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March 8, 1994

HAND DELIVERED

Mr. Dallas W. Safriet
Emission Inventory Branch (MD-14)
Environmental Protection Agency
Research Triangle Park, North Carolina 27711

Rec'd from Dallas
3/14/94
TL

Re: Miller Brewing Company

Dear Mr. Safriet:

Historically, federal and state agencies and the brewing industry have considered VOC emissions from breweries to be negligible. Recently, however, some attention has been directed to the possibility that breweries might be more substantial sources of VOC emissions than formerly suspected, principally in the form of ethanol. Consequently, Miller engaged an engineering firm to conduct an emissions inventory at its brewery in Fulton, New York. The report from the emissions inventory has been completed and I am including a copy of the report with this letter for your information and review.

I hope to have an opportunity to discuss the report with you at the time it is delivered to you. After you have had time to consider the report more fully, please give me a call.

Very truly yours,

SMITH HELMS MULLISS & MOORE, L.L.P.

Harold N. Bynum

Harold N. Bynum

HNB/dp
Enclosure
cc: Myron Whitley(w/enclosure)
Garrett W. Reich (w/out enclosure)
Daniel A. Barthold (w/out enclosure)

AP-42 Section 9.12.1
Reference 19-Vol I
RTP ENVIRONMEN Report Sect. 4
Reference 28

~~PRIVILEGED & CONFIDENTIAL~~

declassified 7-13-95
via 7-7-95 letter
see custody
receipts/LKS

~~CONFIDENTIAL~~

Miller Brewing Company
Fulton, New York

AIR EMISSIONS INVESTIGATION REPORT

Prepared for:

SBE Environmental Company
2 Penn Plaza
New York, New York 10001

Prepared by:

RTP Environmental Associates, Inc.
400 Post Avenue
Westbury, New York 11590

FEBRUARY, 1994

August 8, 1996

TO: Brian Shrager

FR: Roy Neulicht RN

RE: Malt Beverage AP-42
Miller Brewing Company (reference 28) VOC calculations

As you requested I have checked your calculations of the VOC emission rate/factors for the Miller Brewing Company report. I concur with your calculations.

I checked your spreadsheet and did a few calculations by hand (attached). I checke donly the brew kettle calculations.

I added calculations, as propane, to your speadsheet for the brew kettle.

MILLER BREWING COMPANY EMISSIONS DATA--REFERENCE 28

D. Emission Data/Mass Flux Rates/Emission Factors

Test ID	Parameter	Units	Values reported			
			Run 1	Run 2	Run 3	Run 4
1	Stack temperature	Deg F	142	134.5	112.7	
BREW	Moisture	%				
KETTLE	Oxygen	%				
	Process time	min	193	193	193	
	Volumetric flow, actual	acfm	16982	16599	13498	
	Sample volume	liters	79.3	74	70.3	
	Sample volume	ft^3	2.80	2.61	2.48	
	Isokinetic variation	%	NA	NA	NA	
Circle: Production or feed rate Capacity:		1000 bbl	1.1	1.1	1.1	
	Pollutant concentrations:					
	VOC as n-hexane	mg	0.034	0.064	0.015	
	VOC as toluene	ug/ml	5.2	0	0	
	VOC as methane**	mg/cf	0.0812	0.0273	0.00673	
	VOC as propane***	mg/cf	0.0746	0.0251	0.0062	
	Pollutant mass flux rates:					
	VOC as methane	lb	0.587	0.193	0.039	
	VOC as propane	lb	0.539	0.177	0.036	
	Emission factors:					AVERAGE
	VOC as methane	lb/1000 bbl	0.53	0.18	0.035	0.25
			0.49	0.16	0.03	

**Includes both VOC as n-hexane and VOC as toluene converted to a methane basis
mg/cf = ((VOC as n-hexane, mg)*6*16/86.18+(VOC as toluene, ug/ml)*10^-3*30*7*16/92.14)/(sample volume)

***Includes both VOC as n-hexane and VOC as toluene converted to a propane basis
mg/cf = ((VOC as n-hexane, mg)*6/86*44/3+(VOC as toluene, ug/ml)*10^-3*30*7/92*44/3)/(sample volume)

Miller Brewing – VOC's

8/8/96
RMN

$$\text{mg}_{CH_4} = \text{mg Hex} \times \frac{\text{mole Hx}}{86.\ \text{g Hx}} \times \frac{6\ \text{CARBON}}{\text{mole Hx}} \times \frac{\text{mole } CH_4}{1\ \text{CARBON}} \times \frac{16\ \text{g}}{\text{mole } CH_4} = 1.1\ \text{mg Hex}$$

$$\text{mg}_{CH_4} = \text{ug/mL}_{Tol} \times \frac{\text{mL}}{\text{Sample}} \times 10^{-3}\ \frac{\text{mg}}{\text{ug}} \times \frac{\text{mole Tol}}{92\ \text{g}} \times \frac{7\ \text{CARBON}}{\text{mole Tol}} \times \frac{\text{mole } CH_4}{1\ \text{CARBON}} \times \frac{16\ \text{g}}{\text{mole } CH_4} = 3.65\times10^{-2}\ \frac{\text{ug}}{\text{mL}_{Tol}}$$

For Brew Kettle Run # 1

$$\text{mg}_{CH_4} = (1.1 \times 0.34\ \text{mg Hx}) + (3.65\times10^{-2} \times 5.2\ \text{ug/mL Tol}) = 0.227\ \text{mg } CH_4$$

$$\text{mg } CH_4/\text{Ft}^3 = \text{mg } CH_4 / \text{Sample, L} \times \frac{28.32\ \text{L}}{\text{Ft}^3} = \frac{0.227}{79} \times 28.32 = 0.081\ \frac{\text{mg } CH_4}{\text{Ft}^3}$$

Propane

$$\text{mg as Propane} = \text{mg Hexane} \times \frac{\text{moles Hx}}{86\ \text{g}} \times \frac{6\ \text{CARBON}}{\text{mole Hx}} \times \frac{\text{mole Prop}}{3\ \text{Carbon}} \times \frac{44\ \text{g}}{\text{mole Prop}} = 1.02 \times \text{mg}_{Hx}$$

↑ Same for Toluene Conversion

ACKNOWLEDGEMENT

RTP Environmental Associates, Inc. wishes to extend our sincere gratitude to the Miller Brewing Company Staff, both onsite and at the Milwaukee branch, who gave a considerable amount of their time and guidance to assure that we obtained the data needed in developing this inventory report.

Miller Brewing Company
Fulton, New York

Air Emissions Investigation Report

TABLE OF CONTENTS

Miller Brewing Company
Fulton, New York

Air Emissions Investigation Report

TABLE OF CONTENTS

Miller Brewing Company
Fulton, New York

Air Emissions Investigation Report

TABLE OF CONTENTS
(continued)

Miller Brewing Company
Fulton, New York

Air Emissions Investigation Report

TABLE OF CONTENTS
(continued)

Miller Brewing Company
Fulton, New York

Air Emissions Investigation Report

LIST OF TABLES

Miller Brewing Company
Fulton, New York

Air Emissions Investigation Report

LIST OF FIGURES

Miller Brewing Company
Fulton, New York

AIR EMISSIONS INVESTIGATION REPORT

1.0 INTRODUCTION

In July 1992, EPA issued final rules on the minimum elements of air pollutants permit programs to be administered by the states. New York State in October, 1993 issued the proposed draft of 6 NYCRR Part 201 enumerating the permitting requirements of the Title V of the Federal Clean Air Act Amendments (CAAA) of 1990. This emissions survey is the first step of the permitting effort under the proposed regulations. This report provides an investigation of the sources of air pollutants at the Miller Brewing Company, Fulton, New York facility and quantifies the emission rates from selected units for primarily total volatile organic compounds and ethanol. Data on several other pollutants that were inventoried during the series of emission tests performed at the facility are also presented. Effort was not expended on the total suspended particulate (TSP/PM_{10}) inventory, since the facility has already submitted and has had approved operating permits.

The Fulton facility was divided into seven (7) major areas and other miscellaneous sources for the purpose of effectively managing the survey. These major areas include: raw materials, brewhouse, cold services, utilities, packaging, annex and wastewater treatment. Each of these areas further consist of several activities located within the area. The report identifies the specific emission points observed at the time of the pre-test survey and during the full facility test.

The investigation was divided into a series of tasks. The first task included two site visits for determining the general facility layout and for taking initial survey samples for ethanol at numerous locations throughout the facility. The second task related to the full facility emission tests for a total of seven (7) specific air pollutants and collecting concurrent numerous other data on equipment and processes. The final task was the compilation of the data taken during the facility tests into an emissions report for the facility.

To begin the process, an initial sampling plan was provided to the Miller staff for review and comment. The approved sampling plan was the basis for the work performed during the facility tests.

In summary, the report consists of six (6) sections. A facility description is provided in Section 1.2. The technical approach used in this report provided in Section 2.0. Sampling and analytical methods are discussed in Section 3.0. The methods for quantifying emissions from various sources is provided in Section 4.0. A discussion of results in each plant area is presented in Section 5.0 and Section 6.0 is the summary.

1.1 Title V Reporting Requirements

Title V of the CAAA of 1990 is intended to provide a means of identifying and permitting various sources of air pollutants regulated by the Clean Air Act. Facilities will be required to inventory their air pollutant emissions and the state will determine the applicable requirements that are to be followed for each emission unit, all within the context of an operating permit.

At this point, New York State has provided the EPA with a draft of the proposed air pollutant permit program, Part 201. EPA will then comment on the proposal and then direct the state to issue final operating permit rules by November 15, 1994.

The specific reporting requirements will not be defined until the final operating permit rules are issued by the state. However, it is likely that regulated pollutants at this point will include all volatile organic compounds and several other pollutants that are released at the Fulton facility. Therefore, ethanol has been selected along with total volatile organic compounds and others constituents for this initial survey to determine what reporting and control requirements may be imposed on the facility.

1.2 Facility Description and Layout

The Miller Brewing Company, Fulton, New York facility is a large brewery with a design capacity to brew eight (8) million barrels of beer per year. Current operations, however, are at approximately 5 million barrels per year. As shown in Figure 1.1, the facility layout is oriented in a south to north

MILLER BREWING COMPANY
FULTON, NEW YORK

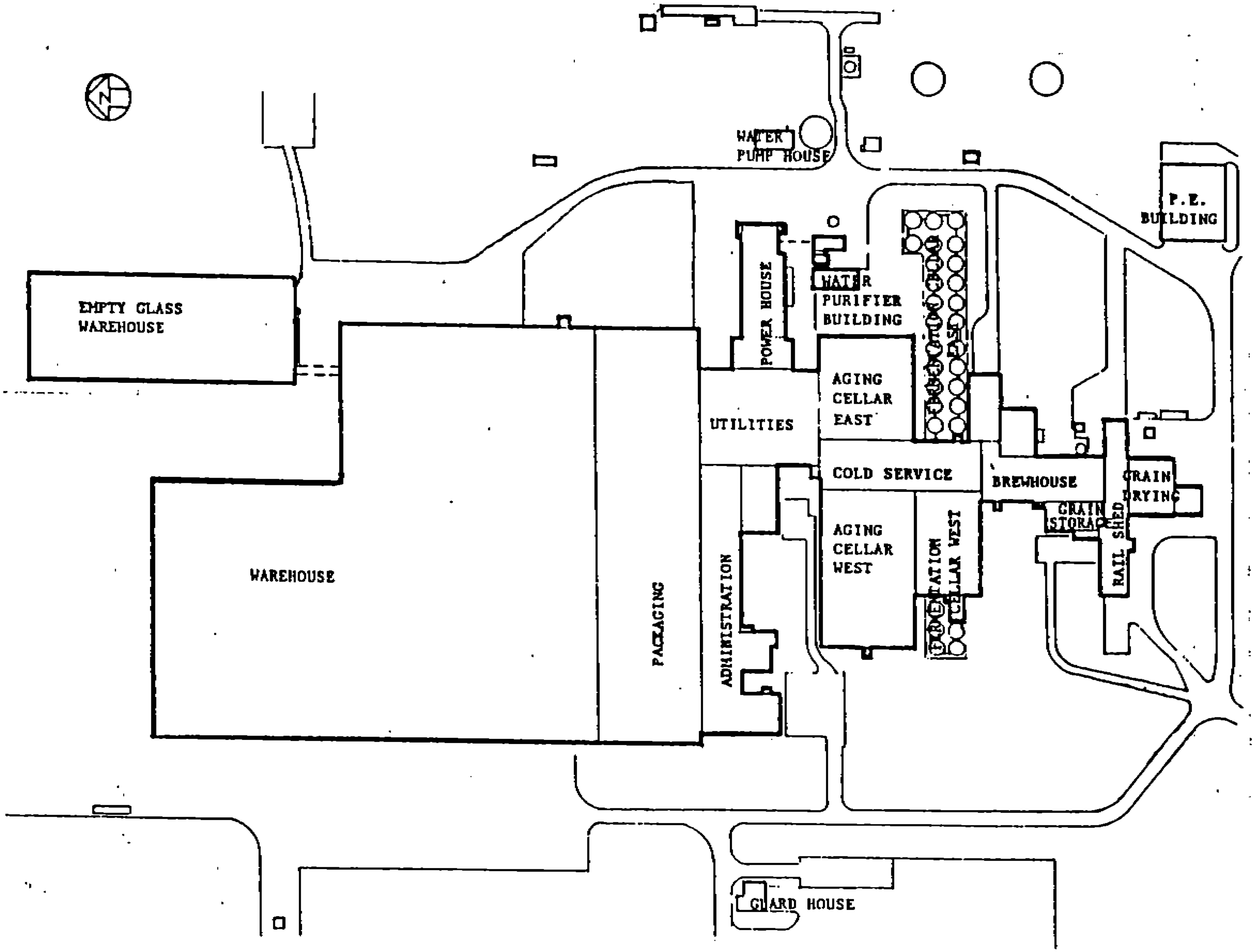


FIGURE 1.1: FULTON BREWERY LAYOUT

RTP Environmental Associates, Inc.®

direction. Raw materials generally enter at the southern end of the facility. The raw materials are dried ? and stored as necessary for use in the brewhouse where the raw materials are combined according to specific recipes and various types of hot wort are produced. ~~Hot~~ Wort is delivered to the one of three fermentation cellars located to either the west or east of the cold services area. The aging cellars are also located to the east and west of the cold services area and just north of the fermentation cellars. Utilities occupies the space just north of the aging cellars. Further north of utilities is packaging where the beer is packaged for warehousing and shipment to distributors. Empty glass is returned to the facility via the annex/empty glass warehouse. One final area of interest for this survey is the wastewater treatment plant which is not shown on Figure 1.1 but is located approximately 1/4 mile to the south of the brewhouse. Each of the above areas will be described in more detail in the sections that follow.

2.0 TECHNICAL APPROACH

2.1 Program Scope of Work

The primary purpose of the emission survey is to provide accurate emission rates for various air pollutants being emitted at the Fulton facility. The emission rates are based on individual source tests for a selected list of compounds. The primary focus is on ethanol emissions although several other compounds, including volatile organic compounds, sodium hydroxide, chlorine, ammonia and formaldehyde have been added to the test program for this facility.

The scope of work has been developed to provide the data necessary to compile the emission survey. Several steps have been taken to carefully structure the scope to maximize the information collected ~~at the lowest cost and time expended~~. ensure As part of the effort, team members visited the site on two occasions prior to conducting the emission test plan. Several aspects of plant operations were determined during the initial visits and these were necessary to properly design an efficient and effective sampling effort.

The facility, for the purpose of the test program, has been divided into six (6) major components. The division is based on activities at the plant. In general, the facility has been divided as follows: brew-house, cold services, utilities, packaging, annex and wastewater treatment. There are other areas at the facility that were not sampled. The emission rates from these areas will either be approximated from other available data or will be sampled under a separate task order. The data collected during the sampling program will be combined with process data on plant operations to provide expected actual and potential annual emission rates. This information will then be combined with data from other sources to provide an overall facility emission survey. The facility test program as conducted is provided in Appendix A.

2.2 Pretest Survey

The development of the sampling plan was based on several discussions with Miller personnel and a pretest site survey. The first site visit was principally to gather general information on the Fulton facility. This information was compiled and a pretest survey was performed where a portable ethanol monitor was used to preliminarily quantify concentrations from the various sources identified for testing. The identified sources were reviewed in detail with plant personnel and a final test plan matrix was established. The sampling test plan, as conducted, is presented in Section 2.4.

The pretest survey provided a considerable amount of data on the ethanol concentrations within various processes at the facility. Tables 2.1 through 2.3 provide the concentrations reported during the pretest survey. It should be noted that the corresponding exhaust flow characteristics, process data and physical characteristics of the sources could not be completely quantified in this first effort. In addition, because of the dynamic nature of the processes, specific timing schedules had to be developed to assure that sampling would occur during periods when processes were operating normally and during a stable portion of the emission cycle. Factors were then developed to cover the entire emission cycle from each source or process. This sampling procedure therefore, for most of the sources, had to be specifically tailored to the process cycle and dynamic range of emissions during the cycle. Not accounting for these dynamics would cause a significant error in the emission estimate as well as cause substantial difficulty in determining appropriate sampling volumes, and therefore, sorbent trap loading. Sample size is always a critical parameter because analytical sensitivity is limited to a specific range which, if exceeded, will result in a failed analysis. Providing an insufficient sample mass results in values below a minimal detection limit for the analytical instruments. These issues are common to each substance and source/ process sampled.

Ethanol concentrations were monitored at various indoor locations throughout the Fulton facility. The grab sample values as measured are presented in Table 2.1. As shown, peak ethanol values occur in the

TABLE 2.1

MILLER BREWING COMPANY
FULTON, NEW YORK

PRELIMINARY INDOOR ETHANOL MEASUREMENTS

Process Area: Packaging, Warehouse and Utilities Area

Source Area	Location	Background Reading (ppm)	Source Reading (ppm)	Actual Concentration (ppm)
Warehouse	Storage for Miller Draft	-0.7	1.2	1.9
	Empty box storage	-0.7	2.0	2.7
	Railcar loading area	-0.7	4.5	5.2
	Pallet unload area	-0.7	2.0	2.7
Bottle Wash	Walkway over washer	-0.7	13.0	13.7
	Recycling area	-0.7	34.0	34.7
	Box opening area	-0.7	10.0	10.7
Utilities	Carbon Bed regeneration vent	-0.7	7.0	7.7
Packaging	Entrance to Packaging/Utilities	0.0	60	60
	Line C9 at filler level	0.0	90	90
	Floor grating	0.0	230	230
	Seamer	0.0	30 to 40	30 to 40
	Drain NW of filler	0.0	30	30
	Line C7 filler level	0.0	30	30
	Floor grating	0.0	160	160
	Seamer	0.0	50	50
	Drain NW of filler	0.0	50-55	50-55
	Line B5 reject dumpster	0.0	15	15
	Line B2 filler discharge	0.0	20	20
	Seamer discharge	0.0	83	83
	Grating under seamer	0.0	30	30
	Reject dumpster	0.0	110	110
	Line B12 seamer discharge	0.0	40	40
	Filler discharge	0.0	90	90
	Grating under filler	0.0	80	80
	Over drain during bowl dump	0.0	100	100

TABLE 2.2

MILLER BREWING COMPANY
FULTON, NEW YORK

PRELIMINARY EXHAUST VENT ETHANOL MEASUREMENTS

Process Area: Various Facility Exhaust Vents

Source Area	Location	Background Reading (ppm)	Source Reading (ppm)	Actual Concentration (ppm)
Cold Services	Heat Wheel Exhaust	-5.7	3.0	8.7
Utilities	Carbon Bed regeneration vent	-6.0	5 to 6	11.0 to 12.0
Packaging	Beer dump exhaust vent	-7.2	8.6	15.8
	Beer dump exhaust vent	-6.8	9.1	15.9
	Bottle Line 1 EF 25	-3.5	0.4	3.9
	Bottle Line 2 EF 24	-2.0	8.5	10.5
	Bottle Line 2 EF 23	-3.0	4.5	7.5
	Bottle Line 3 EF 22	-4.5	3.5	8.0
	Bottle Line 4 EF 19	-5.3	-1.0	6.3
	Bottle Line 5 EF 17	-5.4	2.0	7.4
	Bottle Line 5 EF 18	-6.0	4.2	10.2
	Clean Room #5	-6.0	35.0	41.0
	Clean Room #6	-6.0	55.0	61.0
	Bottle Line 6 EF 16	-5.8	7.0	12.8
	Bottle Line 7 EF 14	-6.5	10.0	16.5
	Bottle Line 8 EF 11	-6.6	10.0	16.6
	Bottle Line 8 EF 12	-5.9	9.0	14.9
	Bottle Line 9 EF 10	-7.4	6.0	13.4
	Bottle Line 9 EF 9	-7.4	3.3	10.7
	Bottle Line 10 EF 8	-6.8	3.0	9.8
	Bottle Line 11 EF 5	-2.8	4.0	6.8
	Bottle Line 11 EF 6	-3.8	9.7	13.5
	Bottle Line 12 EF 4	-4.1	7.0	11.1
	Bottle Line 13 EF 2	-4.0	17 to 23	21.0 to 27.0
	Bottle Line 13 EF 1	-4.1	15.0	19.1

Note: - The bottling lines operating during test were: 2,5,6,7,9,12 & 13.
- Readings were taken on Thursday September 16, 1993 between 1330 and 1530 hours.

TABLE 2.3

MILLER BREWING COMPANY
FULTON, NEW YORK

PRELIMINARY WASTEWATER TREATMENT PLANT ETHANOL MEASUREMENTS

Process Area: Wastewater Treatment Plant

Source Area	Location	Background Reading (ppm)	Source Reading (ppm)	Actual Concentration (ppm)
Influent Wastewater	4' above bar screen	-1.8	2.05	4.3
	1' above screen	-1.8	5	6.8
	2' from top of channel	-1.8	7	8.8
	2' above grit collector	-1.8	2.5 to 9.0	4.3 to 10.8
	1' above gate 2	-1.8	3.5 to 4.0	5.3 to 5.8
	Bar screen in channel	-1.8	8 to 9.0	9.8 to 10.8
Equalization Tank	At weir	-1.8	12 to 30	13.8 to 31.8
	Side edge of tank	-4.5	11	12.8
	Midway of tank on side	-1.8	3.0	4.8
	Downwind edge	-2.2	2.0	4.2
Running Clarifier	5' above center of tank	-2.2	0.2	2.4
	at downwind edge	-2.2	1.5	3.7
Distribution Box	1'above box	-2.2	2.0	4.2
Aeration Tank	near tank at downwind side	-2.6	-1.3	1.3
	near tank at downwind side	-2.6	-1.5	1.1
	1' above grate level	-2.6	-2.0	0.6
	1/3 of way down tank	-2.6	-2.4	0.2
	2/3 of way down tank	-2.6	-2.4	0.2

Notes:
- Plant flow was approximately 3.0 to 3.5mgd.
- Weather conditions were light winds from SW at 0-5 mph. Temperature 63 F.
- Time of test was from 930 to 1030 hours on September 15, 1993.

vicinity of the filling stations in packaging. Generally, levels in other areas are lower. Table 2.2 contains data on the ethanol concentrations that were observed at various roof vents throughout the facility. Although there is considerable variability, parts per million (ppm) ethanol levels are present in nearly all exhaust points tests. Finally, Table 2.3 provides ambient air ethanol concentrations at the Fulton facility wastewater treatment plant. Again, there is considerable variability depending on when and where a sample was taken. Peak levels occurred in the area of the equalization tank near the weir.

These preliminary values were used in establishing the sampling methods and volumes for the various processes at the facility. The data are also used to supplement the monitoring data that was collected during the expanded facility tests that occurred between October 31, 1993 through November 5, 1993.

2.3 Process Descriptions

2.3.1 Raw Materials Receiving and Handling

The first point where air pollutant emissions are possible at the plant, based on the flow of materials through the facility, is where the raw materials for beer production are delivered, unloaded and stored prior to use in the brewhouse. The sampling plan did not include the monitoring of these emissions since they are principally particulates in nature and have been inventoried and permitted. There are some minor issues related to other activities associated with raw materials, such as pesticide/fungicide usage, that will be covered in subsequent sections of this report.

2.3.2 Brewhouse

The brewhouse area, for the purpose of this test plan, is considered to extend from the point at which raw materials enter the brewhouse for processing to the point at which wort is delivered to the cold services area. As ancillary functions, other processes such as the disposal of spent materials are included in the brewhouse area. There are six (6) individual processes that occur in the brewhouse where air pollutant emissions are likely. Five of these processes have the potential to release total Volatile Organic Compounds (VOCs) and one has the potential for releasing ethanol.

