
17	701	1.52	31.78	35.91
17	702	1.46	32.25	35.76
17	703	1.46	34.05	37.30

17	704	1.49	31.95	35.79
17	705	1.38	33.82	35.64
17	706	1.48	33.48	36.38
17	707	1.51	32.68	35.99
17	708	1.39	34.68	36.44
17	709	1.51	33.55	36.73
17	710	1.48	32.01	34.92
17	711	1.37	34.56	35.88
17	712	1.44	33.24	35.55
17	713	1.55	32.43	35.92
17	714	1.40	35.19	36.72

Table C.11. Lethality Summary

Retort	TCID	Point in Process	Temp (°C)	Lethal Rate	F_0 (min)	Contribution to F_0 (min)
6	505	Process start	87.25	0.00	0.00	0.00%
6	505	Process end	114.70	0.23	1.22	30.81%
6	505	End of cool in retort	101.03	0.01	3.96	69.19%
6	506	Process start	87.24	0.00	0.00	0.00%
6	506	Process end	113.77	0.19	1.01	31.17%
6	506	End of cool in retort	100.71	0.01	3.24	68.83%
6	507	Process start	87.98	0.00	0.00	0.00%
6	507	Process end	113.88	0.19	1.04	32.00%
6	507	End of cool in retort	100.58	0.01	3.25	68.00%
6	508	Process start	86.89	0.00	0.00	0.00%
6	508	Process end	113.10	0.16	0.84	27.81%
6	508	End of cool in retort	101.39	0.01	3.02	72.19%
6	509	Process start	86.79	0.00	0.00	0.00%
6	509	Process end	114.22	0.21	1.20	31.41%
6	509	End of cool in retort	100.99	0.01	3.82	68.59%
6	510	Process start	84.69	0.00	0.00	0.00%
6	510	Process end	113.42	0.17	0.78	30.23%
6	510	End of cool in retort	103.46	0.02	2.58	69.77%
6	511	Process start	81.65	0.00	0.00	0.00%
6	511	Process end	113.27	0.16	0.72	31.03%
6	511	End of cool in retort	102.58	0.01	2.32	68.97%
6	512	Process start	82.66	0.00	0.00	0.00%
6	512	Process end	114.38	0.21	0.92	29.39%
6	512	End of cool in retort	104.44	0.02	3.13	70.61%
6	513	Process start	84.62	0.00	0.00	0.00%
6	513	Process end	113.64	0.18	0.88	35.92%
6	513	End of cool in retort	102.48	0.01	2.45	64.08%
6	514	Process start	83.93	0.00	0.00	0.00%
6	514	Process end	113.13	0.16	0.81	35.22%
6	514	End of cool in retort	102.08	0.01	2.30	64.78%
6	515	Process start	84.93	0.00	0.00	0.00%
6	515	Process end	113.67	0.18	0.90	31.80%
6	515	End of cool in retort	101.24	0.01	2.83	68.20%
6	516	Process start	83.57	0.00	0.00	0.00%
6	516	Process end	113.62	0.18	0.90	35.43%

6	516	End of cool in retort	100.15	0.01	2.54	64.57%
6	517	Process start	83.10	0.00	0.00	0.00%
6	517	Process end	113.46	0.21	0.98	39.20%
6	517	End of cool in retort	99.98	0.01	2.50	60.80%
6	518	Process start	82.27	0.00	0.00	0.00%
6	518	Process end	112.95	0.15	0.73	27.76%
6	518	End of cool in retort	101.37	0.01	2.63	72.24%
8	606	Process start	83.95	0.00	0.00	0.00%
8	606	Process end	113.50	0.17	0.88	15.94%
8	606	End of cool in retort	103.29	0.02	5.52	84.06%
8	607	Process start	86.28	0.00	0.00	0.00%
8	607	Process end	113.91	0.19	1.00	21.79%
8	607	End of cool in retort	100.75	0.01	4.59	78.21%
8	608	Process start	87.68	0.00	0.00	0.00%
8	608	Process end	113.88	0.19	1.02	20.00%
8	608	End of cool in retort	101.65	0.01	5.10	80.00%
8	609	Process start	86.44	0.00	0.00	0.00%
8	609	Process end	113.89	0.19	0.99	21.57%
8	609	End of cool in retort	100.73	0.01	4.59	78.43%
8	610	Process start	86.23	0.00	0.00	0.00%
8	610	Process end	113.09	0.16	0.84	19.72%
8	610	End of cool in retort	100.72	0.01	4.26	80.28%
8	611	Process start	86.45	0.00	0.00	0.00%
8	611	Process end	114.20	0.21	1.00	18.18%
8	611	End of cool in retort	102.39	0.01	5.50	81.82%
8	612	Process start	85.01	0.00	0.00	0.00%
8	612	Process end	113.68	0.18	0.91	18.35%
8	612	End of cool in retort	102.01	0.01	4.96	81.65%
8	613	Process start	85.93	0.00	0.00	0.00%
8	613	Process end	114.01	0.20	0.96	19.39%
8	613	End of cool in retort	101.88	0.01	4.95	80.61%
8	614	Process start	86.68	0.00	0.00	0.00%
8	614	Process end	114.38	0.21	1.12	21.66%
8	614	End of cool in retort	101.50	0.01	5.17	78.34%
8	615	Process start	86.23	0.00	0.00	0.00%
8	615	Process end	113.67	0.18	0.95	22.95%
8	615	End of cool in retort	100.74	0.01	4.14	77.05%
8	616	Process start	85.28	0.00	0.00	0.00%
8	616	Process end	114.84	0.24	1.20	19.54%
8	616	End of cool in retort	101.92	0.01	6.14	80.46%
8	617	Process start	84.95	0.00	0.00	0.00%