TABLE 2.4

MILLER BREWING COMPANY
FULTON, NEW YORK

BREWHOUSE EMISSIONS TEST MATRIX

Process	Test Parameter(s)	Test Method(s)	Process Test Condition(s)	Test Site Description	Notes
Cereal Cooker	Stack Flow Rate Total VOCs	EPA Methods 1,2 and 4* NIOSH P&CAM 127	15 minute boil cycle sample time 20 minutes	Cooker Tun Stack, 6th floor roof/brewhouse - hot (115°F), moist and low flow	3 Modified VOST VOCs Flows - delta p & traverse Stack and Ambient Temp & Press
Mash Tun	Stack Flow Rate Total VOCs	EPA Methods 1,2 and 4* NIOSH P&CAM 127	1 hour 30 min. mash cycle sample time 60 min.	Mash Tun stack, 6th floor roof/brewhouse - hot (115°F), moist and low flow	3 Modified VOST VOCs Flows - delta p & traverse Stack and Ambient Temp & Press
Lauter Tun	Stack Flow Rate Total VOCs	EPA Methods 1,2 and 4* NIOSH P&CAM 127	1 hour 30 min filter cycle sample time 90 min.	Lauter Tun stack, 6th floor roof/brewhouse - hot (170°F), moist low flow	3 Modified VOST VOCs Flows - delta p & traverse Stack and Ambient Temp & Press
Kettle	Stack Flow Rate Total VOCs	EPA Methods 1,2 and 4* NIOSH P&CAM 127	1 hour 30 min. boiling cycle sample time 90 min.	Kettle stack, 6th floor roof/brewhouse - hot (200°F), moist moderate flow	3 Modified VOST VOCs Flows - delta p & traverse Stack and Ambient Temp & Press
Hot Wort Tank	Stack Flow Rate Total VOCs	Mass flux NIOSH P&CAM 127	Kettle transfer (~20 min.)	Hot Wort Tank manhole 4th floor roof/brewhouse - hot (200°F), moist moderate flow	1-Charcoal tube sample from tank headspace Flows - net displacement
Spent Grains Tank	Stack/Vent Flow Rate Ethanol	Mass flux NIOSH 1400/bag MIRAN Screen	Tank charging conditions	Stack vent on cold services roof.	No sample

* - Determined via wet/dry bulb temperature differential.

MISSING PG 10!
DESCRIPTIONS OF
CEREAL COOKER,
MASH TUN, AND
LAUTER TUN

Kettle: The Fulton facility has a total of four (4) brew kettles, each serviced by its own exhaust stack. One of the two stacks was selected for the stack testing of VOC emissions (Kettle #1). The kettle is used to cook at a rolling boil all the various ingredients used in the production of hot wort for all beer brands. The kettle cycle time from start to fill to start of knock out is approximately 195 minutes. The heating cycle time when VOC emissions are most likely to occur is approximately 90 to 100 minutes. The rest period prior to removal of the hot wort, the removal and filling portions of the cycle were not tested since minimal VOC emissions were expected during nonboiling periods.

Hot Wort Tank: The facility has two hot wort tanks in the brewhouse. Hot wort produced in the kettles is delivered to the hot wort tank for cooling prior to release to cold services for fermentation. The typical cooling cycle for the hot wort is approximately 100 minutes which does include the knock out of the kettle. The vent location for the hot wort tank is not conducive to collecting samples at Fulton. Therefore, the sampling strategy was to collect a headspace sample from the tank and develop an emission rate via mass balance.

Spent Grains Tank: There is one spent grain tank at the facility. The spent grain tank is supplied by the two P~~p~~ondorf~~s~~ pumps that serve the lauter tuns. The total VOC emissions from this source should be insignificant in that the spent grains have probably released their VOCs during the preceding processes. The materials are cooling at this point and this even further suggests that total VOC emissions should be insignificant.

However, during summer months Sometimes spent yeast NOT VERY OFTEN along with the spent grains are added to the spent grains tank. The spent yeast has the potential for producing ethanol once it is mixed with the grains that are in the spent grain tank. To address this concern, the intention was to test this source for ethanol emissions. However, full facility testing occurred in early November when the addition of spent yeast was not taking place. If conditions warrant, this source could be tested at a later date, or it may be possible to estimate a release rate based on other emissions data derived during brewhouse testing.

There are several other processes and storage activities that occur in the brewhouse area. The spent grains drying activity and storage silos have vents that have permits. The drying and storage of the spent grains was not taking place, and therefore, could not be tested during the full facility test.

2.3.3 Cold Services

The cold services area has a potential to release several air contaminants including ethanol, carbon dioxide, caustic and chlorine based compounds. Significant VOC emissions from this area were not initially expected, and therefore, VOC sampling was not performed. However, upon further review, tests at other facilities have indicated some production of VOCs. The cold services area includes processes that begin with fermentation and end with a final ~~trap~~ FILTER prior to the release of beer to the package release tanks. The equipment in this area undergoes frequent cleaning cycles when ethanol, along with other compounds, is released. The primary interest in the survey, however, is the ethanol emissions from each of the process steps which are identified in Table 2.5. Although not originally envisioned as part of the scope of work, testing for some of the other test plan target compound constituents was conducted along with the testing for ethanol.

Fermentation: The Fulton facility has a total of three (3) fermentation cellars that are used depending on the specific brands that are being produced. One of the primary atmospheric releases of ethanol and carbon dioxide occurs during the initial stages of fermenting. When wort and yeast are introduced to the fermenter, fermentation begins and continues to accelerate until a steady rate of fermentation is reached. During and after filling of a fermenter, all gases within the vessel are discharged to the atmosphere. This discharge occurs over the initial 21 hours of the process and for two (2) hours just prior to the CIP of the vessel. Miller has already quantified the amount of carbon dioxide that is released during this initial stage of fermenting. This data is included in the permits for the fermenters.

All fermenter exhaust gases are directed into a common duct, one in each of the three cellars. Cellar B was selected for source testing because Cellar B provides the most convenient means of assuring a single fermenter was being sampled during the off gassing stage. Cellar B was also chosen because it contains the fewest number of fermenters thereby further assuring testing of the emissions from a single fermenter. Fermenter (B-3) was selected for testing these emissions.

Ethanol emission samples were collected during the 21 hour off gassing process. The amount of carbon dioxide produced during this period was also measured for comparison to the rates provided in the permit applications filed with the NYSDEC.

TABLE 2.5

MILLER BREWING COMPANY
FULTON, NEW YORK

COLD SERVICES EMISSIONS TEST MATRIX

Process	Test Parameter(s)	Test Method(s)	Process Test Condition(s)	Test Site Description	Notes
Fermentation (Part 1)(Cellar "B")	Stack/Vent Flow Rate Carbon Dioxide Ethanol	Pressure Differential EPA Method 3 (w/bag) NIOSH 1400(w/bag)	Once tank is filled start test until CO2 quality causes transfer of emissions to utilities (run ~21 hrs)	Fermenter B-3 at connect to utilities	1 full cycle 8 samples w/MIRAN screen ORSAT analysis
Fermentation (Part 2) "CIP"	Stack/Vent Flow Rate Caustic Chlorine	Mass flux NIOSH 7401 and mass balance OSHA Method 101	60 minute cleaning cycle only (caustic swirl) 15 minute chlorine rinse cycle	Vent port atop Fermenter B-1	Run 3-15 min sodium hydroxide cassette filters Run 1-15 min chlorine mini impinger set
Heat Wheel (cold services building vent)	Vent Flow Rate Ethanol	Fan Curve Bag samples, screen with Miran 1B2 analyzer and sample via NIOSH 1400	Concurrent with fermentation tests	Roof Vent	Screen with MIRAN Collect 8-concurrent inlet vent samples to cold services
Centrifuge Surge Tank	Ethanol Mass Emission Rate	Mass Balance based on fermenter	--	--	Not tested
Spent Yeast Tank	Vent Flow Rate Carbon Dioxide Ethanol	Mass flux EPA Method 3(w/bag) NIOSH 1400(bag)	Test while filling spent yeast tank	Roof vent	Sample 3 times if available Perform ORSAT analysis
Primary Filter CO2 Purge	Vent Flow Rate Carbon Dioxide Ethanol	Mass flux	CIP only	Roof vent	Not tested

TABLE 2.5
(Continued)

MILLER BREWING COMPANY
FULTON, NEW YORK

COLD SERVICES EMISSIONS TEST MATRIX

Process	Test Parameter(s)	Test Method(s)	Process Test Condition(s)	Test Site Description	Notes
Holding Surge Tank	Ethanol mass emission rate	Mass balance based on fermenter	- -	- -	Not tested
Aging/Package Release	Ethanol Mass emission rate	Bag to MIRAN/Draeger Tube, NIOSH 1400	Continuous blanket over aging tanks	Package release vent to atmosphere	Pull bag sample from pressurize release
Final Filter Surge	Caustic Emissions	Mass balance based on fermentation CIP	- -	- -	Not tested
Trap Surge Tank	Caustic Emissions	Mass balance based on fermentation CIP	- -	- -	Not tested
Ceramic Filter Trap	Ethanol Emissions	Bag sample, and screen with MIRAN/Draeger and load charcoal trap	During venting, if possible	Roof vent #25	1 grab sample for ethanol
Fermenter Purge	Ethanol mass emission rate	Collect bag, screen w/ MIRAN/Draeger and load charcoal trap	Empty fermenter just prior to CIP	Fermenter B-1	1-20 min sample

The emission tests included the measurement of process gas exhaust flow rates to determine the volume of gas being released. Special adjustments to these flow measurements will be required to account for the density of the exhaust gases. Carbon dioxide and other diluent gas levels were measured using an ORSAT analysis to accurately estimate gas flows from this source.

The emission concentrations during the venting to the atmosphere, will be combined with the flow rate data and test period production data to provide the average and worst-case hourly release rates for the fermentation off gassing process. Production levels within each of the cellars as monitored by Miller will be used in calculating long term emission values.

The second portion of emission testing in fermentation was directed at developing emission factors for the cleaning in place (CIP) activities as shown in Table 2.5. CIP is performed on every fermenter after the 6-8 day old beer has been sent to a centrifuge surge tank. A single fermenter (B-1) was tested during a cleaning cycle. The cleaning cycle when pollutants are released to the atmosphere consists of a 2-hour air purge, 60-minute caustic wash cycle and a chlorine rinse. The sampling point for the caustic cycle was the access door to the top of the fermenter. The chlorine rinse cycle which lasts 15 minutes was also tested at the same location.

Heat Wheel Air Exchanger: The cold service areas within the plant is ventilated continuously by a heat wheel system. The system is designed to provide ventilation to the cold service area while at the same time conserving energy. The intake and exhaust for the heat wheel system are located on the roof above cold services. Because the cold services area has a variety of activities that occur at various times, it was necessary to collect a series of samples to define the potential range of emissions from the cold services area over a 24 hour period.

Centrifuge Surge Tank: The cold services area contains two centrifuge surge tanks that are feeding two centrifuges. The surge tanks vent to the roof above cold services. The expected ethanol release is expected to be minimal since, during any fermenter emptying, the maximum volume of gas released would be the volume of the surge tank. The concentration level of the exhaust was calculated on the basis of vapor pressure and temperature.

The caustic and chlorine emission rates from this process during CIP, which occurs once every three weeks, were estimated from the CIP at the fermenter and scaled to the tankage and annual CIP schedules as provided by Miller.

The centrifuges are also vented when excessive back pressure occurs. This buildup in pressure can cause a bypass where beer is exhausted through the vent stack, however, this is a nonroutine operation.

Spent Yeast Tank: Spent yeast produced during fermentation and removed from the beer prior to aging by the centrifuges is directed to one of two spent yeast tanks. Since the yeast is cool but still active, ethanol emissions could result from the spent yeast tank prior to disposal of the yeast. The tank vent is on the roof above cold services. The duration of the sampling was dependent on the filling cycle. The total mass flow was based on the filling and emptying cycle frequency of the tanks based on data supplied by Miller.

Primary Filter Surge Tanks: There are four types of surge tanks that have not been discussed to this point. These include surge tanks that service the primary filters, the holding tanks before aging, the final filters and the Trap station ~~final~~ traps prior to the package release tanks. It is our understanding that the surge tanks vent to the atmosphere, however, that venting rate is only significant during the initial filling of the tank after a CIP. This means that the overall ethanol release rate should be minimal.

The CIP process for these tanks is performed once every three weeks for all except the genuine draft tanks where CIP is performed once per week for the tanks after aging has occurred. These sources were not tested for ethanol releases, however, emission estimates were made based on other available data. For other emissions during the CIP process, the emission rates were scaled from data on the CIP of a fermenter.

Primary and Final Filtration: Several filtration steps occur after the beer leaves filtration and prior to package release. These steps discharge ethanol intermittently when pressures in the systems are relieved to allow a filter cleaning cycle. The data on the amount of pressure and the size of the discharge during such cleaning cycles was used to estimate the ethanol release via a mass balance method based on concentrations of ethanol achieved in the fermentation process. Annual rates were projected by including the average number of cleaning cycles per year or per unit of beer brewed.

As part of the primary filter, diatomaceous earth (DE) is used to filter out the impurities in the beer. There are three spent DE tanks that vent to the cold services roof. One could expect a very minor amount of ethanol to be emitted from these sources.

Aging: The Fulton facility contains four aging cellars. Three cellars contain vertical aging tanks with capacities ranging from 2000 to 5850 bbls. and a fourth cellar which contains horizontal tanks with capacities of 1850 bbls. each. The aging process is performed under a blanket of purified carbon dioxide that is generated by utilities. The tanks all have a common carbon dioxide source and are normally sealed unless the blanket pressure exceeds a specified limit. When the limit is exceeded, carbon dioxide is released to the atmosphere via release vents. The measurement of this release is, at best, difficult since its occurrence is infrequent and not monitored.

Package Release: The Fulton facility has a total of 32 package release tanks, four of which are exclusively for genuine draft beer. Ethanol emissions from the package release tanks can occur when the pressure is relieved over the package release tanks as newly produced beer is added to the tanks. Samples were taken from the package release line simulating an atmospheric release.

Ceramic Filtration Systems: The ceramic filtration system is specifically designed to handle genuine draft beer as a final filtration step before packaging. A grab sample from the ceramic filtration vent was taken and analyzed for ethanol concentration.

2.3.4 Utilities

At the Fulton facility, the utilities area provides support to other process operations. The primary services include cooling fluids and purification of carbon dioxide. The primary pollutants of interest for the test plan are ethanol, carbon dioxide, chlorine and ammonia. The inventory focused efforts on seven (7) potential emission points from processes within utilities as provided in Table 2.6. Each of these will be discussed in the following subsections.

Foam Trap Vent: Utilities provides purified carbon dioxide to various processes at the facility. Utilities obtains carbon dioxide primarily from the fermenters. During the 6 to 8 days of fermentation, the fermenter off gasses containing carbon dioxide and ethanol are captured and sent to utilities for

TABLE 2.6

MILLER BREWING COMPANY
FULTON, NEW YORK

UTILITIES EMISSIONS TEST MATRIX

Process	Test Parameter(s)	Test Method(s)	Process Test Condition(s)	Test Site Description	Notes
Foam Trap Vent	Carbon Dioxide Ethanol	EPA Method 1,2,3 NIOSH 1400			Not tested no release to atmosphere
Carbon Bed Vent	Stack/Vent Flow Rate Ethanol	EPA Method 1,2,3 NIOSH 1400	Normal 36-Hour Regeneration	Hot (260°F) and moist	Measure at several points in regen cycle to get full ramp up in temperature
Drier	Ethanol Emissions	NIOSH 1400	During 8-hour regeneration cycle	Inside Utilities vents to room	Not tested
Utilities Exhaust Vent	Stack/Vent Flow Rate Ethanol	Fan curve NIOSH 1400	Normal Venting	Roof of Utilities	2 samples from different active roof vents
Cooling Tower	Chlorine	OSHA 101 Impinger/Mass balance	Normal Operations	Between cooling towers on utilities roof.	
Fugitive Ammonia	Ammonia	NIOSH 5347 Modified NIOSH 205	Normal Operations	Center of cooling towers	
CO2 Storage Tanks	Ethanol	NIOSH 1400	Stored CO2	Sampling valve at each tank	

purification. The off gasses are first directed to a foam trap which removes the liquids and suspended solids. These are two foam traps, one to service Cellars A and B, and one for Cellar C. The foam traps only vent to the atmosphere in emergency conditions when pressure exceeds specified levels. During the release, only a minor amount of carbon dioxide and ethanol are released to the atmosphere. Therefore, this source has not been included in the inventory.

Carbon Bed Vent: Upon leaving the foam trap, the fermenter off gases are directed to a sealed carbon based scrubbing unit to remove impurities in the gas. Scrubbing of the off gases with water sprays is performed first which removes ethanol in the gas stream. The gas stream is then directed to a carbon bed to remove remaining impurities. Ethanol is collected on the carbon bed and released to the atmosphere when the bed is regenerated. The ethanol testing of the carbon bed vent occurred during the regeneration cycle. The cycle time on the carbon bed regeneration is 36 hours.

Drier: The purified carbon dioxide is directed from the carbon beds to driers to remove any remaining moisture. There are four alum driers at the Fulton facility. These vent to the room air within the utilities area. The emission of ethanol from the utilities area was measured by sampling the exhaust vents above the utilities area.

Alumina

Utilities Exhaust Vents: There are nine exhaust vents that are located above the utilities area. These are active vents that serve to remove pollutants generated within the utilities area to the free atmosphere. The expected pollutants include ethanol and ammonia along with carbon dioxide.

Cooling Towers: Utilities maintains a series of cooling towers atop the roof of the utilities area. Chlorine is used to prevent biological growth and fouling of the towers. To estimate the total free chlorine release to the atmosphere, samples were taken in the area of the cooling towers to determine chlorine release under normal conditions. These data were compiled with a mass balance approach based on annual chlorine consumption rates and ratios for released chlorine to determine annual release rates.

Ammonia: Ammonia is used extensively in the cooling systems that are contained within the utility services area. The discharge of ammonia from various flanges and processes is common place. To estimate the amount of ammonia lost to the free atmosphere, samples were taken. These data, and data from other facilities and a mass balance approach were used to quantify annual release rates as fugitives.

Carbon Dioxide Storage Tanks: Carbon dioxide is extensively utilized throughout the Fulton facilities. After purification by utilities, carbon dioxide is stored in a series of storage tanks. These tanks were targeted for sampling as part of the overall testing program.

2.3.5 Packaging and Warehouse Facility Emissions

The package and warehouse facility receives products from cold services after final filtration within the package release facility. Also, returned (used) bottles and kegs are delivered to two bottle washers and single keg wash line from the empty glass warehouse. The bottle and keg wash systems clean and sterilize the bottles and kegs prior to filling with products delivered from the package release facility. Cans, bottles and kegs are filled at individually designated packaging stations. Kegs are filled at the keg-o-matic line, unpasteurized (draft) beer bottle and can packaging is performed at the two unpasteurized beer packaging lines and the remaining pasteurized product is packaged at the nine available pasteurized beer packaging lines. Finished packaged product is then sent to the warehouse for shipping. Reject (partially filled or damaged) bottles and cans are sent to the beer dump process where their contents are removed by the beer crusher, and broken glass and crushed cans are routed to separate recycling bins.

Major processes identified for testing and/or mass balance analysis in the packaging and warehouse facility include: pasteurized beer packaging lines, nonpasteurized beer packaging lines, beer dump, bottle wash, keg wash and packaging/warehouse fugitive emissions. The primary pollutants of concern in this area are the ethanol, chlorine, sodium hydroxide, ammonia and formaldehyde emissions. These were characterized for the packaging and warehouse facility according to the following sampling and/or mass balance procedures.

The sources that were tested as part of the sampling program are identified in Table 2.7. Each of these will be addressed in the following.

Pasteurized Beer Packaging Lines: The Fulton facility currently has nine operating pasteurized beer packaging lines. The ethanol releases from these lines are ventilated to atmosphere by several building exhaust fans located at roof level above the filling and pasteurization stations. These exhaust fans also vent any fugitive emissions released within the packaging area.

TABLE 2.7

MILLER BREWING COMPANY
FULTON, NEW YORK

PACKAGING AND WAREHOUSE EMISSIONS TEST MATRIX

Process	Test Parameter(s)	Test Method(s)	Process Test Condition(s)	Test Site Description	Notes
Pasturized beer packaging lines	Vent Flow Rate Ethanol	Fan curve NIOSH 1400	Normal Operations	Roof vents	Record production occurring during tests
Non-pasterized beer packaging lines(2)	Vent Flow Rate Ethanol Chlorine	EPA Method 1,2 and 4 NIOSH 1400 Mass balance/Impinger	Normal Operating Conditions	Roof vent	Record production occurring during tests
Beer Dump	Vent Flow Rate Ethanol	EPA Methods 1,2 and 4 or fan curve NIOSH 1400	Normal Operations	Single roof vent	Record activity
Bottle Wash Vent	Vent Flow Rate Sodium Hydroxide	EPA Methods 1,2 &4 EPA Modified Method 5/ back half NIOSH 7401	Normal Operations	One roof vent - high humidity	3-1 hour tests
Keg Wash Vent	Vent Flow Rate Sodium Hydroxide	EPA Method 1,2 & 4 EPA Method 5/back half NIOSH 7401	Normal Operations	One roof vent - high humidity	3-1-hour tests
Packaging and Warehouse Building Fugitives	Building exhaust rate Ethanol Formaldehyde	Fan curves NIOSH 1400 EPA TO11	Normal Operations	Various internal & exhaust vent locations	

During the site survey on September 17, 1993, real-time ethanol emission rates were measured using a portable analyzer. Fairly consistent building exhaust ethanol concentrations were observed in the fan exhausts directly above the packaging lines as discussed in Section 2.2. All lines were not operating and those that were operational were at varying production rates. Ethanol at elevated levels was observed over the fully operational packaging lines.

Chlorine emissions from the pasteurizing units and cooling tower were determined by measurements and mass balance methodology. Annual chlorine usage for these units was provided by Miller staff.

Nonpasteurized Beer Packaging Lines: There are a total of two currently operating draft beer packaging lines at the Fulton facility. The bottle filling portion of the line is contained within an enclosed room. The nonpasteurized (draft) beer packaging lines were characterized for ethanol and chlorine emissions. One of the two bottle filling room exhausts for ethanol emissions was tested during normal production conditions. At this specific draft beer packaging line, the ethanol emission factor was combined with total annual draft beer production (supplied by Miller) for the two nonpasteurized beer bottling lines in determining the total annual, actual and potential emissions for the bottle filling portion of these lines.

Chlorine emissions are also released during the packaging of draft beer. Chlorine is applied within the clean room to assure sterile conditions within the bottle filling area. The chlorine release rates for the two nonpasteurized beer bottle filling activities were determined by mass balance. Annual chlorine usage for the two filling stations were provided by Miller staff. These data were combined with onsite measurements to provide annual release rates.

Beer Dump: The beer dump process is located in the beer dump room. This area was characterized for ethanol emissions only, since emissions of other pollutants are expected to be insignificant. Tests were performed at the single roof vent servicing the beer dump room. The loading bay door adjacent to the beer dump room was closed during the test in order to maximize the capture of process fugitives, the primary source of ethanol emissions in this area. Miller staff provided beer dump reject product process data. The emission factor and annual processing rates at the beer dump were combined in order to estimate annual emissions for the beer dump area.

Bottle Wash: The bottle wash process consists of a high concentration caustic wash, low concentration caustic rinse, followed by a final water rinse. All three cleaning phases are contained within the bottle wash unit enclosure. The head space atop each wash/rinse compartment is ventilated to a common stack located above the high concentration caustic wash area. There are a total of two bottle wash lines. Each bottle wash line has a 44,000 bottle capacity.

The bottle wash process is undoubtedly one of the most difficult units to test for sodium hydroxide at the entire Miller facility due to process characteristics and analytical limitations. The approach used in testing for sodium hydroxide included wet impingement sampling followed by hydroxide ion analysis. The test data was used to estimate sodium hydroxide releases from the two bottle lines. These data were combined with the operational data provided by Miller to estimate annual sodium hydroxide emissions from each bottle washing operation.

Keg Wash: The keg washing process at the Fulton facility is located near the center of the packaging and warehouse area. The facility has one keg washing line which is serviced by one exhaust vent. Unlike the bottle wash process, a significant sodium contribution is not anticipated from the kegs since glass is not washed on this line, unless introduced from recycled caustic. Miller provided process data during each test and annual production information for the keg wash line. The annual keg wash sodium hydroxide emissions were estimated using observed emission data under recorded process conditions and applying the resultant emission factor to the annual keg wash production.

Packaging and Warehouse Building Fugitives: Packaging and warehouse building ethanol fugitive emissions were monitored. The observed ethanol concentrations were used to estimate fugitive building exhaust rates (nonpoint source exhaust) while accounting for production conditions during the tests and adjusting the above to annual production (excluding nonpasteurized production). Formaldehyde emissions were anticipated because they were included in earlier inventory test programs prepared for other Miller facilities. Tests for formaldehyde were conducted at a primary warehouse vent.

2.3.6 Annex/Empty Glass Warehouse Emissions

The annex/empty glass warehouse contains return bottles and it is located in a separate building at the Fulton facility. The test program was designed to characterize ethanol emissions as shown in Table 2.8.

TABLE 2.8

MILLER BREWING COMPANY
FULTON, NEW YORK

ANNEX/EMPTY GLASS WAREHOUSE EMISSIONS TEST MATRIX

Process	Test Parameter(s)	Test Method(s)	Process Test Condition(s)	Test Site Description	Notes
Annex Ventilation	Flow rates for three building vents	Fan curve	Normal activities (note test conditions versus average conditions)	Representative Internal sampling locations	
	Ethanol	NIOSH 1400			

Testing was performed under normal operating conditions while the depalletizer lines are operating, with all exterior doors closed. Attempts were made to sample two of the three roof vents including one over the depalletizer lines and one at the far end of building. The fans were not operational and therefore, ethanol samples were taken inside the annex.

2.3.7 Wastewater Treatment Plant Emissions

The wastewater produced at the Fulton facility is directed to the facility's wastewater treatment plant. Treatment consists of primary and secondary treatment and further settling prior to release from the plant.

The wastewater treatment plant's ethanol emissions were determined by evaluating ambient air concentrations in the vicinity of the wastewater treatment plant as shown in Table 2.9. Ethanol levels at fixed upwind (background) and downwind (wastewater treatment plant emission impacts) sampling locations were monitored along with onsite meteorology. Onsite meteorological data was recorded in 15-minute and 1-hour averages concurrent with the ethanol testing. Miller records on wastewater treatment plant operations during these sampling events and production plant operations were obtained.

The wastewater treatment plant's ethanol emissions were calculated by inputting the difference between the observed upwind and downwind monitoring site ethanol concentrations, distance to the emissions source and meteorological conditions into a computer dispersion model. The model's output file contained the plant's ethanol emissions at the source, in grams per second per square meter, under the observed ethanol concentrations and meteorological conditions. Physical characteristics of the facility were used to convert the grams per second per square meter emission rate to a grams per second value. The worst-case hourly ethanol emission (mass/hour) and mean annual ethanol emissions values (mass/year) were computed for this area.

2.4 Sampling Test Plan

The development of the sampling or emissions test plan was based on the pretest survey and discussions with Miller staff on which processes, sources and pollutants were to be included in the emissions inventory report. A test matrix for each plant area was developed, reviewed by Miller staff and finalized. The specific processes in each area tested are also provided in Tables 2.4 through 2.9.

TABLE 2.9

MILLER BREWING COMPANY
FULTON, NEW YORK

WASTEWATER TREATMENT PLANT EMISSIONS TEST MATRIX

Process	Test Parameter(s)	Test Method(s)	Process Test Condition(s)	Test Site Description	Notes
Wastewater Treatment Plant	Ethanol	NIOSH 1400	Normal Operating Conditions	Upwind and downwind ambient air test sites	
	Meteorological data	Portable Meteorological Monitoring Tower	Low to moderate wind speed steady wind direction		

In the hot side of the brewhouse, six separate processes were selected for testing as shown on Table 2.4 and Figure 2.1. All samples were taken from the roof stacks or vents. These included the cereal cooker, mash tun, lauter tun, kettle, hot wort tank and spent grains tank. A single representative stack or tank was selected for five of the processes and three separate samples were collected for VOC analysis. For the spent grains tank, an ethanol test was to be performed, if tank emissions were present. The spent grains tank was not receiving any spent yeast during the test period, and therefore, ethanol would not be produced. The spent yeast is only occassionally added to the spent grain and the spent grain is sold wet. VOC emissions from the spent yeast tank were assumed to be insignificant since the tank receives grains that have already been cooked. These materials are cooling in the tank thereby, further reducing the potential for VOCs to be released. Samples for the brewhouse area were collected from the west brewhouse sources only. The sample times and methods used are provided in Table 2.4.

The cold services area has a variety of processes that were tested. The cold services roof has in excess of 57 individual release points that vent these processes. Table 2.5 and Figure 2.2 identify the sources within cold services that were tested for ethanol emissions. Several samples were also collected for other areas within cold services. Other sources were expected to have minor to insignificant release of ethanol, and therefore, were not tested. The sources of primary interest were the fermenters, the heat wheel and package release activities.

Once a fermenter has been filled, the gases produced during the initial portion of the fermenting process are vented to the atmosphere as the yeast becomes fully active. After approximately 21 hours, the fermenter gases are directed to utilities for carbon dioxide recovery. The release of ethanol during the first 21 hours has not been accurately quantified before, therefore, this process was selected for sampling. A total of eight (8) samples were collected for ethanol from the B-3 fermenter. The heat wheel provides the air exchange mechanism for the cold services area. A substantial amount of air is exchanged which contains significant concentrations of ethanol. Concentrations vary depending on activities within the cold services area, therefore, a complete 24-hour sampling strategy was established to evaluate actual emissions. A total of eight (8) samples were collected from both the intake and exhaust of the heat wheel over the 24-hour period. The package release and aging areas are provided with carbon dioxide to prevent air contact with newly brewed beer. There are periodic releases of the carbon dioxide which contains ethanol, therefore, these processes add to the air concentrations within cold services. A series of additional sources as listed in Table 2.5 were also targeted for testing to provide a more complete

FIGURE 2.1

MILLER BREWING COMPANY
FULTON, NEW YORK

BREWHOUSE (HOTSIDE)
Vent Source Testing Locations

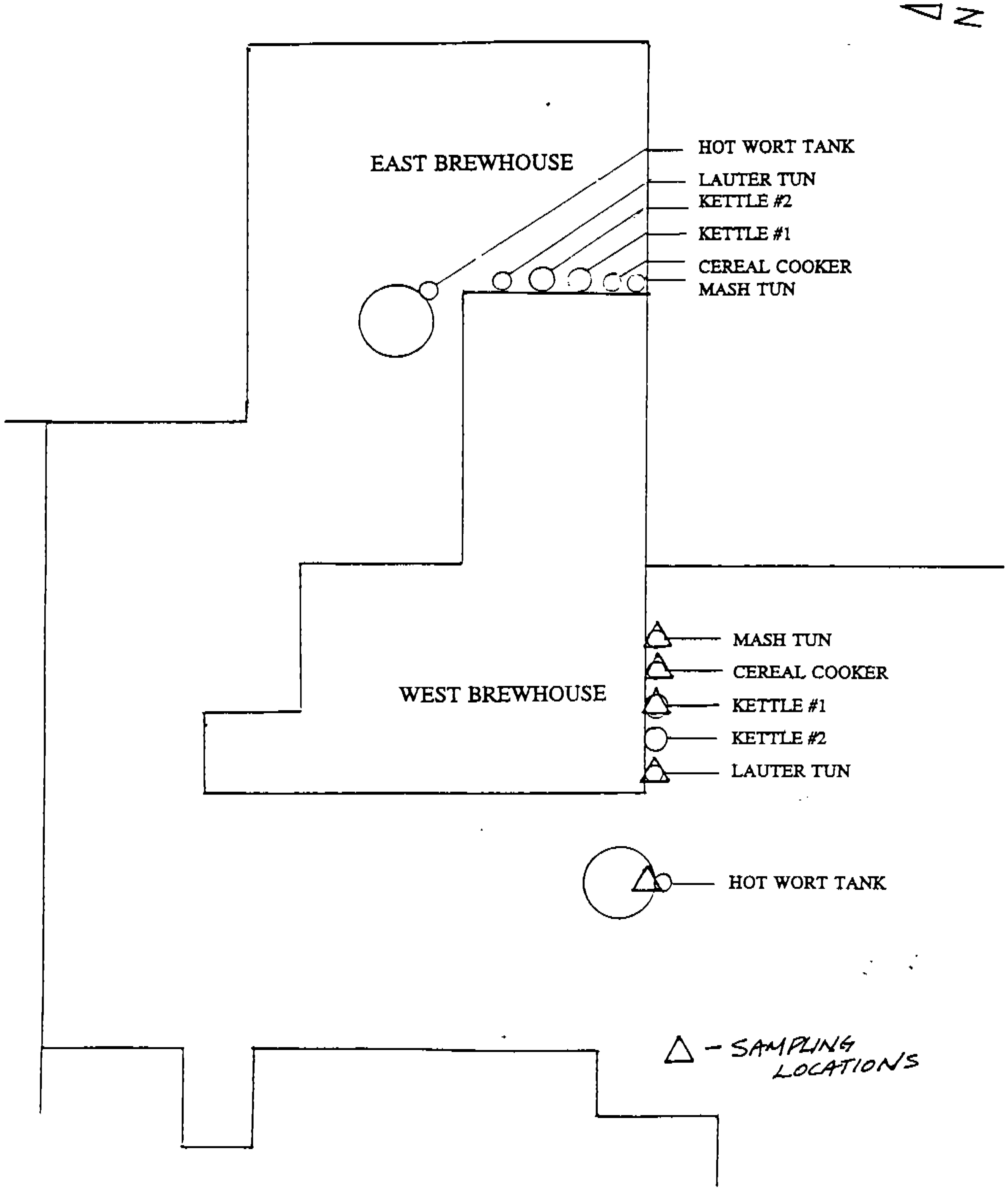
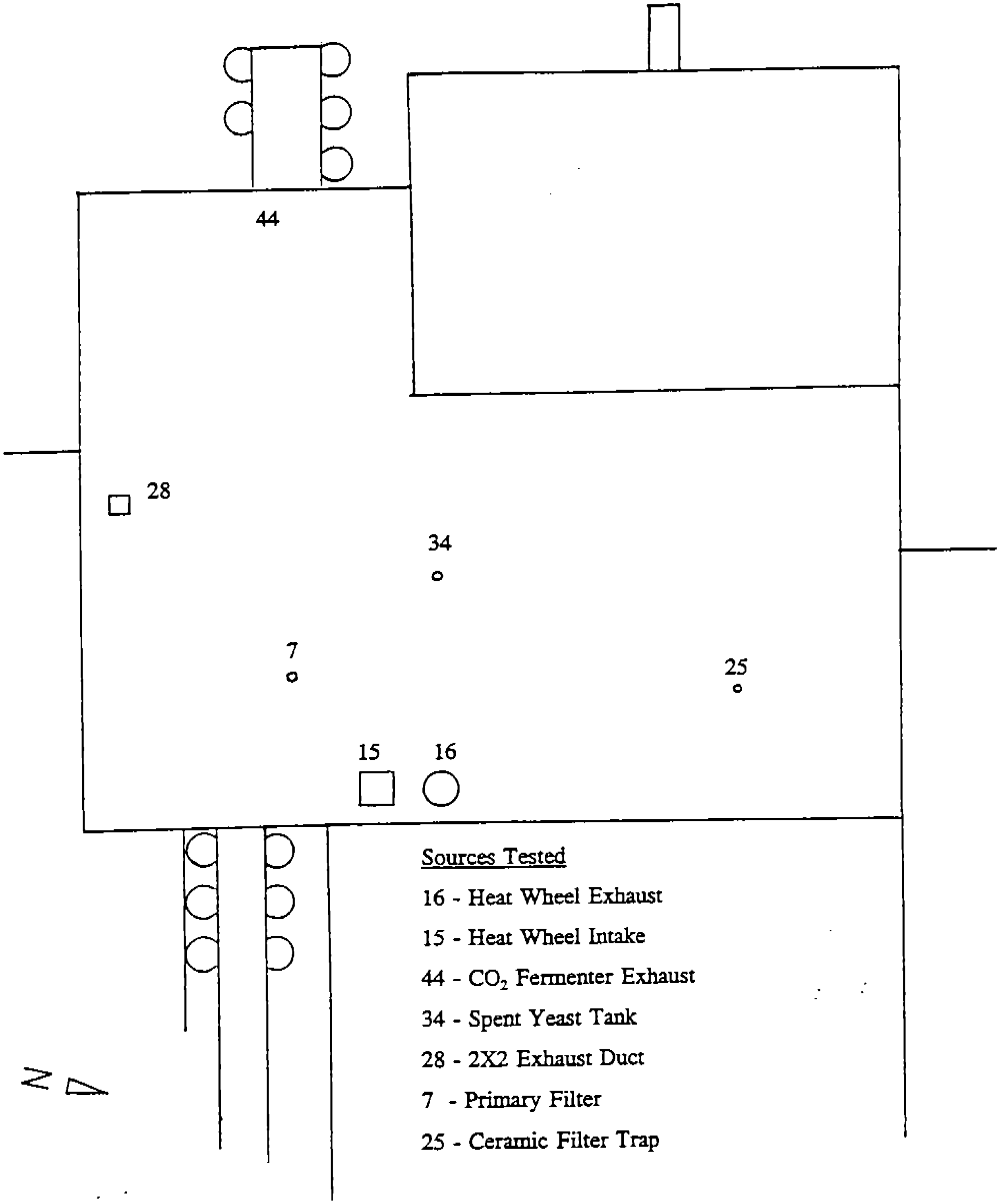


FIGURE 2.2

MILLER BREWING COMPANY
FULTON, NEW YORK

COLD SERVICES, FERMENTATION AGING AREAS AND PACKAGE RELEASE VENT SOURCE TESTING LOCATIONS



Sources Tested

16 - Heat Wheel Exhaust

15 - Heat Wheel Intake

44 - CO_2 Fermenter Exhaust

34 - Spent Yeast Tank

28 - 2X2 Exhaust Duct

7 - Primary Filter

25 - Ceramic Filter Trap

survey for ethanol emissions from the cold services area. In addition, air pollutant emissions from cleaning in place (CIP) activities were also tested in this area.

Table 2.6 and Figure 2.3 provide the processes within utilities that were identified as having potentially significant releases of ethanol, ammonia and/or chlorine. All samples taken from the roof or from storage tank lines. The carbon bed filtration system, during regeneration, releases the gases collected during carbon dioxide purification processes. The sampling plan provided for testing the ethanol releases from this source during regeneration. In addition, the sampling plan investigated the ethanol release from the exhaust vents within the utilities area and the ethanol contained in the stored carbon dioxide. The foam trap vent was not tested since venting only occurs under upset conditions which are infrequent events. The drier exhaust was not tested since the emission is directed into the utilities area and not directly released to the atmosphere. Utilities also uses ammonia and chlorine, some of which is released to the atmosphere. The sampling plan provided a means of defining the atmospheric release from these processes. The sampling times for utility sources are provided in Table 2.6.

Packaging and warehouse areas within the plant were also included in the sampling plan. The specific processes investigated are listed in Table 2.7 and illustrated in Figure 2.4. Samples were taken primarily from the roof although numerous samples were taken indoors as well. The primary ethanol release points as determined by the pretest survey were the exhaust fans directly above the filling stations on the individual packaging lines. Pasteurized and nonpasteurized lines were sampled separately. The other areas for ethanol release included the beer dump activity and fugitive emissions from the packaging and warehouse areas. Separate tasks were established for monitoring sodium hydroxide, chlorine and formaldehyde emissions from these areas as well. Table 2.8 contains the test matrix for the annex/empty glass warehouse which was added to the inventory based on the pretest survey. The specific sampling times and methods used in the test program are also provided in the Table 2.7 and 2.8.

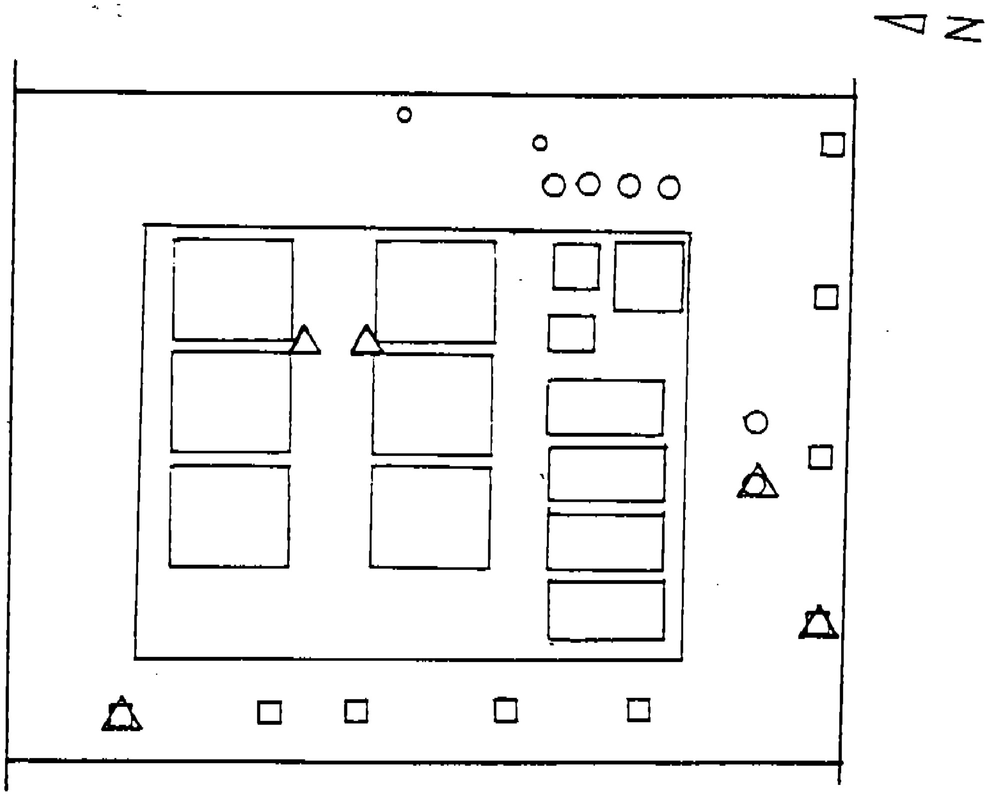
The wastewater treatment plant test matrix is provided in Table 2.9 and sampling points are identified in Figure 2.5. All samples were taken in the free atmosphere. Emissions of ethanol from the wastewater treatment plant were suspected based on the pretest survey that indicated significant concentrations in certain areas. An ambient monitoring program based on concentration gradients was designed to determine the ethanol release rate from the various processes within the wastewater treatment area.

FIGURE 2.3

MILLER BREWING COMPANY
FULTON, NEW YORK

UTILITIES ROOF AREA

Vent Source Testing Locations

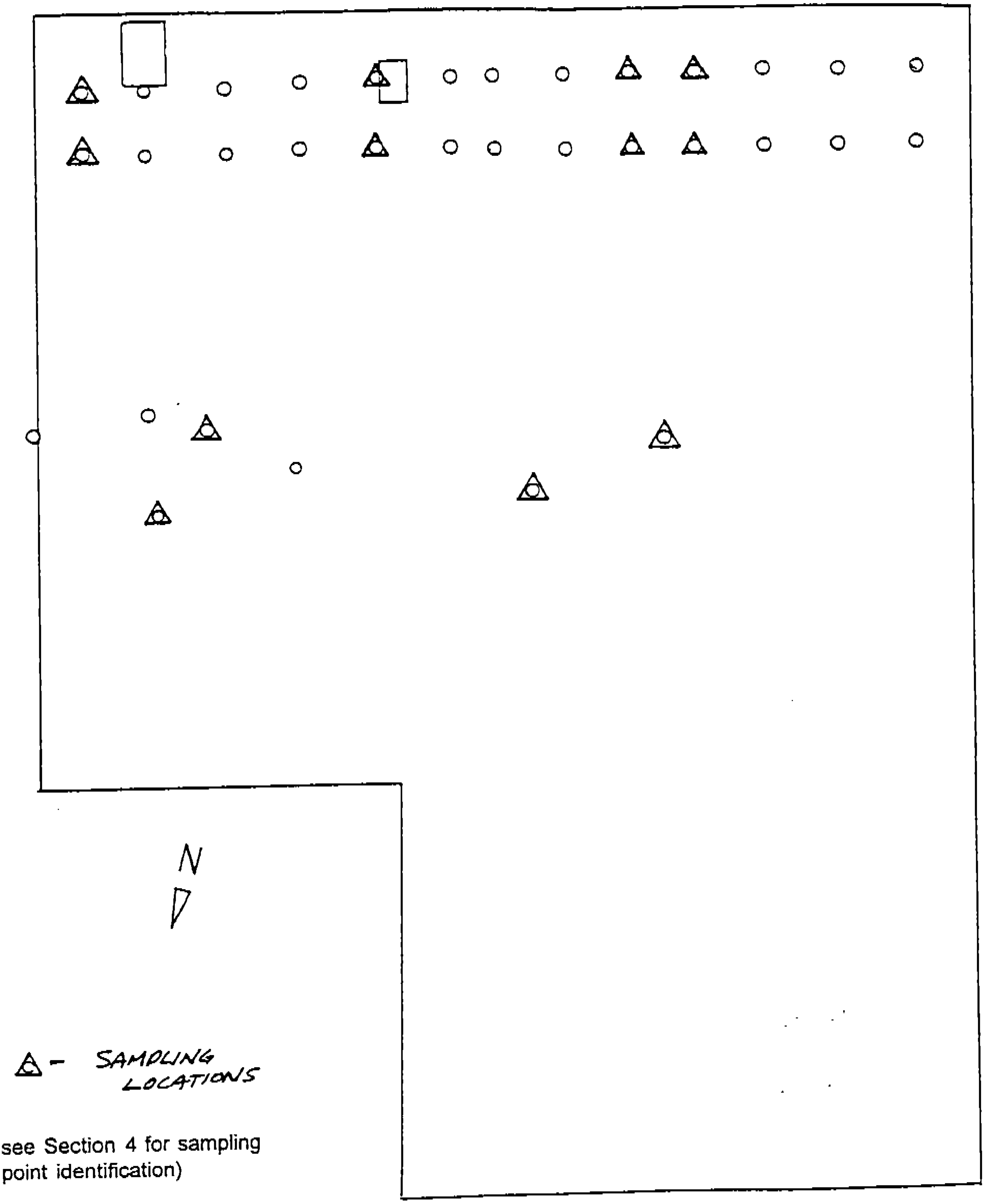


△ - SAMPLING LOCATIONS

FIGURE 2.4

MILLER BREWING COMPANY
FULTON, NEW YORK

PACKAGING & WAREHOUSE AREA
Vent Source Testing Locations

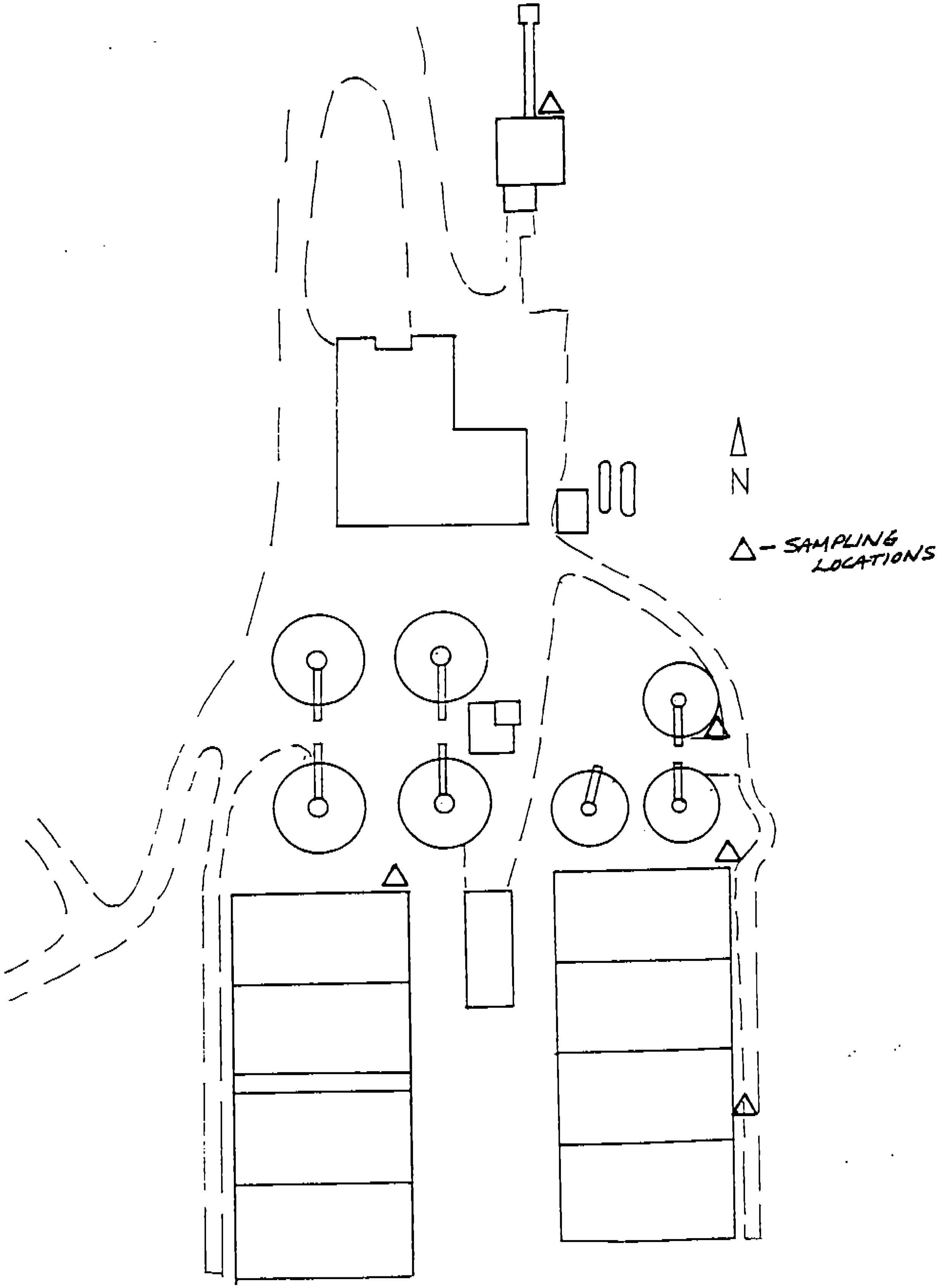


(see Section 4 for sampling point identification)

FIGURE 2.5

MILLER BREWING COMPANY
FULTON, NEW YORK

WASTEWATER TREATMENT PLANT AREA



The emissions test plan as conducted is presented in Appendix A. The test plan provides the day to activities during the full scale field effort. Modification to the original sampling plan were made to accommodate on site conditions and operations. Weather conditions prevented completing all originally scheduled tests during the first day of testing. Therefore, all remaining daily activities schedules were modified to accommodate weather conditions and facility operations. In summary, the sampling activities that were scheduled were completed during some portion of the sampling program period which began on October 31, 1993 and concluded on November 5, 1993.