8	617	End of cool in retort	112.99	0.15	0.81	(Missing data)
8	618	Process start	84.68	0.00	0.00	0.00%
8	618	Process end	112.73	0.15	0.75	18.61%
8	618	End of cool in retort	100.92	0.01	4.03	81.39%
8	619	Process start	84.25	0.00	0.00	0.00%
8	619	Process end	112.64	0.14	0.72	18.37%
8	619	End of cool in retort	100.24	0.01	3.92	81.63%
8	620	Process start	85.42	0.00	0.00	0.00%
8	620	Process end	113.46	0.17	0.90	19.11%
8	620	End of cool in retort	100.40	0.01	4.71	80.89%
17	700	Process start	78.30	0.00	0.00	0.00%
17	700	Process end	112.67	0.14	0.60	19.74%
17	700	End of cool in retort	101.60	0.01	3.04	80.26%
17	701	Process start	78.28	0.00	0.00	0.00%
17	701	Process end	111.86	0.12	0.52	17.51%
17	701	End of cool in retort	102.50	0.01	2.97	82.49%
17	702	Process start	83.63	0.00	0.00	0.00%
17	702	Process end	113.92	0.19	0.94	21.03%
17	702	End of cool in retort	102.76	0.02	4.47	78.97%
17	703	Process start	80.55	0.00	0.00	0.00%
17	703	Process end	111.80	0.12	0.52	20.31%
17	703	End of cool in retort	101.18	0.01	2.56	79.69%
17	704	Process start	78.97	0.00	0.00	0.00%
17	704	Process end	112.14	0.13	0.61	23.74%
17	704	End of cool in retort	100.52	0.01	2.57	76.26%
17	705	Process start	81.48	0.00	0.00	0.00%
17	705	Process end	111.99	0.12	0.59	19.67%
17	705	End of cool in retort	100.24	0.01	3.00	80.33%
17	706	Process start	81.87	0.00	0.00	0.00%
17	706	Process end	111.69	0.11	0.55	20.75%
17	706	End of cool in retort	99.62	0.01	2.65	79.25%
17	707	Process start	81.63	0.00	0.00	0.00%
17	707	Process end	112.23	0.13	0.61	16.67%
17	707	End of cool in retort	101.67	0.01	3.66	83.33%
17	708	Process start	80.73	0.00	0.00	0.00%
17	708	Process end	112.09	0.13	0.57	20.88%
17	708	End of cool in retort	99.15	0.01	2.73	79.12%
17	709	Process start	81.07	0.00	0.00	0.00%
17	709	Process end	111.47	0.11	0.50	17.24%
17	709	End of cool in retort	100.44	0.01	2.90	82.76%
17	710	Process start	82.52	0.00	0.00	0.00%

17	710	Process end	112.48	0.14	0.65	21.67%
17	710	End of cool in retort	103.31	0.02	3.00	78.33%
17	711	Process start	82.03	0.00	0.00	0.00%
17	711	Process end	111.86	0.12	0.57	18.39%
17	711	End of cool in retort	104.71	0.02	3.10	81.61%
17	712	Process start	83.89	0.00	0.00	0.00%
17	712	Process end	113.34	0.17	0.78	22.87%
17	712	End of cool in retort	103.25	0.02	3.41	77.13%
17	713	Process start	81.94	0.00	0.00	0.00%
17	713	Process end	112.03	0.12	0.57	20.88%
17	713	End of cool in retort	102.65	0.01	2.73	79.12%
17	714	Process start	80.71	0.00	0.00	0.00%
17	714	Process end	111.83	0.12	0.52	19.05%
17	714	End of cool in retort	102.93	0.02	2.73	80.95%