Appendix B provides the test protocols and analytical methods applied during the survey. Appendix C provides the individual field data sheets for all samples taken during the test effort. Once the field/source samples were collected, they were forwarded to the analytical laboratory and the chain of custody forms are provided in Appendix D. The analytical results are summarized in Appendix E and the meteorological data collected over the entire field effort are provided in Appendix G.

3.0 SAMPLING AND ANALYTICAL METHODS

3.1 Discussion of Sampling Methods

The test program was designed to investigate the emission of total volatile organic compounds, ethanol, sodium hydroxide, ammonia, chlorine and formaldehyde from a variety of sources at the Fulton facility. This section briefly discusses the specific sampling and analytical methods applied in developing the emission inventory.

The sampling plan divided the facility into several sections which correspond to specific plant areas. The sections include the brewhouse, cold services, utilities, packaging and warehouse, annex/empty glassware warehouse and the waste water treatment plant. A summary of the specific processes to be tested in each section of the facility was provided in Section 2.4. Tables 2.4 through 2.9 provided the test parameters, test methods, process conditions during the test, a description of the test site and notes relating to the tests to be performed. These tables were used during the test effort to assure that all critical parameters for determining release rates were measured. They also provide the process duration to schedule specific tests for several processes. Many processes only operate a portion of the available time. Knowing when a specific process was operating and when a potential release would occur was therefore, critical to providing an accurate estimate of facility emissions.

The compound specific test methods as identified in Tables 2.4 through 2.9 are provided in Appendix B. The specific sampling protocol for each source and constituent is provided.

Flow Measurements

In general, flows from stacks were measured using EPA Methods 1 and 2. In some cases, for example the hot wort tank, flows were calculated by using displaced volumes in the tank. Method 1 provides the procedures for selecting sampling points for exhaust stacks. Method 2 provides the procedures for taking velocity measurements with an S-type pitot tube. Where appropriate, these two methods were used to determine flow volumes. Temperature and moisture levels were measured simultaneously with the velocity measurements to adjust the flow rate for dry standard conditions. Barometric pressures were also recorded during the flow measurements to adjust flows for normalized atmospheric pressure conditions. EPA Method 3 was also applied in cases where diluent gas concentrations were required. Method 3 provides the procedures for evaluating diluent gas constituents.

Where moisture levels in the stack exhausts were significant, EPA Method 4 and/or wet/dry bulb determination was applied. EPA Method 5 sampling trains were applied where isokinetic conditions for sample collection were required. All EPA Methods are provided in 40 CFR Part 60, Appendix A.

Source Sampling

Source sampling activities involved a series of tasks from mobilization, equipment calibration, process review, selection of sampling locations, individual test runs and concurrent source information, sample management, quality assurance and control, laboratory analyzes and intermediate analyses, laboratory data reporting and review and finally, data analysis. A variety of techniques were used to collect or extract source samples during the test program. The specific sampling trains for each compound selected for monitoring are presented in Appendix B along with the specific sampling protocol to be followed in collecting a sample. The compound specific methods provide detailed information on the sampling media to be used, the recommended collection procedure, recommended sampling rate, analytical procedure and method detection limits. The compound specific methods applied in sampling for ethanol, volatile organic compounds, chlorine, ammonia, sodium hydroxide and formaldehyde are summarized in Appendix B.

Sample collection rates were measured via calibrated rotameters. Individual sample volumes were determined by approximating the concentrations of constituents prior to sample collection when samples were collected directly onto the sampling media. In cases where concentrations were unknown or high concentrations were expected, bag samples were collected for ethanol screening via a MIRAN 1B2 analyzer or Draeger detector tubes. Sample volumes were selected that would contain between 0.004 milligrams and 10 milligrams of ethanol per sample. Loading ranges were established for the other constituents of interest based on expected concentration ranges within the exhaust gas streams being sampled. Each sample volume was corrected to source conditions (temperature, pressure, % H_2O) for use with the applicable source volumetric flow rate in actual cubic feet per minute (acfm).

Real-Time Sample Analysis

In addition to source specific test methods other analyzers were used to determine ethanol concentrations for onsite analysis. The primary tool was a MIRAN 1B2 analyzer which was used to quantify ethanol concentrations during the preliminary site visit and during the full field test. A description of the analyzer is provided in Appendix B. The principal used of the MIRAN was to quantify the approximate level of ethanol within certain gas exhaust streams, so that, carbon traps could be loaded to the appropriate level for laboratory analysis. In these cases, bag samples were taken as specified sources for specific time periods. These were first run on the MIRAN to determine the relative concentration in the sample. The concentration then was used to determine the appropriate range for loading the charcoal tubes for laboratory analysis. If concentrations within the bag sample exceeded several hundred part per million (ppm) a second method (Draeger detector tubes), was used to quantify the concentration within the sample. The operating range of the MIRAN 1B2 analyzer is quoted as 0 to 1000 ppm. The Draeger tube effective detection range is from 100 ppm to 10,000 ppm.

The carbon dioxide level associated with several sources was well outside the normal range for standard source tests. To account for these very high carbon dioxide levels, ORSAT analysis were performed onsite.

3.2 Analytical Methods

The laboratory analytical methods used in evaluating the various compounds sampled during testing at the Fulton facility are presented in Appendix B. Extensive discussions were held with analytical laboratory staff to assure that collection and analysis methods were appropriate for the compounds and concentrations encountered.

Analytical Laboratories

The samples after collection onto various media were forwarded to Environmental Health Laboratories (EHL) for analysis. In all seven different analytical procedures were used in evaluating sample concentrations. The sample labeling sequence allowed for convenient designation of where specific samples were taken and which compound was being tested.

The specific procedure for handling the samples are presented in Appendix B. The sample chain of custody records were developed for each sample including the sample handling procedures from preweighing and test sampling media through final sample analysis.

3.3 Quality Assurance and Control Methods

Standard quality assurance and control procedures were followed in all aspects of the test effort for the emissions survey. The primary objectives of quality assurance and control were met by developing a detailed work plan, assuring personnel were well trained and utilization of equipment and methods that provided reliable data.

The first step in the QA plan was to perform the initial site visit and pretest survey. These were completed to develop the final scope of work and to provide initial data to allow the utilization of equipment and methods that would result in an accurate emissions estimate. Because of the variety of chemical compounds in use and the variety of sources at the facility, the program test plan had to be limited to acquire a data base to reasonably provide an emission inventory. The final scope of work intentionally reduced the number of samples, sources and pollutants of interest. The sources that were not tested would be estimated, where possible, from the data collected during the pretest and site tests that were performed.

Instrumentation calibration and periodic accuracy checks are critical to assuring accuracy of the data collected. Sampling pumps were checked before and after each sampling period. Rotameters for determining flows were checked using precision flow measuring units referenced to NBS. The onsite analyzer had internal and external precision checks performed on a regular basis. The meteorological station was calibrated prior to field installation. Flow measurement equipment was checked prior to field application using internal and external standards. The Method 5 trains underwent prior calibrations as well as onsite checks and post calibration checks.

The types and condition of the sampling media and glassware used during the test effort are also critical to assuring accurate data is obtained during the field program. The primary focus of sampling media was to pretest the tubes used in the field program. All sampling lines for sample collection were replaced for each test. Handling of all glassware and sample media was performed with clean gloves to avoid contamination of the trap or other collection media or devices. The glassware used in various sampling trains, where appropriate, was cleaned and triple rinsed prior to use. All chemical reagents or fixing agents used were certified to specified purity standards.

Field sampling included the collection of trip and field blanks as well as triplicate samples for precision checks at most sources. In special cases, inlet and outlet samples as well as ambient and background samples were collected to prevent double counting of emissions and to establish actual background values or zero points, where appropriate.

The analytical laboratory, Environmental Health Laboratory (EHL), used exclusively for evaluating samples has their own internal and external quality assurance and control procedures which were applied in this case.

In summary, high quality assurance and control goals were set for all field efforts and the pre/post sampling activities. Data points were check and rechecked against known standards and previously collected data to, where possible, verify the data presented herein.

4.0 EMISSION QUANTIFICATION METHODS

4.1 Raw Materials

The principal emissions from the raw materials area is from the drying of spent grains. There are a variety of raw materials in brewing that are used in the production of beer at the Fulton facility. An inventory of these are provided in Table 4.1. Other emissions including fugitive emissions from the processes associated with the raw materials for brewing are difficult to accurately quantify. However, these quantities are not large contributors to the total facility emissions.

An estimate of these emissions can be made by using data and mass balance equations already compiled by AeroVironment, Inc. (AV) for the emissions inventory documentation of the Miller facility in Irwindale, California (AV, 1989-92). According to AV, the Irwindale facility produced approximately 15,000 barrels of beer daily or 5,480,000 annually. However, the design capacity of the plant is 5,000,000 bbls. In 1993, the Fulton facility produced approximately 5,305,000 bbls. By using the ratio of the annual barrels of beer produced at each facility and assuming the two facilities have similar processes and associated emissions, estimates can be made for the Fulton facility's emissions by using the Irwindale emission quantities.

The General Mass Balance Model (USEPA, 1973) is as follows:

$$\text{Emissions} = (U \times P) \times [1 - (C + W)] \times (1 - CE) \qquad \text{Equation 1}$$

where:

U = quantity of "substance of concern" (substance) used in 1993 (or most recent year available)
P = fraction (by weight) of substance in chemical
C = fraction of substance that is chemically converted during the process to another substance
W = fraction of substance that is cleared from the process via a waste stream
CE = fractional removal efficiency from all control devices attached to the device

4.1.1 Emissions from Grains Handling and Storage

Grains are transported to the facility via rail and phytotoxin is used to fumigate the grains in railroad cars. As the grain is transferred from the rail cars to the storage silos, phostoxin breakdown and releases

TABLE 4.1

MILLER BREWING COMPANY
FULTON, NEW YORK

BREWING RAW MATERIALS INVENTORY

Material	Consumption Rate January 1992 (lbs)
MALT	10,146,570
GRITS	1,526,540
LIQUID CORN ADJUNCT	3,257,700
ISOHUMULONE-ALPHA LBS.	
GYPSUM (TERRA ALBA)	29,335
PHOSPHORIC ACID	
CALCIUM CHLORIDE	9,325.1
LIQUID DEXTROSE	2,133,244
HAAS CLUSTER EXTRACT	0
ADJUZYME CONCENTRATE	337.5
WATER (Gallons)	72,000,000
HALLERTAU HOP PELLETS	0
CARMEL MALT	10,600
YEASTEX	810
CASCADE HOP PELLETS	1,031.90
FOGGLE HOP PELLETS	1,359.10
BLACK MALT	24,675
CLUSTER CO2 EXTRACT-ALPHA	1,024
CLUSTER HOP PELLETS	4,240.20
BULLION HOP PELLETS	
GALENA HOP PELLETS	2,346
HOP CHARCTER FRACTION	323.4
TETRALONE	3,352
REDIHOP	4,495
SILICA DIOXIDE HYDRA	62,200
SILICA GEL/CHILL GARDE	52,424
POLYCLAR A.T.	594
DIATOMACEOUS EARTH (DE)	
DIATOMACEOUS EARTH (DE)	
VERSENE	
CLR OR OTHER FIBER AID	1,046
TOTAL DE	221,311

Source: Miller Brewery Department

phosphine and ammonia gases. A mass balance equation is used to compute these emissions. The calculations assume 50% of the phostoxin (i.e., the degradation products are ammonia and phosphine) have already been emitted prior to arrival at the facility which should be very conservative.

AAE (ammonia) = (A ÷ mw1) x mw2 x 0.5 Wf   Equation 2
and, AAE (phosphine) = B x 0.5

where:
AAE = average annual emissions rate, lbs/year
A = annual usage of the substances, used/year
B = phosphine emissions where B = A x 0.333 as per manufacturer
mw1 = molecular weight of phostoxin
mw2 = molecular weight of phosphine, or ammonia
Wf = weight fraction factor, lbs/lbs

(AV, 1991 and EPA Form R Submission, 1993)

The emissions from the storage of grains onsite have been reviewed according to Miller staff. Phostoxin is also used to fumigate the grain silos. A similar mass balance equation as above can be used for this situation except that 100% of the phostoxin is assumed to be emitted to the atmosphere during fumigation of the silos (AV, 1991/1992).

4.1.2 Water Treatment

Water is treated in activated carbon beds which are regenerated once per week. The Fulton facility uses approximately 72 million gallons of water per month. During the carbon regeneration process, gases are scrubbed and the process water is sent to the wastewater treatment facility. Any remaining gases are reinjected into the carbon beds. Therefore, according to Miller staff, there are no significant air releases associated with the water treatment system. This includes both the carbon adsorption/desorption processes as well as chlorination after the carbon beds.

4.2 Brewhouse

The brewhouse at the Fulton facility was evaluated for total volatile organic compounds, ethanol and sodium hydroxide emissions. The approach used to quantify each are presented below.

4.2.1 Total Volatile Organic Compounds (VOCs)

The measurement of total VOC emissions from the brewhouse facility was performed on November 1 and 2, 1993. Sampling was performed at four (4) stack locations on the sixth floor roof of the brewhouse and included the kettle, lauter tun, mash tun and cereal cooker. Further testing for the hot wort tank on the 4th floor of the brewhouse was performed on November 3, 1993 from the tank head space.

Sample volume calculations are presented in Appendix H. Source flow rates were calculated from the flow traverses performed on the stacks and also calculated using a displacement volume rate for the hot wort tank and are represented in Appendix I.

Separate analyses of each charcoal trap from each sample pair revealed no significant ($\leq 25\%$) breakthrough. All brewhouse samples contained detectable levels of VOCs. Two of eight sample pairs had detectable condensate values that were added to their respective sample mass. The emissions from the kettle, lauter tun, mash tun, cooker and hot wort tank were estimated by calculating a test release rate in milligrams per minute from the following equation:

$$TRR = C \times Q \times 28.32 \qquad \text{Equation 3}$$

where:

TRR =test release rate, mg/min
C = measured concentration, mg/liter
Q = source flow, acfm
28.32 = conversion of liters to ft^3

However, an additional requirement of the survey was to calculate emission rates based upon pounds per one thousand barrels (lbs/1000 bbls) of finished product. Therefore, the test release rate, process time (PRT) and process volume (Vp) are utilized in calculating a test emission factor (TEF) in lbs/1000 bbls. This is calculated by the following:

$$TEF = 2.205 \times 10^{-3} (TRR \times PRT \div Vp) \qquad \text{Equation 4}$$

where:

TEF = test condition emission factor, lbs/1000 bbls
TRR = test release rate, mg/min
PRT = process time, min
Vp = process volume, bbls
2.205×10^{-3} = conversion of milligrams per bbl to pounds per 1000 bbls

The process times and volumes have been determined by reviewing the daily brewhouse schedules during the sampling. Throughout the remainder of the calculations in Section 4.0, it is to be noted that a process time is directly applied and the process volume is the barrels of beer brewed or packaged. The VOC emission calculations per sample are summarized and shown below in Table 4.2. To further evaluate the emissions of the brewhouse facility on an annual basis, an average test emission factor (TEF_{av}) is calculated for each brewhouse location and applied in Section 5.2 to an annual volume of beer brewed. The TEF_{av} factors are as follows for VOCs at the brewhouse: kettle (K1, K2, K3) 0.212 lbs/1000 bbls, lauter tun (LT1, LT2, LT3) 0.005 lbs/1000 bbls, mash tun (MT1, MT2, MT3) 0.053 lbs/1000 bbls, cereal cooker (C1, C2, C3) 0.007 lbs/1000 bbls and the hot wort tank 0.017 lbs/1000 bbls.

4.2.2 Ethanol

Ethanol emissions from the brewhouse occur during the summer months where spent yeast is added to the spent grains tank. However, due to the time of season, this did not occur during the field tests at Fulton and thus the activity was not sampled.

4.2.3 Sodium Hydroxide

The measurement of the sodium hydroxide (NaOH) emissions from the brewhouse were performed on November 2, 1993 during a CIP on the kettle #1 in the west brewhouse. An estimate of the kettle flow rate was necessary for this sample since the kettle fan does not operate during the CIP and the flow is below detection limits of the velometer (100 ft/min). Therefore, since sodium hydroxide was detected in the sample, an exit velocity of one foot per second was assumed. This results in a calculated exhaust flow rate of 577 actual cubic feet per minute (acfm) and is presented in Appendix I. Sample Volume calculations are presented in Appendix H.

The kettle CIP sample (Na-BH-K1) contained a detectable level of sodium hydroxide. The calculated concentration of sodium hydroxide for the kettle CIP and the calculated exhaust flow rate are listed in Table 4.2 and are used to calculate the test release rate by using Equation 3.

TABLE 4.2

MILLER BREWING COMPANY
FULTON, NEW YORK

BREWHOUSE EMISSION FACTOR CALCULATIONS
Total Volatile Organic Compounds

Sample ID	M (mg)	Sample Vol. (Liters)	Conc. (mg/l)	Actual Gas Flow Rate (acfm)	Test Release (mg/min)	Process Time (min)	Process Volume (bbl)	Test Emission Factor (lb/1000bbl)
VOC-BRH-K1	0.190(1)	79.3	0.0024	16982	1152	193	1100	0.446
VOC-BRH-K2	0.064	74.0	0.0009	16599	406.37	193	1100	0.157
VOC-BRH-K3	0.015	70.3	0.0002	13498	81.58	193	1100	0.032
Kettle Average								0.212
VOC-BRH-LT1	0.110	134.1	0.0008	1216	28.25	103	1100	0.006
VOC-BRH-LT2	0.059	103.2	0.0006	826	13.37	108	1100	0.003
VOC-BRH-LT3	0.120	119.2	0.0010	1180	33.64	110	1100	0.007
Lauter Tun Average								0.005
VOC-BRH-MT1	2.100	44.1	0.0476	149	201.3	94	1100	0.038
VOC-BRH-MT2	1.900	41.0	0.0464	331	435.2	94	1100	0.082
VOC-BRH-MT3	1.200	39.1	0.0307	240	209.1	94	1100	0.039
Mash Tun Average								0.053
VOC-BRH-C1	0.434(2)	172.1	0.0025	1507	107.6	45	1100	0.010
VOC-BRH-C2	0.180	176.9	0.0010	1507	43.43	45	1100	0.004
VOC-BRH-C3	0.350	172.1	0.0020	1507	86.80	44	1100	0.008
Cereal Cooker Average								0.007
VOC-CS-WT1	0.520	7.8	0.0663	228	428.3	20	1100	0.017

SODIUM HYDROXIDE

Sample ID	M (mg)	Sample Vol. (Liters)	Conc. (mg/l)	Actual Gas Flow Rate (acfm)	Test Release (mg/min)	Process Time (min)	Process Volume (bbl)	Test Emission Factor (lb/1000bbl)
Na-BH-K1	0.00068	27.2	2.50E-05	577	0.41	50	2200	1.02E-05

Notes: ?
M - mass of ethanol Appendix E
Sample Volume (SV) - Appendix H
Flow Rates - Appendix I
(1) 30 milliliter condensate sample VOC-BRH-K1C included.
(2) 30 milliliter condensate sample VOC-BRH-C1C included.

The kettle CIP occurs after every other brew and therefore, has an estimated process volume of 2200 barrels. The process time for the cleaning is 50 minutes. By using Equation 4, a test emission factor can be calculated and this value is presented in Table 4.2.

The sample Na-BH-K1 calculated values listed in Table 4.2, are used to estimate the emissions for the brewhouse triweekly CIP activity. The triweekly CIP for the brewhouse is performed on the kettle, mash tun, hot wort tank, lauter tun and cooker and all have a process time of ten hours (600 minutes). Each of these locations has a process volume equal to 230,769 barrels except for the cereal cooker; which has a process volume of 166,154 barrels. The process volumes are based upon available brewing data from Miller presented in Appendix J. The sodium hydroxide test emission factors in the brewhouse are as follows: kettle (1.26 E-05) lbs/1000 bbls, cooker (3.25 E-06) lbs/1000 bbls, and the remaining sources are at (2.34 E-06) lbs/1000 bbls. The kettle value takes into account the triweekly brewhouse CIP and the CIP for every other brew. These values will be discussed in Section 5.2.

4.3 Cold Services

The cold services area at Fulton contains several processes including fermentation, filtration, aging and package release. In this area, ethanol, sodium hydroxide and chlorine are the primary compounds of interest for this survey and quantification methods for these are discussed below.

4.3.1 Ethanol

The measurements of ethanol emissions from cold services occurred at the heat wheel inlet and exhaust vents; fermenters B3, C2 and C8; cold filter trap; primary filter trap; spent yeast tank; and cold services ventilation duct from November 2 to November 5, 1993.

Heat Wheel

The heat wheel ethanol emissions were measured at approximately 3-hour intervals over a 24-hour period from November 2, 1993 to November 3, 1993. The flows for the heat wheel exhaust and inlet vents were determined from fan curve data supplied by Miller. A total of seven samples were to be collected at this source directly onto pairs of carbon traps. During the sampling, one test had been aborted due to carbon tube breakage. Of the six remaining samples, two were discarded because of unresolved differences and data compatibility. For each test sample, a test release rate was calculated using Equation 3 as provided in Table 4.3.

The heat wheel inlet and exhaust vents operate 24 hours per day (1,440 minutes). The process volume of beer in the cold services area during the test was assumed to be equal to the volume of beer leaving the package release for that day and included an average of 2.5 percent beer loss. Using Equation 4, a test emission factor was calculated for the release of ethanol from the heat wheel inlet and exhaust vents.

Since there were several samples for which release rates and inlet rates were calculated, it is necessary to compute an average test emission factor for the exhaust from cold services via the heat wheel. This average test emissions factor (TEF av) is calculated by the following:

$$TEF_{AV} = [\Sigma (HW_i - IV_i)] \div n \qquad \text{Equation 5}$$

where:

TEF_{AV} = net average test emission factor, lbs/1000 bbls
HW_i = test emission factor from the heat wheel exhaust, lbs/1000 bbls
IV_i = test emission factor from the heat wheel inlet, lbs/1000 bbls
n = number of samples considered, unitless

The TEF_{AV} for the heat wheel from Equation 5 is calculated to be 1.33 lbs/1000 bbls. The TEF_{AV} is a net emission factor due to the close proximity of the heat wheel exhaust to the heat wheel intake and other vents on the roof of cold services. Essentially, the heat wheel inlet has the ability to draw in emissions that the heat wheel has exhausted or other sources have released. The samples used in calculating emission values for the heat wheel are listed in Table 4.3.

Fermentation

The fermenter B3 was measured for ethanol concentrations approximately every three hours from November 2 to November 3, 1993 for a 24 hour period while it was venting to the atmosphere. The exhaust flow from the vent pipe was measured using a hand held velometer during each sampling period. The sampling was performed according to the analytical methods listed in Appendix B. Tedlar whole air bags were taken and screened with the Miran 1B2 analyzer to determine ethanol concentration and appropriate loading volumes onto a single carbon trap. This method assured proper loading, avoidance

TABLE 4.3

MILLER BREWING COMPANY
FULTON, NEW YORK

COLD SERVICES EMISSION FACTOR CALCULATIONS
Ethanol

Sample ID	M (mg)	Sample Vol. (Liters)	Conc. (mg/l)	Actual Gas Flow Rate (acfm)	Test Release (mg/min)	Process Time (min)	Process Volume (bbl)	Test Emission Factor (lb/1000bbl)
Heat Wheel								
E-CS-HW.1	0.3200	16.0	0.0200	30500	17288.6	1440	18067	3.0384
E-CS-HW.2	0.1000	16.4	0.0061	30500	5260.6	1440	18067	0.9245
E-CS-HW.3	0.0850	16.4	0.0052	30500	446.7	1440	18067	0.7850
E-CS-HW.5	0.0800	16.3	0.0049	30500	4240.9	1440	18067	0.7453
E-CS-IV.1	0.0061	15.6	0.0004	37600	415.5	1440	18067	0.0730
E-CS-IV.2	0.0020	16.4	0.0001	37600	126.9	1440	18067	0.0223
E-CS-IV.3	0.0054	16.4	0.0003	37600	351.2	1440	18067	0.0617
E-CS-IV.5	0.0020	16.3	0.0001	37600	127.4	1440	18067	0.0224
Average							TEF Avg.	1.33
Fermentation*								
E-CS-FERM B3.1	0.6200	3.9	0.1572	1	4.45	0		
E-CS-FERM B3.2	0.6200	3.9	0.1572	1	4.45	197	4431	0.0004
E-CS-FERM B3.3	0.4400	3.9	0.1115	2	6.32	179	4431	0.0005
E-CS-FERM B3.4*	0.4950	3.9	0.1253	2	7.10	169	4431	0.0006
E-CS-FERM B3.5	0.5500	4.0	0.1387	2	7.85	190	4431	0.0007
E-CS-FERM B3.6	0.7000	4.0	0.1762	2	9.98	180	4431	0.0008
E-CS-FERM B3.7	0.8100	3.9	0.2085	27	160.2	365	4431	0.0155
E-CS-FERM B3.8	0.8100	3.0	0.2707	38	293.2	178	4431	0.0201
E-CS-FERM B3.9	0.9400	3.0	0.3126	48	424.5	252	4431	0.0450
							Sub Total	0.0835
E-CS-FERM, displ.			0.0786	51	113.5	360	4431	0.0203
E-CS-FC.1	0.0063	2.0	0.0031	1060	94.01	120	4431	0.0056
							Total	0.1095
Other Sources								
E-CS-CFT 25.1	0.5300	3.7	0.1428				28,364	0.0003
E-CS-PFII.1	0.1900	2.0	0.0973				23,887	0.0016
E-CS-SYT 34.1	0.6100	3.9	0.1573	26	115.79	7500	47,268	0.041
E-CS-2x2.1	0.0170	30.4	0.0006	3738	59.28	1440	9161	0.0205
EPR TANK HEAD	1.1000	1.9	0.5738					

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TABLE 4.3
(Continued)

MILLER BREWING COMPANY
FULTON, NEW YORK

COLD SERVICES EMISSION FACTOR CALCULATIONS

Sodium Hydroxide

Sample ID	M (mg)	Sample Vol. (Liters)	Conc. (mg/l)	Actual Gas Flow Rate (acfm)	Test Release (mg/min)	Process Time (min)	Process Volume (bbl)	Test Emission Factor (lb/1000bbl)
Na-CS-FB1.1	0.0100	15.7	0.0006	180	3.26	45	4431	0.0001
Na-CS-FB1.2	0.0120	15.7	0.0008	180	3.91	45	4431	0.0001
Na-CS-FB1.3	0.0027	15.7	0.0002	180	0.88	45	4431	0.0000
Fermenter CIP							TEF Avg	0.00006

Chlorine

Sample ID	M (mg)	Sample Vol. (Liters)	Conc. (mg/l)	Actual Gas Flow Rate (acfm)	Test Release (mg/min)	Process Time (min)	Process Volume (bbl)	Test Emission Factor (lb/1000bbl)
Cl-CS-B3.1	0.0660	15.7	0.0042	180	21.49	15	4431	0.0002

Notes:
M - mass of ethanol from Appendix E
Sample Volume (SV) from Appendix H
Flow Rates from Appendix I

* Interpolated data point based on B3.3 and B3.5 samples.

of breakthrough and detection of ethanol was reported on all samples. The process volume for fermenter B3 is given by Miller to be 4431 barrels and is presented in Appendix J. For each sample taken, a test release rate was calculated using Equation 3. The results are provided in Table 4.3.

By plotting each release rate over the fermenter sampling duration and calculating the area under the curve (the sum of each incremented average release rate multiplied by the associated time between those samples), an overall test emission factor was calculated for the fermenter during the ventilation to the atmosphere. The fermenter test emission factor associated with each sample listed in Table 4.3 was calculated using Equation 4.

In addition to the samples taken during the 21 hour venting period, there were two additional values incorporated into an overall emission factor for the fermenter. The first was a displacement emission during the filling of the fermenter which was assumed to have a concentration equivalent to half of the first measured sample concentration. The second emission value considered was measured during the two hour venting period prior to a fermenter CIP with an assumed exhaust flow of 1,060 cubic feet per minute. This flow was estimated by an approximate exit velocity of ten feet per second and a measured vent diameter of eighteen inches. These two emission events have been added into the emission factor and represent the ethanol emission of a fermenter throughout a full fermenting cycle per one thousand barrels of beer. The fermenter emission factors and associated values are listed in Table 4.3. The overall average value is 0.1095 lbs/1000 bbls. for a fermenter cycle including the above processes.

Primary Filter and Polishing Filter

The primary filter exhaust was measured on November 2, 1993 during a carbon dioxide purge from the filter vent. A flow was not measurable from this vent because of the wet venting process, therefore, a displacement volume was used in the calculation of a test release rate. The measured concentration was assumed to be the concentration of the exhaust gas during the entire filter purge cycle. The volume of the filter is 85 barrels (9973 liters) and the filter is also under approximately three atmospheres of pressure. Thus, the actual exhaust volume was approximated to be 29,920 liters. However, both primary filters purge a total of six times per day. Therefore, the total exhaust volume for one day is 179,523 liters. The average process volume of beer during one day was provided as 23,887 barrels by Miller for both primary filters. The following equation can be used to calculate the emission factor for this process.

$$TEF = C \times V \div Vp \times 2.205 \times 10^{-3} \qquad \text{Equation 6}$$

where:

TEF = test emissions factor, lbs/1000 bbls
C = ethanol conc., mg/l
V = filter volume, liters
Vp = process volume, bbls
2.205×10^{-3} = conversion of milligrams to lbs per 1000 barrels

By using Equation 6, a test emission factor is calculated to be 1.61E-03 lbs/1000 bbls. The results are listed in Table 4.3 under Other Sources as Sample ID E-CS-PFII. This test emission factor will be applied further in Section 5.0 to develop annual and potential emissions rates. Furthermore, a value for the remaining polishing filters will be applied using the above concentration of the PFII sample.

There are a total of three polishing filters; two of which filter pasteurized beer. The third polishing filter filters only the nonpasteurized beer. An average process volume of 35,288 barrels of beer is processed through these filters per day as given by Miller and of that average, approximately 7,500 barrels of non pasteurized beer is filtered. Therefore, there is a net process volume for two pasteurized polishing filters at 27,788 barrels and a process volume of 7,500 barrels for the nonpasteurized polishing filter.

The two pasteurized polishing filters (polish regular filter) purge twice a day at a corrected volume of 119,682 liters. By using the above process volume of 27,788 barrels and applying the equivalent sample concentration and above purge volume the test emission factor for the polish regular filter is calculated to be 9.24E-04 lb/1000 bbls.

There remains one nonpasteurized polishing filter (polish draft filter) which purges once per day. The corrected purge volume for this filter is calculated to be 29,920 liters. The process volume for this filter is 7,500 barrels. By applying the sample concentration of E-CS-PFII, the above process volume and purge volume to Equation 6, the test emission factor is calculated to be 8.56E-04 lbs/1000 bbls.

Ceramic Filtration System

The ceramic filtration system or cold filter trap, was measured on November 3, 1993. The flow was measured using a hand held velometer from the exhaust vent. This system is responsible for filtering the nonpasteurized beer at a cold temperature prior to packaging.

The sample taken was first collected in a whole air sample Tedlar bag, screened with the Miran 1B2 analyzer and then metered onto a carbon trap. The sampling occurred between purges prior to the filter trap cleaning. The emissions from the ceramic filter trap were estimated by calculating the test release rate by using Equation 6.

The filter purge process occurs weekly and the purge volume is assumed to be equal to that of the primary filter, 29,920 liters. The process volume has been calculated to be 28,364 barrels extrapolated from the packaging values for the Nov. 1-Nov 5th data supplied by Miller and applying a 6.5% beer loss and 1.325 dilution factor for "D brew". The test emission factor for the ceramic filter is listed in Table 4.3 under Other Sources as Sample E-CS-CFT 25.1.

Spent Yeast Tank

The spent yeast tank was measured for ethanol emissions on November 3, 1993. A flow rate was measured from the ventilation exhaust of the tank and is reported in Table 4.3. The sampling was performed by collecting a whole air sample. Screening was performed with a Miran 1B2 unit and by knowing the sample concentration, an appropriate sample volume was loaded onto a carbon trap. The analysis of the charcoal trap reported a detectable level of ethanol. The test release rate from the spent yeast tank was calculated by using Equation 3. The results are presented in Table 4.3 under other sources as Sample ID E-CS-SYT 34.1.

The release rate, the process time and volume of the spent yeast tank were considered in calculating a test emissions factor. The process time of the spent yeast tank venting being considered is one week of brewing time or approximately 125 hours (7,500 min). The process volume is the sum of the last two weeks in October, taking into consideration a package release of 62,630 barrels of beer and applying a 1.325 "D brew" factor to get a corrected process volume of 47,268 bbls. The test emission factor was calculated using Equation 4 and is equal to 0.041 lbs/1000 bbls.

Cold Services Vents

The cold services also has an independent ventilator that is separate from the heat wheel system, this ventilator operates continuously and was measured on November 5, 1993. A vent flow rate was taken during sampling using a hand held velometer. The sample taken was loaded directly onto a carbon trap and a detectable ethanol concentration was reported. For the test sample, the test release rate was determined by using Equation 3. A test emission factor was calculated using Equation 4 based on one day of venting and the process volume was assumed to be equivalent to the volume of beer leaving packaging release on the day of the test.

The calculated values for the cold services ventilator for both the test release rate and the test emission factor are listed in Table 4.3. The emission factor for this source is 0.0205 lbs/1000 bbls.

Finally, cold services has emergency vents that clear the cellars when carbon dioxide levels exceed acceptable limits. A test of the package release tank headspace indicates high ethanol concentrations, however, no data could be gathered on the frequency or volume of gas exhausted during emergency conditions.

Spent Diatomaceous Earth Vent

This source contains ethanol at levels similar to those occurring initially in the spent yeast tank. The test release rate is provided in Table 4.3 under other sources as Sample ID E-CS-SYT 34.1.

Surge Tanks

There are twelve surge tanks that were accounted for in the survey. The surge tanks only vent after a CIP and under excess pressure conditions. They were not sampled directly, however, ethanol concentrations leaving the surge tanks during the tank fill after CIP are probably equivalent to that of the aging tank head space since the surge tanks contain brewed beer. Therefore, the emissions from this source are dependent upon the frequency of CIP and the displacement volume of the tanks. The surge tanks are cleaned once every three weeks and the surge tanks have a volume of 800 bbls. each (93,868 liters). No account is made for emissions during emergency venting conditions.

By using the concentration of the aging tank headspace (0.574 mg/l) and multiplying through by the assumed displacement volume of 93,870 liters, a mass of 53,505 milligrams (0.118 lbs) is calculated by Equation 6. Multiplying this mass by twelve (12) surge tanks and assuming 17.3 individual tank releases per year, based upon a triweekly CIP, an estimated annual ethanol emission rate is calculated to be 24.5 lbs/yr. Furthermore, by dividing through by the 1993 beer production in brewed barrels, a test emission factor of 0.00613 lbs/1000 barrels is estimated. This value can be applied directly to an annual value for barrels of beer brewed per year.

4.3.2 Sodium Hydroxide

Sodium hydroxide emissions from cold services occur as a result of CIP activities. Emission estimates for this compound can be calculated based upon the CIP performed on the fermenter that was measured on November 2, 1993. The sodium hydroxide released during a fermenter CIP occurs during the 45 minute caustic rinse cycle. Three samples were taken for sodium hydroxide emissions from fermenter B-1 during a CIP. All sodium hydroxide sample cartridges contained detectable levels of sodium hydroxide and a test release rate was calculated according to Equation 3.

The flow rate (Q) of this source could not be monitored by conventional means because of the nature of the cleaning cycle. A flow was estimated by timing the duration of the release and estimating the exit velocities that were occurring. The test emission factor includes a process time of 45 minutes for an average fermenter brew of 4400 bbls. and is estimated to be 0.00006 lbs/1000 bbls.

The resultant test emission factor is believed to be an underestimate of sodium hydroxide release from a fermenter during CIP activity based on the observations of the actual exhaust made during the test. Due to this process intermittent release (highly variable exhaust rate and concentration), variable mixed phase nature of the emission and standard sampling method and equipment limitations, a representative test sample is difficult to obtain without disproportionate expense. Further investigation will be necessary to calculate a representative sodium hydroxide emission factor for fermenter CIP.

For the remaining areas of cold services that were not sampled, the average sodium hydroxide concentrations of the fermenter during caustic rinse sampling can be applied. The largest sodium hydroxide source is the fermenter CIP. The second largest source would be the surge tanks. The surge tanks have a test emission factor of 0.0000015 lbs/1000 bbls. These cold service areas will be addressed in Section 5.0.

4.3.3 Chlorine

Chlorine emissions to the atmosphere occur during CIP of the fermenters and other equipment in cold services. The chlorine emissions for the cold services is approached in the same manner that the sodium hydroxide emissions are calculated. A single chlorine sample was taken during a CIP of fermenter B-1. The test emission rate was calculated by using the approximation for flow developed for the sodium hydroxide CIP. The results are provided in Table 4.3 for the fermenter and surge tanks. The fermenter test emission factor is 0.00016 lbs/1000 bbls and the surge tank total is 0.0000123 lbs/1000 bbls.

4.3.4 Other Releases

There is a combination of 57 potential relief vents and/or sources located on the cold services roof. These have been identified by Miller staff and are presented in Appendix J. Beyond the sources identified in the preceding section, no further attempts have been made to quantify the constituents or the amount of atmospheric releases resulting from these vents/sources.

4.4 Utilities

4.4.1 Ethanol

Utilities processes fermentation off-gas by filtered through various traps, carbon beds and driers. The purified gas is primarily sent to aging to maintain a blanket of carbon dioxide over brewed beer that is being aged for packaging.

There are four carbon beds or purifiers at the Fulton facility. At any given time, one of these beds will be on a regeneration cycle. During this cycle, the carbon bed is flushed with clean air and thermally regenerated to clean the carbon bed of any organics. The measurement of ethanol emissions from carbon bed regeneration was taken during a 36 hour period from November 2, 1993 to November 3, 1993. During the sampling period, flow rates were determined for the carbon bed vent. Samples were first taken into a whole air Tedlar sample bag, screened on the Miran 1B2 analyzer and then metered onto a carbon trap for subsequent analysis via a certified laboratory. A total of seven (7) samples was taken and all contained a detectable level of ethanol as shown in Table 4.4.

A test release rate for the carbon regeneration was calculated by using Equation 3. The process time of 36 hours (2,160 minutes) and a process value of 24,000 barrels of brewed beer were used to calculate a test emission factor. The process value is based on the average volume of beer produced while the carbon bed was on filtration. These values were used to obtain a test emission factor by following Equation 4. The TEF_{AV} for the carbon regeneration process is 0.035 lbs/1000 bbls.

In addition to the carbon regeneration process emissions, utilities has nine exhaust vents. Two of the utilities exhaust vents were measured for ethanol emissions by direct loading onto a carbon trap on November 3, 1993. Four of the nine exhaust vents were operating in the utilities building during the test. Both vent samples contained detectable ethanol concentrations. Exhaust flow rates were measured with a hand held velometer and were also approximated from fan curves supplied by Miller.

The test release rate as calculated by using Equation 3 is presented in Table 4.4. The test emission factor was calculated by factoring in the amount of brewed beer that was released to packaging. The calculated value is 2.62 lbs/1000 bbls of brewed beer with four fans operating. One can expect emissions to decrease as more fans go on line. The test emission factor is again used in calculating the annual and maximum annual emission rates in Section 5.0.

4.4.2 Ammonia

A significant amount of ammonia is used in the refrigeration processes occurring within utilities. To develop an emission factor for ammonia is difficult since the ammonia is used throughout the facility and a mass balance approach may be the only way of arriving at a value. Ambient air tests were conducted for ammonia in amongst the heat exchange units on the roof of utilities. Those tests show some ammonia is released, however, obtaining an accurate value for the release was not possible.

TABLE 4.4

MILLER BREWING COMPANY
FULTON, NEW YORK

UTILITIES EMISSION FACTOR CALCULATIONS

Ethanol

Sample ID	M (mg)	Sample Vol. (Liters)	Conc. (mg/l)	Actual Gas Flow Rate (acfm)	Test Release (mg/min)	Process Time (min)	Process Volume (bbl)	Test Emission Factor (lb/1000bbl)
EU-CREGN.1	0.0690	4.1	0.0166	360	169.7	2160	18,067	0.045
EU-CREGN.2	0.0810	4.3	0.0187	360	190.9	2160	18,067	0.050
EU-CREGN.3	0.0520	6.8	0.0076	360	77.85	2160	18,067	0.021
EU-CREGN.4	0.0810	7.2	0.0113	353	113.0	2160	18,067	0.030
EU-CREGN.5	0.0900	7.4	0.0122	360	124.7	2160	18,067	0.033
EU-CREGN.6	0.0940	7.5	0.0125	265	93.85	2160	18,067	0.025
EU-CREGN.7	0.0920	7.6	0.0121	461	157.4	2160	18,067	0.041
Carbon Regeneration							TEF Avg	0.035
EU-EXH-C2.1	0.1300	19.0	0.0068	16200	3132	1440	18,067	0.550
EU-EXH-C9.1	0.1800	19.1	0.0094	16200	4312	1440	18,067	0.758
Utilities Ventilation							TEF Avg	0.655

Ammonia

Sample ID	M (mg)	Sample Vol. (Liters)	Conc. (mg/l)	Actual Gas Flow Rate (acfm)	Test Release (mg/min)	Process Time (min)	Process Volume (bbl)	Test Emission Factor (lb/1000bbl)
NH3-U.1	0.0026	5.6	0.0005					
NH3-U.2	0.0025	5.6	0.0004					
NH3-U.3	0.0047	5.6	0.0008					
NH3-U.4	0.0028	5.6	0.0005					

Chlorine

Sample ID	M (mg)	Sample Vol. (Liters)	Conc. (mg/l)	Actual Gas Flow Rate (acfm)	Test Release (mg/min)	Process Time (min)	Process Volume (bbl)	Test Emission Factor (lb/1000bbl)
CL-U.1	<.022	25.6						
CL-U.2	<.021	24.3						
CL-U.3	<.019	23.8						

4.4.3 Chlorine

Chlorine gas and as well as chlorine generated from the usage of various chemicals is also released at the Fulton facility. Measurements were taken above the utilities area in the ambient air to evaluate chlorine levels present near the cooling towers. All measurements were at below detection levels. Thus, the chlorine release cannot be quantified without further investigation.

4.5 Packaging and Annex

The primary pollutant of concern from packaging and the annex is ethanol. In addition, samples for sodium hydroxide, chlorine and formaldehyde were collected in the packaging area only.

4.5.1 Packaging: Ethanol

Measurement of ethanol emissions from the packaging facility was performed on November 4 and 5, 1993. Sampling was performed at various roof vents above the pasteurized and nonpasteurized bottling and canning lines, beer dump and the B5 nonpasteurized bottling line on November 4. The roof vents servicing the keg filling station area and indoor building air near the railroad car staging area were sampled on November 5. Field data sheets are provided in Appendix C. Final sample volumes corrected to source conditions are provided in Appendix H.

Ventilation/exhaust rates supplied by Miller via fan specifications were used in calculating all emission rates with the exception of the high velocity fan located above the line 13 filling station (EF2) and the exhaust servicing the non-pasteurized B5 line. Both exhausts were measured using a velometer and/or hot wire anemometer.

All packaging samples contained detectable levels of ethanol with the exception of all three beer dump test charcoal sample traps. All charcoal trap mass loadings were within the designed range. Therefore, sample breakthrough, if any, was insignificant.

Emissions from each roof vent sampled above the bottling and canning areas of the packaging facility were first calculated as a test release rate in milligrams per minute by applying Equation 3. These values are presented in Table 4.5. These values were further converted to lbs/hr values.

Emissions for the pasteurized and nonpasteurized bottling and canning lines were estimated by averaging the observed ethanol emissions from six vents for five (5) 1-hour November 4, 1993 production periods as provided in Table 4.5. Production values in barrels (bbls) for seven packaging lines (B4, B5, C7, C8, C9, B12 and B13) are provided for each 1-hour production period and averaged for all five (5) 1-hour periods per line. A total hourly average of 799.1 barrels is calculated for lines B4, C7, C8, C9, B12 and B13. Line B5 (nonpasteurized) average hourly production was not added to this value since this line is serviced by a separate process exhaust vent. However, fugitives from other conveyors and equipment on line B5 are believed to contribute to roof exhaust ethanol emissions. Eliminating B5 average hourly production from the total hourly average production will likely yield a slightly more conservative pasteurized and nonpasteurized bottling and canning line ethanol emission factor.

Next, an ethanol emission and beer production profile of the roof vent exhaust and production floor was developed in order to estimate an average ethanol emission for each of the two rows of roof exhausts over the filling and pasteurization (if applicable) sections of the packaging lines. Average production and A and B vent exhausted ethanol values from Table 4.6 were plotted in Figure 4.1. The A vents are identified as those directly above the filling stations and the B vents are above the pasteurizing section of each line. The ethanol exhaust rates for each A and B vent was estimated by profiling the observed B4, C9 and B13 emissions. An average emission rate for all A vents and all B vents was estimated by calculating the average concentration for each emission rate curve in Figure 4.1. The average A and B vent emission rates were 1.39 and 0.498 pounds per hour (lbs/hr), respectively.

The pasteurized bottling and canning line emission factor was calculated by multiplying the sum of the average A and B vent emission rates by the number of A/B vent pairs (13) and correcting this value to a per 1,000 barrel production value using the 799.1 barrel total hourly average from Table 4.6. Using the following equation with applicable data, the calculated pasteurized bottling and canning line test emission factor TEF is 30.7 lbs/1000 bbls.

$$TEF = (ER_A + ER_B) \text{ x } (\text{A/B vent pairs}) \text{ x } 1{,}000 \div PRH \qquad \text{Equation 7}$$

or, $$TEF = ((1.39 \text{ lbs/hr} + 0.498 \text{ lbs/hr}) \text{ x } (13) \text{ x } (1{,}000 \text{ bbls})) \div 799.1 \text{ bbls/hr}$$

TABLE 4.5

MILLER BREWING COMPANY
FULTON, NEW YORK

PACKAGING AND ANNEX EMISSION FACTOR CALCULATIONS

Packaging: Ethanol

Sample ID (1)	M (2) (mg)	Sample Vol. (3) (Liters)	Conc. (mg/l)	Actual Gas (4) Flow Rate (acfm)	Test Release (mg/min)
A/B Roof Vents					
EP-B13-A.1*	0.540	19.6	0.0275	20106	15670
EP-B13-A.2*	0.570	19.7	0.0289	20106	16470
EP-B13-B.1	0.320	19.6	0.0163	13500	6233
EP-B13-B.2	0.410	19.7	0.0208	13500	7954
EP-C9-A.2	0.810	19.7	0.0412	13500	15750
EP-C9-A.3	1.000	19.6	0.0510	13500	19490
EP-C9-B.1	0.270	20.4	0.0133	13500	5072
EP-C9-B.2	0.280	20.6	0.0136	13500	5202
EP-B4-A.1	0.110	22.3	0.0049	13500	1885
EP-B4-A.2	0.110	22.3	0.0049	13500	1885
EP-B4-A.3	0.110	23.2	0.0047	13500	1812
EP-B4-B.1	0.072	21.9	0.0033	13500	1258.0
EP-B4-B.2	0.081	20.6	0.0039	13500	1502
EP-B4-B.3	0.057	20.2	0.0028	13500	1079
EP-B5.1*	1.100	22.5	0.0490	6013	8338
EP-B5.2*	0.660	21.3	0.0309	6013	5268
EP-B5.3*	0.600	18.2	0.0330	6013	5614
Keg Wash Vent					
EP-EF29.1	0.030	19.2	0.0016	13500	596.6
EP-EF29.2	0.026	18.8	0.0014	13500	529.6
EP-EF29.3	0.020	18.8	0.0011	13500	407.4
Beer Dump					
EP-BD-13.1	<.0039	19.9			
EP-BD-13.2	<.0039	20.1			
EP-BD-13.3	<.0039	14.8			
Indoor Samples					
EP-RC.1	0.1000	19.5	0.0051		
EP-RC.2	0.0690	19.9	0.0050		

TABLE 4.5
(Continued)

MILLER BREWING COMPANY
FULTON, NEW YORK

PACKAGING AND ANNEX EMISSION FACTOR CALCULATIONS

Packaging: Chlorine

Sample ID (1)	M (2) (mg)	Sample Vol. (3) (Liters)	Conc. (mg/l)	Actual Gas (4) Flow Rate (acfm)	Test Release (mg/min)
CL-P-B5.1*	<0.066	26.6	0.0025	6013	<422.46
CL-P-B5.2*	<0.066	26.0	0.0025	6013	<432.16
CL-P-B5.3*	<0.019	26.6	0.0007	6013	<121.76
CL-P-B13.1*	<0.026	28.5	0.0009	20106	<518.93
CL-P-B13.2*	<0.022	27.0	0.0008	20106	<463.16

Annex: Ethanol

Sample ID (1)	M (2) (mg)	Sample Vol. (3) (Liters)	Conc. (mg/l)	Actual Gas (4) Flow Rate (acfm)	Test Release (mg/min)
EA-CW.1	0.0720	21.0	0.0034	13500	1311.25
EA-CW.2	0.0760	21.7	0.0035	13500	1337.59
EA-CW.3	0.0700	21.7	0.0032	13500	1231.56
EA-1B9.1	0.1100	19.7	0.0056	13500	2140.01
EA-1B9.2	0.0990	20.5	0.0048	13500	1843.21
EA-1B9.3	0.1100	20.4	0.0054	13500	2058.57

(1) Refer to Appendix D for a more detailed description of each sample identification.
(2) M - sample catch as reported by the contract laboratory (EHL) see Appendix E.
(3) Sample volume corrected to source conditions. See Appendix H.
(4) Actual gas flow rate as provided by Miller or measured by the SBE team. See Appendicies I and C, respectively.
* Measured flow rate.

TABLE 4.6

MILLER BREWING COMPANY
FULTON, NEW YORK

PACKAGING BOTTLE AND CAN FILLING ETHANOL EMISSIONS NOVEMBER 4, 1993 FACILITY TEST

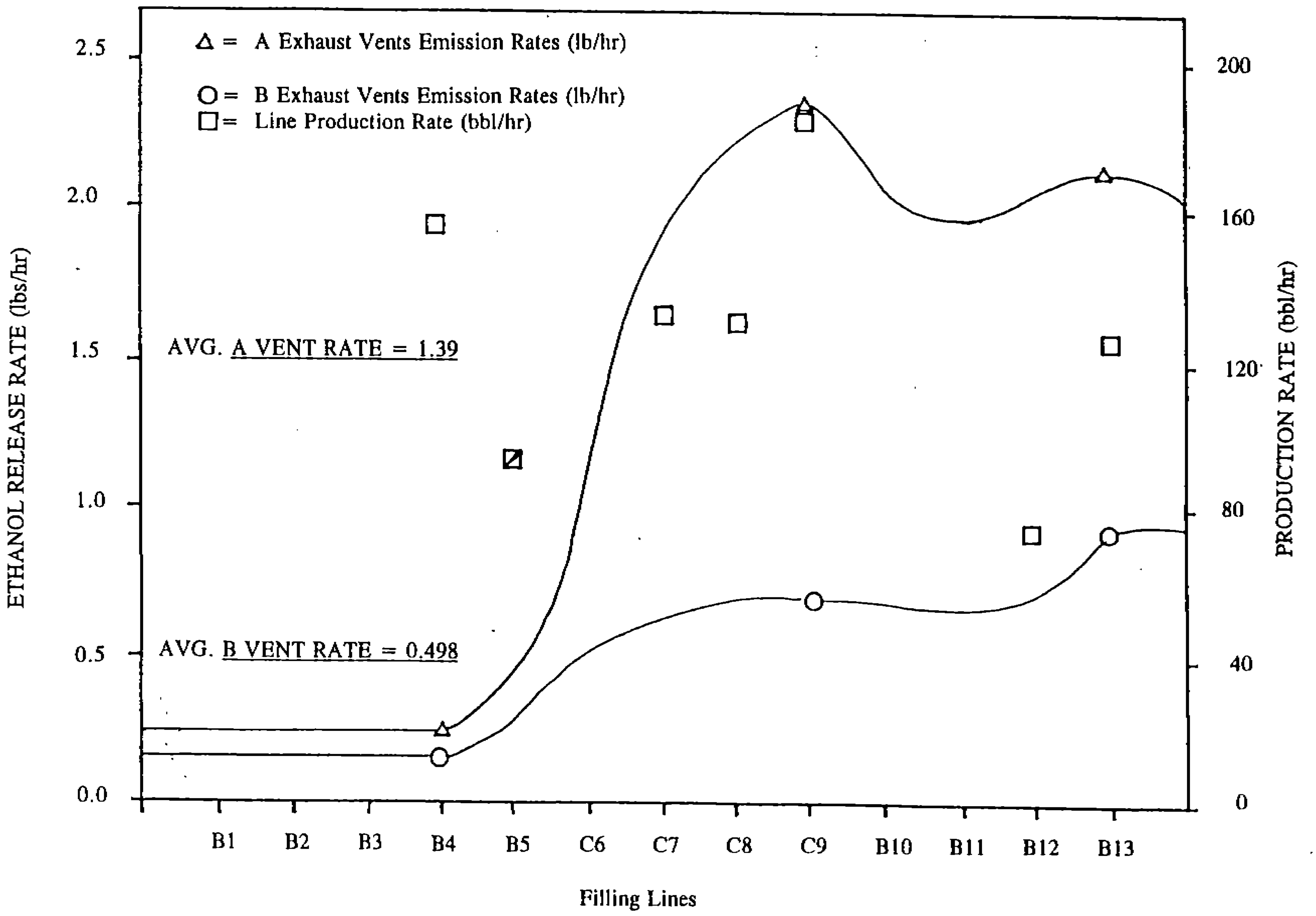
Test Time	0830-0930		0930-1030		1030-1130		1330-1430		1430-1530		Test Average	
Line ID	Production (bbl)(1)	Exhausted Ethanol (A/B vent)(3) (lbs)(2)	Production (bbl)(1)	Exhausted Ethanol (A/B vent)(3) (lbs)(2)	Production (bbl)(1)	Exhausted Ethanol (A/B vent)(3) (lbs)(2)	Production (bbl)(1)	Exhausted Ethanol (A/B vent)(3) (lbs)(2)	Production (bbl)(1)	Exhausted Ethanol (A/B vent)(3) (lbs)(2)	Production (bbl)(1)	Exhausted Ethanol (A/B vent)(3) (lbs)(2)
B1												
B2												
B3												
B4	181.4	0.249/	169.3	0.249/0.166	145.1	0.240/	157.2	/0.199	122.4	/0.143	155.1	0.246/0.169
B5(3)	87.1		87.1		108.9	1.103(4)	87.1	0.697	101.4	0.743	94.4	0.848
C6(3)												
C7	72.6		130.6		167.5		188.7		101.1		132.1	
C8	195.9						195.9		253.6		129.1	
C9	98.4		170.1		217.7		225.0	2.083/0.671	204.9	2.578/0.688	183.2	2.331/0.680
B10												
B11												
B12	8.9		87.1		79.8		101.6		95.6		74.6	
B13	116.1	2.072/0.825	137.9	2.179/1.052	123.4		108.9		138.6		125.0	2.126/0.939
										Total(5)	799.1	

1. Production provided by Miller per line per 1 hour test time. Blank values denote zero production for that line.
2. Observed ethanol emissions assumed for the 1 hour test time. Blank values denote no test data.
3. A vent - Roof vent located over the filling station of the associated line.
   B vent - Roof vent located over the pasteurization section of the associated line.
4. Non-pasteurized lines B5 and C6 data are presented but not used for profiling the average roof vent exhaust rate. Each non-pasteurized line has only one process exhaust vent.
5. Non-pasteurized production (B5) was not averaged into the total average production value by assuming that all ethanol emissions are serviced by the single process vent therefore influencing a more conservative pasteurized bottling and canning emission factor (see Figure 4.1).

FIGURE 4.1

MILLER BREWING COMPANY
FULTON, NEW YORK

PACKAGING EMISSION RATE ESTIMATES



where:
TEF = test emission factor, lbs/1000 bbls
PRH = total hourly average production, bbls/hr
1,000 = emission factor conversion to lbs/1,000 bbls/hour
A/B vent pairs = number of A/B vent pairs (13)
ER_A = average A vent emission rate, lbs/hr
ER_B = average B vent emission rate, lbs/hr

A test emission factor for the nonpasteurized line clean room was based on the measured exhaust concentration and the exhaust flow rate as shown in Table 4.5.

The nonpasteurized bottling line (B5) emission factor, 8.98 lbs/1,000 bbls, based only on the clean room vent is less than the pasteurized bottling and canning line emission factor (30.7 lbs/1,000 bbls). However, B5 fugitives cannot be determined. Thus, the final nonpasteurized bottling and canning line, B5 line and C6 respectively, emission factor will assumed to be equal to the pasteurized bottling and canning operation emission factor.

As mentioned above, the beer dump ethanol samples were reported by the analytical laboratory as not detected (Table 4.5 Sample EP-13). In estimating a beer dump emission factor, the A vent emission value (bottling and canning lines) corrected to 1,000 barrels of production will be used since MIRAN measurements indicated exhaust concentrations were similar. This beer dump test emission factor (1.74 lbs/1,000 bbls) is calculated according to the following equation and input parameters:

$$TEF = (ER_A) \times (1{,}000) \div PRH \qquad \text{Equation 8}$$

or, $$TEF = (1.39 \text{ lbs/hr}) \times 1{,}000 \text{ bbls} \div 799.1 \text{ bbls/hr}$$

where:
ER_A = average A vent emission rate, lbs/hr
PRH = total hourly average production, bbls/hr
1,000 = conversion factor to lbs/1,000 bbls/hr

The roof vents located above the two bottle wash lines were not sampled for ethanol emissions, however, fugitive releases primarily associated with the adjacent filling and packaging activities have been estimated using the average B vent emission value (bottling and canning lines) corrected to 1,000 bbls of production. Based on the test results, the bottle wash emission factor, 0.623 lbs/1,000 bbls, was calculated according to Equation 8.

Sampling on November 5, 1993 included sampling of the roof vent servicing the keg filling station (keg-o-matic). The emission factor for the keg-o-matic line is calculated by dividing the average observed hourly ethanol emission rate by the recorded concurrent keg-o-matic production rate. The keg-o-matic test emission factor is 0.338 lbs/1,000 bbls based on the following equation and input parameters:

$$\text{TEF} = (\Sigma\ \text{TRR}) \div 3 \times 60 \div 453{,}592 \times 1000\ \text{bbls} \div 200\ \text{bbls} \qquad \text{Equation 9}$$

where:

Σ TRR = sum of three emission tests
3 = three emission tests
60 = minute to hour conversion
453,592 = milligrams per pound
1000 = normalized rate production, bbls
200 = test rate production, bbls

Lastly, an emission factor must be determined for all ethanol fugitives not accounted for in the above mentioned exhaust points. An estimated packaging building fugitive emission rate was calculated by assuming that the majority at the fugitive releases occur in the northern third of the packaging building where the building air is likely exhausted through doors and cracks due to this areas lack of exhaust vent and distance from active building exhaust vents. The fugitive volumetric flow rate is estimated by multiplying the building's exchange rate by one third the building volume. The building's ventilation exchange rate 1.22 room exchanges per hour, was calculated by using the following equation:

$$\text{VER} = (Q_T \times 60) \div V_B \qquad \text{Equation 10}$$

or,

$$\text{VER} = (436{,}882\ \text{cfm} \times 60) \div 21{,}500{,}000\ \text{ft}^3$$

where:

VER = ventilation exchange rate, room exchanges per hour
Q_T = total building exhaust flow rate, cfm
60 = minutes to hours conversion
V_B = packaging building volume

Therefore, the fugitive volumetric flow rate, 8,740,000 cfh is calculated using the following equation.

Q_F = VER x V_B ÷ 3 Equation 11

or, Q_F = 1.22 room exchanges per hour x (21,500,000 ft^3 ÷ 3)

where:

Q_F = fugitive volumetric flow rate, cfh
VER = ventilation exchange rate, room exchange per hour
V_B = packaging building volume

Finally, an ethanol building concentration must be applied to the estimated fugitive volumetric flow rate to calculate an emission rate. Indoor air ethanol sampling was performed on November 5, 1993 at the railroad car staging on the northern third of the packaging building. The average indoor ethanol concentration of the two tests is 0.00505 mg/liter. The packaging fugitive test emission factor, 2.76 lbs/hr, is calculated using the following equation:

TEF = (C x Q_F x 28.32) ÷ 453,592 Equation 12

or, TEF = (0.00505 x 8,740,000 x 28.32) ÷ 453,592

where:

TEF = packaging fugitives ethanol test emission factor, lbs/hr
C = average railroad car staging area ethanol concentration, mg/liter
Q_F = fugitive volumetric flow rate, cfh
28.32 = liters cubic to feet conversion
453,592 = milligram to pounds conversion

Sodium Hydroxide

The primary source of sodium hydroxide emissions for the packaging facility include the two bottle wash lines and the keg wash portion of the keg-o-matic line. Modified EPA Method 5 sodium hydroxide sampling was performed at the keg-o-matic line on November 3, 1993 and the number two (2) bottle wash line on November 4, 1993.

Potentiometric titration hydroxide analysis of the keg wash test impinger solutions revealed low levels of hydroxide ion. The highest detected value was less than twice the detection limit.

The detection limit was assumed for all nondetected sample results and reported as less than the potential (at detection limit) sodium hydroxide catch. Sample break through was not observed. Table 4.7 presents the sample conditions, stack conditions and sodium hydroxide emissions for all three keg wash tests. All

TABLE 4.7

MILLER BREWING COMPANY
FULTON, NEW YORK

SUMMARY OF MEASURED SODIUM HYDROXIDE EMISSIONS FOR KEG OPERATIONS

Test No. Date Time	1 11/3/93 1247-1351	2 11/3/93 1424-1527	3 11/3/93 1556-1658	AVERAGE
Sample Conditions				
Volume (DSCF)[A]	55.892	55.021	55.573	55.495
Catch (mg)	<1.06	<0.696	<0.715	<0.824
Isokinesis (%)	91.3	98.1	97.6	95.7
Stack Conditions				
Flow Rate (DSCFM)[B]	2,900	2,660	2,690	2,750
Temperature (°F)	82	80	76	79.3
Moisture (%)	8.55	7.52	7.23	7.77
Stack Gas MW[C]	27.9	28.0	28.1	28.0
Sodium Hydroxide Emissions				
Concentration (ug/m^3)[D]	<670	<447	<454	<524
Mass Emission Rate (lb/hr)[E]	<0.00728	<0.00445	<0.00458	<0.00540

(A) Dry standard cubic feet at standard conditions (68°F, 29.92 in Hg).
(B) Dry standard cubic feet per minute at standard conditions.
(C) Stack gas molecular weight assuming 79% nitrogen and 21% oxygen.
(D) Concentration in micrograms per cubic meter (ug/m^3).
(E) Mass emission rate in pounds of sodium hydroxide per hour of operation (lb/hr).

test isokinesis were within 90 - 110%. The average keg wash sodium hydroxide mass emission rate/test emission factor (TEF) was <0.00540 lbs/hr of operation as calculated by applying the following equation:

$$TEF = (M \div SV) \times Q \times (1/453{,}592) \times 60 \qquad \text{Equation 13}$$

or,

$$TEF = (<0.824 \text{ mg} \div 55.495 \text{ DSCF}) \times 2{,}750 \text{ DSCFM } (1/453{,}592) \times (60)$$

where:

TEF = keg wash sodium hydroxide test emission factor, lbs/hr
M = average sodium hydroxide sample catch for three emission tests, mg
SV = average test sample volume, dry standard cubic feet
Q = average test flow rate, dry standard cubic feet per minute
1/453,592 = milligrams to pounds conversion
60 = minutes to hours conversion

The Number 2 bottle wash line was sampled for sodium hydroxide emission on November 4, 1993 using the same sampling (modified EPA Method 5) and analytical methods (NIOSH 7401) used for the keg wash sodium hydroxide sampling. Laboratory results revealed significant first impinger breakthrough. In order to compensate for any sampling train breakthrough all silica gel moisture gain was multiplied by the second impinger sodium hydroxide concentration. The resultant silica gel sodium hydroxide catch was added to the total impinger catch. Otherwise all test conditions for the three bottle wash sodium hydroxide tests were normal. Bottle wash sample conditions, stack conditions and sodium hydroxide emissions are summarized in Table 4.8. The average bottle wash sodium hydroxide mass emission rate/ test emission factor (TEF) was 1.25 lbs/hr of operation as calculated by applying Equation 13.

Chlorine

Chlorine samples were collected from the process vent servicing the B5 filling station on November 4, 1993 and a roof vent over line B13 while B12 was operating on November 5, 1993. Field data sheets are provided in Appendix C. Final sample volumes corrected to source conditions are provided in Appendix H. The ventilation/exhaust rates supplied by Miller via fan specifications are provided in Appendix I.

All packaging samples contained nondetected levels of chlorine. The average B5 test result was <0.0019 mg/l or 0.656 ppm. The average B13 test result was <0.00085 mg/l or <0.293 ppm. A faint chlorine

TABLE 4.8

MILLER BREWING COMPANY
FULTON, NEW YORK

SUMMARY OF MEASURED SODIUM HYDROXIDE EMISSIONS FOR BOTTLE WASH OPERATIONS

Test No. Date Time	1 11/4/93 0900-1003	2 11/4/93 1027-1129	3 11/4/93 1340-1442	AVERAGE
Sample Conditions				
Volume (DSCF)[A]	91.429	43.702	44.851	59.994
Catch (mg)	70.0	40.0	31.3	47.1
Isokinesis (%)	96.2	99.2	96.2	97.2
Stack Conditions				
Flow Rate (DSCFM)[B]	11,500	11,900	12,500	12,000
Temperature (°F)	68	63	69	67
Moisture (%)	4.33	4.72	4.22	4.42
Stack Gas MW[C]	28.4	28.3	28.4	28.4
Sodium Hydroxide Emissions				
Concentration (ug/m^3)[D]	27,000	32,300	24,600	28,000
Mass Emission Rate (lb/hr)[E]	1.16	1.44	1.15	1.25

(A) Dry standard cubic feet at standard conditions (68°F, 29.92 in Hg).
(B) Dry standard cubic feet per minute at standard conditions.
(C) Stack gas molecular weight assuming 79% nitrogen and 21% oxygen.
(D) Concentration in micrograms per cubic meter (ug/m^3).
(E) Mass emission rate in pounds of sodium hydroxide per hour of operation (lb/hr).

odor was detected at the B5 exhaust during the test. The recognition odor threshold for chlorine is 0.41 ppm (Leonardos, 1969). Therefore, since the B5 chlorine concentration could be less than the minimum detection limit (0.656 ppm) but still be perceived as a recognizable odor at 0.41 ppm, the minimum detection limit will be assumed as the B5 (and C6) exhaust concentration (0.656 ppm).

The chlorine emission from the B5 process vent was calculated as a test release rate by applying Equation 3 and converting to a pound per hour value for all three tests. The test emission factor is then calculated by averaging the three test release rates. The B5 test emission factor is <0.0436 lbs/hr. Since the C6 line is similar to the B5 line, the identical B5 test emission factor (<0.0436 lbs/hr) will be applied for the C6 filling line.

The B13 line chlorine samples also were reported by the laboratory as not detected. However, in this case, chlorine odors were not detected in the B13 exhaust or the other surrounding roof exhaust vents. Therefore, an exhaust chlorine concentration could not be assigned to any of the other remaining roof ventilators.

Formaldehyde

Indoor air in the packaging building was sampled for formaldehyde in order to confirm their insignificance as reflected in the Irwindale report (AV, 1991). As reported by the contract laboratory (EHL), the sample catch was below the minimum detection limit. Therefore, no further computations were made for formaldehyde.

4.5.2 Annex: Ethanol

Ethanol sampling was performed in the annex building on November 4, 1993. Triplicate samples were collected at the depalletizer unit (location 1B9) and on the catwalk on the opposite third of the building. Field data sheets are provided on Appendix C. Final sample volumes corrected to source conditions are presented in Appendix H. Ventilation/exhaust rates supplied by Miller via fan specifications.

All annex samples contained detectable levels of ethanol. All charcoal trap mass loadings were within the designed range. Therefore, sample breakthrough, if any, was insignificant. Analytical results are presented in Appendix E.

Emissions for the annex building were estimated by averaging the averaged observed ethanol concentrations at both sample locations mentioned above and multiplying by the total annex building exhaust rate. The annex building ethanol mass emission rate/test emission factor is 0.219 lbs/hr of operation as calculated by applying Equation 12 and substituting the total volumetric flow for each of the three 13,500 acfm exhaust vents. These calculations are provided in Table 4.5.

4.5.3 Other Emissions

There are a series of other chemicals that are used in packaging and these have been identified by Miller staff. The 1992 inventory is supplied in Table 4.9. The CIP within packaging generally consumes the chemical inventory listed. The specific atmospheric releases were not quantified by this test program. The inventory has not been verified. However, calculation of the specific atmospheric releases from this inventory has been attempted in Section 4.7.

4.6 Wastewater Treatment Plant

The wastewater treatment plant was tested for ethanol during the pretest and final test of the Fulton facility. The other air pollutants emitted at the wastewater facility were not measured and should be investigated further.

4.6.1 Ethanol

The sampling for ethanol occurred as part of the pretest survey where instantaneous values were measured. Grab samples (30-minutes) were taken during the full field effort. Both values were used in defining the ethanol release rate for the facility. Meteorology was collected during both field efforts so that diffusion modeling could be applied to calculate ethanol release rates from the various portions of the wastewater treatment plant. The plant for modeling purposes was divided into three areas: the equalization tank area, the primary clarifiers and the aeration basins. Other areas of the plant were not monitored. One could expect to see some release of ethanol at the bar screens for the plant which are

TABLE 4.9

MILLER BREWING COMPANY
FULTON, NEW YORK

1992 PACKAGING MATERIALS INVENTORY

Material	Annual Total Usage(bbl)
ACE-M-ALL Floor Cleaner	53
30% Phosphoric Acid	47
Clorinated Cleaner	36
Claro 50	38
Conveyor Lube	19,855
Bacto-Con	166
Ensure Quat	3
Potassium Hydroxide 11.25%,EDTA, Sodium Glucomate	55
Fome Add	2
Meaner Green	5 Totes
Isopropyl Alcohol	0
Mon-o-chlor	13
Muriatic Acid	80
N-Propyl Alcohol	5
PBC-10	10
16-2500 Ink	7*
16-2505 Make-up	22*
16-3400 Cleaner	22*
16-8200 Ink	39*
16-8205 Make-up	413*

*Cases

not located within the immediate wastewater treatment plant area. The emissions from the bar screens are difficult to quantify since they relate primarily to the volume of wastewater arriving at the plant (Table 4.10). However, as an estimate, the bar screen emissions were assumed to be equivalent to those at the equilization tank.

The emission rate (g/m^2-sec.) near the bar screen may be of the same order of magnitude as the equalization tank area. The actual emissions, though, should be relatively minor as the bar screen surface area is small as compared to the rest of the WWTP. However, since ethanol and other compounds are volatilized at this location, further testing is recommended.

Modeling for Ethanol Emissions at the WWTP

The U.S. EPA computer model CAL3QHC developed by the firm Parsons, Brinkerhoff, Quade and Douglas (1990) was chosen to simulate the ethanol dispersion characteristics in ambient air at the WWTP. This model was selected for its ability to predict near field receptor concentrations. Other similar models have not been as well documented in this regard.

By simulating ethanol dispersion in air using CAL3QHC and having sampled the air at selected locations (i.e., receptor sites) around the WWTP, emission release rates were developed for the three main WWTP areas (i.e., sources) identified above. The CAL3QHC modeling was operated based upon the idea that the model, originally developed to predict pollutant concentrations for mobile sources near roadway intersections, could be applied to the release of ethanol from a waste stream. This seemed reasonable for dispersion predictions given the short distances between sources and receptors modeled.

Other factors upon which the modeling was based included:

- Ethanol will behave as an inert pollutant similar to carbon monoxide over the distances modeled.
- The following ratios were equivalent: ethanol emission rate (g/m^2-sec.) : carbon monoxide emission rate and ethanol concentrations at the receptor sites where samples were taken: carbon monoxide concentrations at the same receptor sites.

TABLE 4.10

MILLER BREWING COMPANY
FULTON, NEW YORK

WASTEWATER TREATMENT PLANT CALCULATED ETHANOL EMISSION FACTORS

SOURCE	TOTAL AREA (m^2)	CALCULATED 1993 EMISSION FACTORS	
		(g/m^2 - sec)	(lbs/1000 bbls)
Equalization Tank Area	300	2.66×10^{-3}	10.5
3 Primary Clarifiers	650	2.56×10^{-4}	2.2
4 Aeration Basins	2,900	8.25×10^{-5}	3.2

- The influent waste stream channel, equalization tank, weir, etc. could be considered individual line sources, each with associated emission factors. These sources' emission factors were weighted by their associated surface areas and then summed to give a total emission factor for the equalization tank area. Similarly, discrete line sources, consisting of those WWTP components contributing emissions to a specified receptor, could have emission factors calculated based upon modeling results which were then weighted and summed to obtain a total source area emission factor.

- Emission factors for the individual line sources could be determined by matching the actual sampled concentrations to the concentration outputs from the model. This was done by initially assuming a source emission factor and then refining this assumption to match the observed data.

- The average sampled receptor concentration for ethanol at the various areas downwind were representative of normal plant operations.

- The meteorological data taken during sampling events was used for determining emission factors.

- No significant ethanol emissions occur after the aeration basins due to the biodegradation processes which occur within these basins limiting the amount of ethyl alcohol remaining in the wastewater.

The emission factors developed from the modeling and field sampling efforts are listed in Table 4.10. The modeling runs can be found in Appendix K.

4.7 Other Sources

There are several other sources which have been reviewed for their air pollutant emissions to complete the inventory. Mass balance equations can be used for these sources, except for drying spent grain as discussed in Section 4.7. The identified emissions from these other sources are ammonia from the refrigeration system, VOC from adhesives and inks and VOCs from drying spent grain. The cooling towers also emit a small amount of chlorine. The laboratories and underground fuel storage tanks do not have significant emissions based on other reports (AV, 1991-92). Quantities of purchased materials for the other sources are listed in Table 4.11, as provided by Miller.

4.7.1 Refrigeration System (EPA Form R Submission, 1993)

Ammonia is routinely emitted during normal operation of the refrigeration system at the facility. A

TABLE 4.11

MILLER BREWING COMPANY
FULTON, NEW YORK

OTHER SOURCES' MATERIALS INVENTORY

SOURCE	MATERIAL	ESTIMATED ANNUAL USAGE (lbs)
Refrigeration	Ammonia	67,742* 14,538**
Labels and Adhesives	Inks	9,410**
	Adhesives	NA
Laboratories**	Sodium Hydroxide	NA
	Hydrochloric Acid	NA
	Ammonia	NA
	Formaldehyde	NA
	Methanol	NA
	Potassium Dichromate	NA
	Mercuric Chloride	NA
Cooling Towers	Chlorine	15,278**
Fuel Storage Tanks	Gasoline	NA
	Kerosene	NA
	Fuel Oils(#1,#2 and #6)	NA
Drying Spent Grain	Grain	20646***

* From Fulton's 1993 EPA Form R Submission.
** From Irwindale's 1992 EIR using 5,305,000/5,480,000 = 97% as conversion factor.
*** From Fulton's 1992 NYS Fuel/Industrial Process Emission Survey.
NA - Not available

material balance can be performed to calculate these emissions using purchase records and the assumption that all ammonia which is not captured by water absorption at the wastewater treatment facility is emitted. The Fulton value as presented in the Form R Submission is significantly different than the Irwindale plant. These values are both presented in Table 4.11 for comparison.

4.7.2 Label Adhesives and Inks

The volatile organic compound emissions from adhesives and inks, which are used to package and label beer containers, may be determined using the following mass balance equation (AV, 1991-92):

$$AAE = (P - D) * Wf \qquad \text{Equation 14}$$

where:
AAE = average annual emissions, lbs/year
P = quantity of ink/adhesive purchased, lbs/year
D = amount of ink/adhesive disposed of, lbs/year
Wf = weight fraction of toxic in the inks, lbs/lbs

With this assumption, the total ink emissions including methanol and glycol ether are assumed to be 3,477 lbs/yr (3,200 lbs methanol and 277 lbs glycol ether).

In the case of label adhesives and inks, the quantities have been assumed to be 97% of those reported for the Irwindale facility by AV in the 1992 EIR (5,305,000 barrels @ Fulton : 5,480,000 barrels @ Irwindale = 97%). The Fulton values have been based on the Irwindale facility and are calculated in Section 5.7.

4.7.3 Laboratories

Air emissions from listed chemicals in the laboratories are minimal due to the small quantities used and the form in which the substances exist (many are in powdered form) (EPA Form R Submission, 1993). A listing of these compounds is provided in Table 4.11. Atmospheric releases from these sources were not calculated.

4.7.4 Cooling Towers

An emissions factor was applied by AV from 1989 Pasteurization Cooling Tower data in the emissions inventory at Irwindale whereas the Fulton 1993 EPA Form R Submission assumed the chlorine was essentially used up. The reported chlorine usage from Irwindale scaled down to Fulton would be 15,278 lbs/yr. The atmospheric release of chlorine in Irwindale was approximated based on the assumption that 3% of the inventory is released to the atmosphere.

4.7.5 Fuel Storage Tanks

The facility has the following fuel storage tanks:

- 520 gallon gasoline tank used for maintenance
- Two 570 gallon #1 diesel tanks for fire pumps
- 280 gallon #2 diesel tank for fire pumps
- 280 gallon kerosene tank for maintenance (refilled approximately four times per year)
- 10,000 gallon #2 diesel tank for wastewater treatment
- 38,000 gallon #2 diesel tank for utilities
- 24,000 gallon #6 fuel oil tank for utilities

These tanks do not have significant emissions either due to their low usage (i.e.: gasoline, kerosene, and #1 diesel) or low volatility (#2-#6 fuel oils).

4.7.6 Drying Spent Grain

Source testing was recommended to determine emission rates from the thermal drying of spent grains. However, no test was performed at the time of the facility test due to insufficient availability of the spent grains, as the grains are shipped off-site in the winter. Therefore, the only data currently available comes from the NYS 1992 Fuel/Industrial Process Emission Survey and this value is presented in Table 4.11.

5.0 DISCUSSION OF RESULTS

The results of the emission tests, annual usage rates and other data are used in this section to calculate the actual annual release rates and potential annual release rates. The sections that follow correspond to the sections presented in Section 4.0.

5.1 Raw Materials

There are two primary emissions that were identified by the inventory in addition to those already permitted. Ammonia and phosphine emissions for the Fulton facility are based on data from the Irwindale, CA facility.

Using Equation 2, the quoted ammonia and phosphine release rates for Irwindale are 8.3 lbs/yr and 14.1 lbs/yr, respectively. Applying a 0.97 conversion factor for Fulton (to match facility production rates) the actual and potential Fulton emission rates were calculated. The resulting rates are presented in Table 5.1. A similar procedure was followed in calculating the emission rates for grain storage. In this case, only 50% of the phostoxin was emitted. The resulting values are presented in Table 5.1.

5.1.1. Water Treatment

As previously indicated, the scrubbing and recovery of the gases during carbon regeneration results in no significant emissions for this process according to Miller staff.

5.2 Brewhouse

The brewhouse facility test emission factors calculated in Section 4.2 will be applied in this section to the 1993 brewing production values for the generation and presentation of estimated 1993 annual emission rates (AER) associated with brewhouse activities. Potential emission rates (PER) will be based on an extrapolated value of 6,040,000 barrels brewed to produce 8,000,000 finished barrels packaged at peak capacity.

5.2.1 Total Volatile Organic Compounds (VOCs)

The total VOC test emission factors for the brewhouse facility (Table 4.2) have been averaged for each location and presented in Table 5.2. There are five sources of VOC emissions in the brewhouse: kettle,

TABLE 5.1

MILLER BREWING COMPANY
FULTON, NEW YORK

RAW MATERIALS ACTUAL AND POTENTIAL EMISSIONS

COMPOUND/SOURCE	ACTUAL EMISSION ESTIMATE (lbs/yr)	POTENTIAL ANNUAL EMISSIONS (lbs/yr)
Ammonia		
- Grain transport	8.0	12.1
- Grain storage	11.7	17.7
Phosphine		
- Grain transport	13.7	20.7
- Grain storage	20.0	30.2

TABLE 5.2

MILLER BREWING COMPANY
FULTON, NEW YORK

BREWHOUSE ACTUAL AND POTENTIAL EMISSIONS

COMPOUND/SOURCE	TEST EMISSION FACTOR(1) (lb/1000 bbls)	1993 ANNUAL PRODUCTION(2) (bbls)	1993 ANNUAL AVERAGE EMISSIONS(3) (lb/yr)	POTENTIAL ANNUAL EMISSIONS(4) (lb/yr)
Volatile Organic Compounds				
Kettle	0.212	4000000	846	1278
Mash Tun	0.053	4000000	212	321
Hot Wort	0.017	4000000	69	104
Lauter Tun	0.005	4000000	22	33
Cooker	0.007	2880000	20	31
		Total	**1169(5)**	**1766**
Sodium Hydroxide				
Kettle	1.26E-05	4000000	0.05	0.08
Cooker	3.25E-06	2880000	0.01	0.01
Mash Tun	2.34E-06	4000000	0.01	0.01
Lauter Tun	2.34E-06	4000000	0.01	0.01
Hot Wort Tank	2.34E-06	4000000	0.01	0.01
Spent GrainTank	2.34E-06	4000000	0.01	0.01
		Total	**0.10(5)**	**0.15**

(1) Based on emission factor calculations presented in Section 4.2.
(2) Based on brewhouse process data presented in Appendix J.
(3) Result of the emission factor multiplied by 1993 annual production.
(4) Potential emissions (lbs/yr) are based upon a 8,000,000 barrel plant production capacity. A 1.51 conversion factor was used to translate the 1993 emissions to a potential emission value (8,000,000 bbls capacity/ 5,300,000 bbls 1993 production).
(5) VOC's Brewhouse = 1169 lbs/yr = 0.292 lbs/1000 bbls of finished beer.
NaOH Brewhouse = 0.10 lb/yr = 2.5x10 lbs/1000 bbls of finished beer.

mash tun, hot wort tank, lauter tun and cereal cooker. Each relative average test emission factor is then multiplied through by the 1993 brewery process volume calculated from brew data (See Appendix J) to obtain an annual emission rate in pounds per year.

All locations had an annual process value of 4,000,000 bbls. applied to the average test emission factors except for the cereal cooker. The cereal cooker is responsible for approximately 72 percent of the wort produced and the remaining 28 percent is brewed for Miller Lite which does not require the cereal cooker process. Therefore, the annual cooker process volume for 1993 is 2,880,000 bbls.

From the ratio of barrels brewed at capacity (6,0404,000 bbls) to the 1993 process value at the brewery (4,000,000 bbls), a factor of 1.51 is established. This factor is then used to multiply the 1993 annual emission rates to obtain the potential annual emission rates. The estimated 1993 kettle, mash tun, hot wort tank, lauter tun and cereal cooker VOC emission rates are 846, 212, 69, 22 and 20 lbs/yr, respectively. The estimated potential VOC emission rates are 1278, 321, 104, 33 and 31 lbs/yr, respectively. These values are listed in Table 5.2.

5.2.2 Sodium Hydroxide

The sodium hydroxide (NaOH) test emission factor for the brewhouse kettle (Table 4.2) was applied further for the brewhouse CIP. The triweekly brewhouse CIP was unable to be sampled and therefore, the following assumptions must apply. The brewhouse CIP is a caustic rinse of the cereal cookers, mash tuns, kettles, lauter tun, hot wort tanks and spent grain tank. It was assumed that the sodium hydroxide concentration from the kettle CIP that occurs after every other brew was equivalent to the concentrations in all brewhouse locations during the triweekly facility-wide CIP. Similarly, the actual gas flow rates were also assumed to be equivalent during the entire brewhouse CIP for all locations of the facility and, therefore, all test release rates are equal according to Equation 3.

The process volume for the triweekly CIP is estimated to be equal to three weeks of brewing (230,769 bbls). By using Equation 4, the test emission factors are calculated and directly applied to Table 5.2. Note that the calculated test emission factor for the kettle CIP has been added to the triweekly kettle CIP test emission factor in Table 5.2.

As discussed in Section 5.2, the annual process volume of 4,000,000 barrels of wort brewed is applied to the test emission factors to calculate an annual release rate. The cereal cooker annual release is based on a process volume of 2,880,000 barrels of wort brewed. Potential annual release rates are again calculated by multiplying the 1993 annual emission rate by a factor of 1.51 as done in Section 5.2. The 1993 annual emission rates and potential emission rates are listed in Table 5.2.

5.3 Cold Services

The cold services facility test emission factors calculated in Section 4.3 will be applied in this section to 1993 brewing production values for generation and presentation of estimated 1993 emissions associated with fermentation, ventilation and heat transfer, filtration, spent yeast tanks and aging processes. Potential emissions will be based on a 6,040,000 barrel plant production capacity from brewing.

5.3.1 Ethanol

The ethanol test emission factors for cold services facility (Section 4.3) have been applied to Table 5.3. The assigned average emission factor for each source is then multiplied by the 1993 annual production values supplied by Miller (see Appendix J) to calculate an annual emission rate. In Table 5.3, there are nine sources of ethanol emissions: heat wheel, fermentation, spent yeast, ventilation, surge tanks, primary filter, regular polish filter, draft polish filter, and cold filter.

Heat Wheel

The heat wheel test emission factors (Table 4.3) are further applied to Equation 6 to calculate the average test emission factor as discussed in Section 4.3. The calculated average test emission factor for the heat wheel is listed in Table 5.3.

To calculate the annual emission rate in pounds per year, the average test emission factor is multiplied by the 1993 annual production of brewed beer. Additionally, the potential annual emission rate is calculated by multiplying by the capacity to 1993 annual production factor of 1.51. The estimated 1993 heat wheel ethanol emissions are 5,314 lbs/yr. The estimated potential ethanol emission is 8,024 lbs/yr.

TABLE 5.3

MILLER BREWING COMPANY
FULTON, NEW YORK

COLD SERVICES ACTUAL AND POTENTIAL EMISSIONS

COMPOUND/SOURCE	TEST EMISSION FACTOR(1) (lb/1000 bbls)	1993 ANNUAL PRODUCTION(2) (bbls)	1993 ANNUAL AVERAGE EMISSIONS(3) (lb/yr)	POTENTIAL ANNUAL EMISSIONS(4) (lb/yr)
Ethanol				
Heat Wheel	1.33E+00	4000000	5313.84	8023.9
Fermentation	1.09E+00	4000000	437.84	661.14
Spent Yeast	4.05E-02	4000000	162	245
Ventilation	2.05E-02	4000000	82.19	124.11
Surge Tanks	6.13E-03	4000000	24.50	37.00
Primary Filter	1.61E-03	4000000	6.45	9.74
Regular Polish Filter	9.24E-04	4028000(5)	3.72	5.62
Draft Polish Filter	8.56E-04	1272000(5)	1.09	1.64
Cold Filter	3.32E-04	1272000(5)	0.42	0.64
		Total	**6032(6)**	**9108**
Sodium Hydroxide(7)				
Fermenter-NaOH	6.00E-05	4000000	0.24	0.36
Surge Tanks-NaOH	1.54E-06	4000000	0.01	0.01
		Total	**0.25(6)**	**0.37**
Chlorine				
Fermenter-Cl	1.60E-04	4000000	0.64	0.97
Surge Tanks-Cl	1.23E-05	4000000	0.05	0.07
		Total	**0.69(6)**	**1.04**

(1) Based on emission factor calculations presented in Section 4.3.

(2) Based on brewhouse process data in Appendix J.

(3) Result of the emission factor multiplied by 1993 annual production.

(4) Potential emissions (lbs/yr) are based upon a 8,000,000 barrel plant production capacity. A 1.51 conversion factor was used to translate the 1993 emissions to a potential emission value (8,000,000 bbls capacity/ 5,300,000 bbls 1993 production).

(5) Based on 1993 finished barrels of 5,300,000.

(6) Ethanol for Cold Services = 6044 lbs/yr = 1.14 lbs/1000 bbls of finished beer.
Sodium Hydroxide for Cold Services = 0.25 lbs/yr = 4.7 x 10 lbs/1000bbls.
Chlorine for Cold Services = 0.69 lbs/yr = 1.3 x 10 lbs/1000 bbls.

(7) Sodium hydroxide test emission factors are believed to be underestimated as discussed in Section 4.3. Therefore, sodium hydroxide emissions are also believed to be underestimated.

Fermentation

The fermentation test emission factors listed in Table 4.3 for ethanol have been summarized into one overall test emission factor listed in Table 5.3. This value, as discussed in 4.3, was calculated by taking the area under the curve generated by sampling over a 24-hour period and includes the fermentation displacement during the fill sequence and the two hour venting period prior to fermentation CIP.

The annual emission rate in pounds per year is then calculated by multiplying the average test emission factor by the 1993 annual brewing process volume. A further multiplication of 1.51 yields the potential annual emission rate. The estimated 1993 fermentation ethanol emission rate is 438 lbs/yr. The estimated potential ethanol emission rate is 661 lbs/yr.

Primary and Polishing Filters

The primary filter test emission factor for ethanol listed in Table 4.3 is applied directly to Table 5.3. The annual emission rates are calculated by multiplying the average test emission factor by the 1993 brewing process volume. The potential emissions are calculated by multiplying the actual 1993 value by 1.51. The estimated 1993 primary filter ethanol emission rate is 6.45 lbs/yr. The estimated potential combined primary filter ethanol emissions rate has been calculated to be 9.74 lbs/yr.

The polish regular filter test emission factor calculated in Section 4.3 is presented in Table 5.3. Note that the 1993 process volume that is used in the primary filter calculations is different than the 1993 process volume for both types of polishing filters. Up to this point, the annual process volume has been 4,000,000 barrels of beer brewed per year. However, prior to polish filtration and "D brew" is added to the beer. As a result, process volumes are increased by a factor of 1.325. Therefore, 4,000,000 barrels brewed is equivalent to the 5,300,000 finished barrels packaged and this increased value is now the 1993 process volume.

Between regular and draft beer, there is approximately a 76 percent and 24 percent split, respectively. Therefore, the 1993 process volume of the regular polish filter is equal to 4,028,000 barrels and the draft polish filter is 1,272,000 barrels. The 1993 process volume in finished barrels for these locations and the test emission factors are presented in Table 5.3.

The estimated 1993 regular polish filter and draft polish filter ethanol emission rates are 3.72 and 1.09 lbs/yr, respectively. The estimated potential regular polish filter and draft polish filter ethanol emission rates are 5.62 and 1.64 lbs/yr, respectively.

Ceramic Filtration System

The ethanol test emission factor for the ceramic filtration system calculated in Section 4.3 is presented in Table 5.3. The ceramic filter is responsible for the cold filtering of all nonpasteurized beer. The annual process volume for the nonpasteurized beer has been estimated from the total barrels brewed in 1993 and a 24 percent production of cold filtered beer; this being equivalent to 1,272,000 barrels as a process volume.

From these values, listed in Table 5.3, the estimated 1993 ceramic filter ethanol emission rate has been calculated to be 0.42 lbs/yr. The potential ceramic filter ethanol emission rate has been calculated to be 0.64 lbs/yr.

Spent Yeast Tank

The ethanol test emission factor for the spent yeast tank calculated in Section 4.3 is presented in Table 5.3. The spent yeast tank is a storage unit for all fermentation yeast filtered out of the beer. The annual process value for the spent yeast tank is equivalent to the annual barrels of beer brewed in 1993 and is listed in Table 5.3.

From the test emission factor and process volume, the estimated 1993 spent yeast tank ethanol emission rate has been calculated to be 162 lbs/yr. The potential spent yeast tank ethanol emission rate has been calculated to be 245 lbs/yr.

Ventilation

The ethanol test emission factor for the cold services ventilation calculated in Section 4.3 is presented in

Table 5.3. Unlike the heat wheel, this source is a general ventilation unit. The annual process volume for this source is equivalent to the annual barrels of beer brewed in 1993 and is presented in Table 5.3.

From the test emission factor and annual process volume data, the estimated 1993 ventilation ethanol emission rate has been calculated to be 82.2 lbs/year. The estimated potential ventilation ethanol emission rate has been calculated to be 124.1 lbs/year.

Surge Tanks

The ethanol test emission factor for the surge tank calculated in Section 4.3 is presented in Table 5.3. The calculation in Section 4.3 was based completely on the fill cycles of the surge tank. The annual process volume of the surge tank is equivalent to the annual barrels of beer brewed in 1993 and is presented in Table 5.3.

From the test emission factor and annual process volume, the estimated 1993 surge tanks ethanol emission rate has been calculated to be 24.5 lbs/yr. The estimated potential surge tank ethanol emission rate has been calculated to be 37 lbs/yr.

5.3.2 Sodium Hydroxide

The sodium hydroxide test emission factors for the cold services facility calculated in Section 4.3 have been presented in Table 5.3. Sodium hydroxide was tested for during a fermenter CIP cycle. The caustic usage during CIP is assumed to be consistent in the fermenters and surge tanks; the two primary locations of CIP in cold services. Therefore, the fermenter concentration and estimated flow rate have been assumed to be equivalent to a surge tank. The calculated test emission factors for these locations have been averaged and presented in Table 5.3.

The test emission factors for sodium hydroxide in cold services have been multiplied by the 1993 annual production values supplied by Miller (see Appendix J) to calculate an annual emission rate. The estimated 1993 fermenter and surge tank sodium hydroxide emission rates are 0.24 lbs/yr and 0.01 lbs/yr, respectively. The estimated potential fermenter and surge tank sodium hydroxide emission rates are 0.36

lbs/yr and 0.01 lbs/yr. The estimated potential sodium hydroxide emission rate is calculated by multiplying the 1993 emission rate by the capacity to actual levels factor of 1.51.

5.3.3 Chlorine

The chlorine test emission factors for the cold services facility calculated in Section 4.3 have been presented in Table 5.3. Chlorine was tested for during a fermenter CIP cycle. The chlorine usage during a CIP is assumed to be consistent in all fermenters and surge tanks. Therefore, the fermenter concentrations measured and estimated flow rates have been assumed to be equivalent to the surge tank. The calculated test emission factors for these locations have been average and presented in Table 5.3.

The test emission factors for chlorine in cold services have been multiplied by the 1993 annual production values supplied by Miller (see Appendix J) to calculate an annual emission rate. The estimated 1993 fermenter and surge tank chlorine emission rates are 0.64 lbs/yr and 0.05 lbs/yr, respectively. The estimated potential fermenter and surge tank emission rates are 0.97 lbs/yr and 0.07 lbs/yr, respectively. The estimated potential emission rate is calculated by multiplying the 1993 emission rate by the capacity to actual barrel production factor of 1.51.

5.4 Utilities

The utilities facility test emission factors calculation in Section 4.4 was applied to 1993 brewing production values for generation and presentation of estimated 1993 emissions associated carbon bed regeneration and utility ventilation units. Potential emissions will be based on a 6,040,000 barrel plant production capacity from brewing.

5.4.1 Ethanol

The carbon regeneration emission factor used to calculate the annual emission rates is presented in Table 5.4. The ethanol test emission factor per vent for the utilities facility was calculated (Section 4.4) and is used to determine the actual annual 1993 emission rate. Under average conditions, four vents are assumed to be operating. A total utilities test emission factor is then multiplied by the 1993 annual production values supplied by Miller (See Appendix J) to calculate an annual emission rate.

TABLE 5.4

MILLER BREWING COMPANY
FULTON, NEW YORK

UTILITIES ACTUAL AND POTENTIAL EMISSIONS

COMPOUND/SOURCE	TEST EMISSION FACTOR (1) (lb/1000 bbl)	1993 ANNUAL VOLUME PRODUCTION (2) (bbls/yr)-brew	1993 ANNUAL AVERAGE EMISSIONS (3) (lb/yr)	POTENTIAL ANNUAL EMISSIONS (4) (lb/yr)
Ethanol				
Utilities Vent	2.62E+00	4000000	10467	15804
Carbon Reg'n	3.00E-02	4000000	140	211
		Total	**10606(5)**	**16015**

(1) Based on emission factor calculations presented in Section 4.4.
(2) Based on brewhouse process data in Appendix J.
(3) Result of the emission factor multiplied by 1993 annual production.
(4) Potential emissions (lbs/yr) are based upon a 8,000,000 barrel plant production capacity. A 1.51 conversion factor was used to translate the 1993 emissions to a potential emission value (8,000,000 bbls capacity/ 5,300,000 bbls 1993 production).
(5) Ethanol for Utilities = 10,607 lbs/yr = 2.00 lbs/1000 bbls of finished beer.

The estimated 1993 carbon regeneration and utilities ventilation ethanol emission rates are 140 lbs/yr and 10,467 lbs/yr, respectively. The estimated potential ethanol emission rates for the carbon regeneration and utilities vents are 211 lbs/yr and 15,804 lbs/yr, respectively.

5.5 Packaging and Annex

Packaging and annex facility test emission factors calculated in Section 4.5 were applied to 1993 packaging production values for generation and presentation of estimated 1993 emissions associated with packaging and annex activities. Potential emissions will be based on a 8,000,000 barrel plant production capacity of finished product.

5.5.1 Packaging

Ethanol

Ethanol test emission factors for the packaging facility derived in Section 4.5 are presented in Table 5.5. As noted in this table, there are five major sources of ethanol emissions: bottling and canning lines, beer dump, bottle wash roof vents, keg-o-matic and fugitives. The assigned emission factor for each source is then multiplied by the 1993 annual production values as supplied by Miller (see Appendix J).

The bottling and canning lines 1993 annual production value was based on the facility's total 1993 production (5,300,000 barrels) of which 85.9% (4,500,000 barrels) consisted of bottled and canned beer. This production value was also assumed for the bottle wash roof vents where ethanol emissions are primarily influenced by bottling and canning activities.

The beer dump pass through volume was estimated by assuming 10% of the total 1993 packaging facility losses are processed at the beer dump. Packaging losses for 1993 are estimated to be 5.7% (average from January to August 1993) or 302,000 barrels. Ten percent of the 1993 total 302,000 barrel packaging loss (assumed beer dump pass through) would be 30,200 barrels. The keg-o-matic line production was provided by Miller.

TABLE 5.5

MILLER BREWING COMPANY
FULTON, NEW YORK

PACKAGING ACTUAL AND POTENTIAL EMISSIONS

COMPOUND SOURCE	TEST EMISSION FACTOR(1)	1993 ANNUAL PRODUCTION(2)	1993 ANNUAL AVERAGE EMISSIONS (3) (lb/yr)	POTENTIAL ANNUAL EMISSIONS(4) (lb/yr)
Ethanol				
Bottling/Canning lines	30.7 lb/1,000 bbls	4,550,000 bbls	140,000	211,000
Beer dump	1.74 lb/1,000 bbls	30,200 bbls (5)	52.5	79.37
Bottle wash roof vents	0.623 lb/1,000 bbls x2	4,550,000 bbls	5,670	8,560
Keg-o-matic	0.338 lb/1,000 bbls	750,000 bbls (6)	254	384
Fugitives	2.76 lb/hr	6,240 hrs/yr (7)	17,200	26,000
		Total	163,000 (8)	246,000
Sodium Hydroxide				
Keg wash	<0.00540lb/hr	4,896 hrs	<26.4	<39.9
Bottle wash unit #1	1.25 lb/hr	1,260 hrs	1,580	2,390
Bottle wash unit #2	1.25 lb/hr	5,688 hrs	7,110	10,700
		Total	<8,720(8)	<13,100
Chlorine				
Non-pasteurized bottling and canning lines (B5&C6)	<0.0436 lb/hr x 2	6,240 hrs (7)	<544 lb/yr	<821 lb/yr
Pasteurized bottling and canning lines	NA	–	NA	NA
		Total	NA	NA

(1) Based on test emission factor calculations presented in Section 4.5.
(2) 1993 annual production values provided by Miller except for ethanol fugitives which are released 24 hours per day, 5 days per week, 52 weeks per year.
(3) Result of the emission factor multiplied by 1993 annual production.
(4) Potential emissions (lbs/yr) are based upon a 8,000,000 barrel plant production capacity. A 1.51 conversion factor was used to translate the 1993 emissions to a potential emission value (8,000,000 bbls capacity/ 5,300,000 bbls 1993 production).
(5) Based on the assumption that 10% of the packaging beer losses pass through the beer dump. 1993 packaging beer losses are estimated to be 5.7% (average from January to August 1993) or 302,000 barrels.
(6) Keg-o-matic (keg 80) line consisted of 14.1% (750,000 bbls) of the 1993 production (5,300,000 bbls).
(7) 24 hours per day, 5 days per week 52 weeks per year.
(8) Ethanol Packaging = 163,000 lb/yr = 30.8 lbs/1000 bbls finished beer
Sodium Hydroxide Packaging <8,720 lbs/yr = <1.65 lbs/1000 bbls finished beer

NA = Not available

Fugitive emissions at the Miller facility were considered during a 24-hour per day, 5-day per week, 52-week per year production schedule. Therefore the test emission factor will be applied to 6,240 hours (6,240 hours/yr).

The estimated 1993 packaging facility ethanol emissions are calculated by multiplying the assigned test emission factor by the corresponding 1993 annual production value for each location presented in Table 5.5. The estimated total 1993 packaging facility ethanol emissions are 163,000 pounds (81.5 tons/year). The potential annual emissions are calculated by multiplying each 1993 emission value by the ratio of the facility's capacity to the actual 1993 production (8,000,000 barrel capacity/5,300,000 barrel 1993 production), 1.51. The resulting total potential packaging facility annual ethanol emission is 246,000 pounds per year (123 tons/year).

Sodium Hydroxide

Sodium hydroxide test emission factors for the packaging facility were derived in Section 4.5 and are presented in Table 5.5. There are three major sources of sodium hydroxide emissions in the packaging facility: keg wash (keg-o-matic line), bottle wash unit #1 and bottle wash unit #2. In the keg wash operation the method detection limit was used as basis for the factor.

Estimated 1993 packaging facility sodium hydroxide emissions are calculated by multiplying the test emission factor by the individual 1993 annual production value, as supplied by Miller (see Appendix J), for each line. The estimated total 1993 packaging facility sodium hydroxide emissions are <8,720 pounds (<4.38 tons/year). As mentioned earlier, a 1.51 conversion factor (8,000,000 barrel capacity/5,300,000 barrel 1993 product) was used to translate the 1993 emissions to a potential annual emission value. The total potential packaging facility annual sodium hydroxide emission is <13,100 lbs/year (<6.55 tons/year).

Chlorine

Chlorine test emission factors for the packaging facility are derived in Section 4.5 and presented in Table 5.5. Chlorine emissions data are limited.

Estimated 1993 packaging facility chlorine emissions could not be determined due to the limited nature of the field program, however, the 1993 chlorine emissions only for B5 and C6 nonpasteurized bottling and canning lines, respectively were defined as <544 pounds (<0.272 tons/yr) combined. Multiplying this value by the 1.51, 1993 annual to potential annual emission conversion factor, the resultant potential annual emission is <821 pounds (<0.411 tons/year). This value is obviously an over estimate since the overall production for both lines can only increase by a factor of 1.40 (8,760 hours/6,240 hours). The 1993 annual production in hours of operation was assumed to be 6,240 hours (24 hrs/day, 5 days/wk, 52 wk/year) for each line. The potential hours of operation is 8,760 (24 hrs/day, 365 days/year).

5.5.2 Annex

Ethanol

The annex ethanol test emission factor derived in Section 4.5 is presented in Table 5.6. The three annex building exhaust fans were assumed to operate 24 hours per day, 365 days per year (8,760 hours per year). The annex building 1993 ethanol emission for each vent was calculated by multiplying the test emission factor by the 1993 hours of operation. The individual 1993 ethanol emission for each vent was 1918 pounds. The estimated total 1993 packaging facility ethanol emissions are 5755 pounds per year. Once again, the potential annual ethanol emission rate for the annex was calculated by multiplying by the standard 1.51 conversion factor (8,000,000 barrel capacity/5,3000,000 1993 barrel production). The potential annual annex ethanol emission is 8,688 pounds/year.

5.6 Results of WWTP Ethanol Emission Calculations

5.6.1. Modeling Results

The output of the CAL3QHC modeling using field sampling results determined the ethanol emission factors in lbs./1000 bbls. for each source area as shown in Table 4.10. These emission factors were then applied to the 1993 annual production of 5,300,000 bbls. and potential annual production of 8,000,000 bbls. to determine the total annual ethanol emissions for each source area (see Table 5.7). These figures were totaled for the WWTP: 1993 actual emissions were 84,300 lbs. or 42.2 tons and potential annual ethanol emissions could be 63.7 tons.

TABLE 5.6

MILLER BREWING COMPANY
FULTON, NEW YORK

ANNEX ACTUAL AND POTENTIAL EMISSIONS

COMPOUND/ SOURCE	TEST EMISSION FACTOR (1) (lb/hr)	1993 ANNUAL HOURS OF OPERATION(2)	1993 ANNUAL AVERAGE EMISSIONS (3) (lb/yr)	POTENTIAL ANNUAL EMISSIONS(4) (lb/yr)
Ethanol				
Roof vent #1	0.219	8,760 hrs	1,918	2,896
Roof vent #2	0.219	8,760 hrs	1,918	2,896
Roof vent #3	0.219	8,760 hrs	1,918	2,896
		Total	**5,755**	**8,688**

(1) Based on emission factor calculations presented in Section 4.5.
(2) 1993 annual production values based on exhaust fans running 24 hours per day 365 days per year.
(3) Result of the emission factor multiplied by 1993 annual production.
(4) Potential emissions (lbs/yr) are based upon a 8,000,000 barrel plant production capacity. A 1.51 conversion factor was used to translate the 1993 emissions to a potential emission value (8,000,000 bbls capacity/5,300,000 bbls 1993 production).
(5) Ethanol Annex = 5,755 lb/yr = 1.09 lbs/1000 bbls finished beer.

TABLE 5.7

MILLER BREWING COMPANY
FULTON, NEW YORK

WASTEWATER TREATMENT PLANT ACTUAL AND POTENTIAL EMISSIONS

COMPOUND/SOURCE	1993 ACTUAL EMISSION ESTIMATE (lbs/yr)	POTENTIAL ANNUAL EMISSIONS (lbs/yr)
Ethanol		
- Equalization Tank Area	55,400	83,700
- 3 Clarifiers	11,700	17,700
- 4 Aeration Basins	17,200	26,000
Total	**84,300**	**127,400**

5.6.2 Comparison to Coors Study

The Coors Study (Coors, 1992) used the BASTE model developed by CH2M-Hill to represent the Golden, Colorado brewery's Process Waste Treatment Plant (PWTP). The average influent to the Coors PWTP was 5.7 million gallons per day with an average ethanol concentration of 600 parts per million. The output of the BASTE model indicated an annual emissions of 77.5 tons of ethanol. In comparison, Fulton's WWTP had an average of 3.5 million gallons per day with an average ethanol concentration of 570 parts per million. The CAL3QHC modeling resulted in estimated 1993 ethanol emissions of 42.2 tons. If the Fulton WWTP processed the same quantity of liquid waste as the Coors PWTP, the Fulton WWTP 1993 ethanol emissions would be 68.7 tons. Given all the variables involved, these results are consistent and add validity to the modeling procedure.

5.6.3. Comparison to EPA's Industrial WWTF VOC Emission Estimates

In sharp contrast to the similar results found between the Fulton CAL3QHC modeling of the WWTP and the Coors BASTE modeling of their PWTP, the typical values for VOC emissions from industrial wastewater developed by EPA (EPA, 1990) are 1-2 orders of magnitude different.

EPA has developed correlations of VOC mass fraction emitted as a function of Henry's Law Constant to estimate VOC emissions from various sources at a 'typical' wastewater treatment facility. In a sample calculation by EPA with given waste stream influent conditions, it was found that the adjusted mass fraction of acetaldehyde emitted from a clarifier was 1.44×10^{-5}. Since the Henry's Law constants for acetaldehyde is 5.5 atm/mole fraction and for ethanol it is 4.5 atm/mole fraction, the mass fraction of ethanol emitted from a clarifier would be predicted to be on the order of 10^{-5} in magnitude.

This may be compared to the Fulton WWTP value for the clarifiers obtained from the CAL3QHC model. If there was approximately 10% of the 5,300,000 bbls. of beer in the 1993 WWTP waste stream with approximately 3.5% ethanol, then there was approximately 3.9 million lbs. of ethanol in the waste stream. Given the 3,900 lbs. of calculated emissions from the Fulton clarifiers results in a mass fraction of emitted ethanol of 1.0×10^{-3}, instead of 10^{-5}. Similarly, the EPA sample calculation gives acetaldehyde adjusted mass fraction of VOC emitted for an aerated biobasin as 0.0168, and therefore, 10^{-2} order of magnitude for ethanol emissions. Using the calculated emissions of 4,300 lbs. for a Fulton aeration basin results in a mass fraction of 1.1 x 10^{-3}. Finally, the EPA's adjusted mass fraction for nonaerated equalization basins is 0.262 or 10^{-1} in magnitude. This is in contrast to the modeling results of 55,400 lbs. of ethanol emitted in 1993 at Fulton's WWTP which results in the mass fraction emitted of 1.4 x 10^{-2}.

The dissimilar results of the modeling approaches versus EPA's generic VOC emission values are beyond the scope of this report. However, this warrants further investigation.

5.7 **Other Sources**

A review of the data indicates a few significant discrepancies between the values in AV's emissions inventory for the Irwindale facility and in quantities reported for the Fulton facility on the 1993 EPA Form R Submission. These concern ammonia in the refrigeration system and chlorine in the cooling towers. The other areas were emissions are occurring were examined and air pollutant emission estimates were made where possible. However, these should be investigated further to more accurately assess the actual and potential emissions. The emission rates for the following processes have been summarized in Table 5.1.

5.7.1 Refrigeration Systems

Mass balance calculations performed by AV for the Irwindale EIR indicate 4,496 lbs/year of ammonia was emitted to the atmosphere. According to the 1993 EPA Form R submission calculations 67,742 lbs in 1992 of ammonia were used in refrigeration. Plant staff has estimated 105 lbs/day of ammonia is discharged to the wastewater treatment plant. This results in 29,442 lbs/yr being emitted. The plant values differ by a factor of more than 6.5, with the Fulton plant being significantly higher.

5.7.2 Labels and Adhesives

In the case of label adhesives and inks, the quantities have been assumed to be 97% of those reported for the Irwindale facility by AV in the 1992 EIR. The Irwindale values have been used to estimate the emissions of volatile organic compounds and these values are presented in Table 5.8.

TABLE 5.8

MILLER BREWING COMPANY
FULTON, NEW YORK

OTHER SOURCES ACTUAL AND POTENTIAL EMISSIONS

COMPOUND/SOURCE	ACTUAL EMISSION ESTIMATE (lbs/yr)	POTENTIAL ANNUAL EMISSIONS(2) (lbs/yr)
Ammonia		
- Refrigeration	29,442(1)	44,457
Volatile Organic Compounds		
- Inks and adhesives	3,477	5,250
- Spent grain drying	54,500	82,295
- Fuel storage	NA	NA
Chlorine		
- Cooling towers	458(3)	692

NA - Not available
(1) Annual 1992 usage and 43% is released to atmosphere(Form R).
(2) Assumes a factor of 1.51 times actual.
(3) 3% of total inventory based on 15,278 lbs. from Irwindale (AV,1992).

5.7.3 Laboratories

The AV documentation for Irwindale as well as the 1993 EPA Form R submission concur that the laboratories do not produce any significant emissions.

5.7.4 Cooling Towers

According to the NYS 1992 Fuel/Industrial Process Emission Survey and the EPA 1993 Form R Submission, the facility emitted a total of 5 lbs. of chlorine gas. However, AV's 1992 EIR calculated for the utilities cooling tower chlorine emissions of 32 lbs. based on 1800 lbs. chlorine injected and for the pasteurizer cooling tower 499 lbs. of chlorine emitted based on 13,950 lbs. of chlorine injected. In addition, the pasteurizer cooling tower emitted 3,785 lbs. of glutaraldehyde according to AV calculations. The Irwindale values are used in Table 5.8 to estimate Fulton release rates. Ambient air concentration profile testing could help to resolve this discrepancy.

5.7.5 Fuel Storage Tanks

As previously indicated, no emission calculations were performed for the fuel storage tanks because of either low usage or fuel volatility.

5.7.6 Drying Spent Grains

According to the NYS 1992 Fuel/Industrial Process Emission Survey for the Fulton facility, there were 20,647 tons of spent grain which were thermally dried. This resulted in emissions of 54,500 lbs. of VOCs. There are also emissions associated with the fuel combustion for thermal drying which should be determined during evaluation of combustion sources.

6.0 SUMMARY AND CONCLUSIONS

The development of an air pollutant emissions inventory for the Fulton facility required extensive source testing and data analysis. The process was compressed by budgetary and time constraints which imposed limitations on this report. Also, the primary pollutants of concern for the inventory were volatile organic compounds from the brewhouse and ethanol emissions from the remainder of the plant. As an adjunct to the testing, sodium hydroxide, ammonia, chlorine and formaldehyde for only specific sources, were added to the overall test program. Thus, the inventory, although extensive, has its limitations. The report has been compiled in a fashion that would allow the data collected and the factors developed to be easily adjusted for use at other facilities.

A summary of the emission inventory results for each target compound tested is provided in Table 6.1. The data is presented in pounds per year and in pounds per 1000 barrels of finished product. The pounds per year values are divided by the 1993 Fulton facility finished product volume of 5,300,000 barrels per year to provide the release rate in pounds per 1000 barrels of finished product.

The individual emission factors that comprise each of the areas identified in Table 6.1 are provided in Section 5.0. The specific rationale associated with those emission factors are provided in Section 4.0. The source testing methods used and analytical methods applied to the samples are also provided to present a complete basis for each emission factor that was developed.

Caution must be taken in applying these values. Direct comparisons to other facilities should be on the same basis for all sources contributing to the overall factor in each area. For facilities with differing equipment or processes approaches it may be necessary to adjust the factors presented herein.

It is also important to recognize that the emissions inventory of the processes occurring at Fulton requires a variety of currently available methods. In some cases, methods specifically designed to monitor the sources had to be modified because the source characteristics are complex. For a simple source, source sampling normally occurs under steady state conditions. For complex sources, steady state conditions are not achieved, therefore, more effort is required in developing the appropriate sampling approach and in evaluating the data that results.

A comparison of the values presented in Table 6.1 for the Fulton facility has been made to the Coors facility where extensive testing was also performed for ethanol. A comparison of the two facilities (Fulton and Coors) on an equivalent barrels of finished product basis reveals similarities and differences. The normalized Coors facility inventory for ethanol indicates a total of 188 tons per year versus Fulton

TABLE 6.1

MILLER BREWING COMPANY
FULTON, NEW YORK

SUMMARY OF 1993 ACTUAL EMISSIONS

COMPOUND/ SOURCE AREA	1993 ACTUAL ANNUAL EMISSIONS (lb/yr)	FULTON 1993 EMISSION FACTOR (lbs/1000 bbls)
Ethanol:		
Brewhouse Area	--	--
Cold Services Area	6,032	1.14
Utilities Area	10,606	2.00
Packaging Area	163,000	30.8
Annex Area	5,755	1.09
Wastewater Treatment Area	84,300	15.9
Total	**269,694**	**50.9**
Volatile Organic Compounds:		
Brewhouse area only	1,169	0.292
Inks and adhesives	3,477	0.656
Spent grain drying	54,500	10.28
Total	**59,146**	**11.2**
Sodium Hydroxide:		
Brewhouse Area	0.10*	--
Cold Services Area	0.25*	--
Packaging Area	8,720	1.65
Total	**8,720**	**1.65**
Ammonia:		
Raw Materials	19.7	–
Refrigeration	29,442	5.55
Total	**29,462**	**5.55**
Chlorine:		
Cold Services	0.69	--
Packaging (Line B5 & C6 only)	544	0.103
Cooling Towers	458	0.086
Total	**1,003**	**0.189**

Note: lbs/1000 bbls of finished product.
Other minor constituent compounds are included in the text.
* A review of source test data indicates that these values may be significantly underestimated.

which is 135 tons per year. The brewhouse volatile organic compound emission factor for Coors is 1.04 lbs/1000 bbls versus 0.292 lbs/1000 bbls at Fulton. Coors reports that an additional 43.9 lbs/1000 bbls of volatile organic compounds are released in other areas of the facility. These other areas at Fulton were not tested for these compounds. However, the value presented by Coors appears to be quite high especially for the bottle wash activity and is not recommended for use at Fulton.

In summary, the test data and process evaluations indicate a significant inventory of air pollutants are emitted into the atmosphere. The inventory also uncovered several areas where additional tasks will need to be performed to complete the inventory process. And finally, a comparison of the data to other facilities indicates a reasonable agreement in the overall emission values considering the significant differences that exist between facilities and potential differences in the estimating of final release rates.

REFERENCES

EPA, 1991, Standards of Performance for Stationary Sources, 40 CFR Part 60, Appendix A.

Heidt, W. Zimmerman J., and Varani F., Coors Brewing Company 1992, Clean Air Act Impacts on the Brewing Industry.

AeroVironment Inc., 1989 and 1991, AB2588 Emission Inventory Plan and Update for Miller Brewing Company's Irwindale California Facility

AeroVironment Inc., 1990 and 1992 AB2588 Emission Inventory Report and Update for Miller Brewing Company's Irwindale, California Facility

Leonardos G., D. Kendall & N. Barnard (1969). Odor Threshold Determinations of 53 Odorant Chemicals. J. Air Pollution Control Association, 19, 91-95

Miller Brewing Company, 1993, NYSDEC 1992 Fuel Industrial Process Emission Survey for Fulton Facility

Miller Brewing Company, 1993, EPA Section 313 Form R Submission for Fulton Facility

Parsons, Brinkerhoff, Quade, Douglas for USEPA 1990, User's Guide to CAL3QHC

Radian Corporation for USEPA 1990, Industrial Wastewater Volatile Organic Compound Emissions -- Background Information for BACT/LAER Determinations.

APPENDIX A
EMISSION TEST PLAN

Miller Brewing Company
Fulton, New York

EMISSION INVENTORY REPORT

JANUARY 1994

APPENDIX A

Miller Brewing Company
Fulton, New York

EMISSION TEST PLAN

DATE: October 31, 1993

Sunday PM

SITE SETUP/MOBILIZATION

Test team members arrived onsite on Sunday afternoon between 2 PM and 3 PM. The Sunday activities were as follows:

- Signed in at main gate security
- Safety orientation
- Equipment unloading and staging
- Inventory checklist
- Staging area setup for battery and analyzer charging, calibrations, sample processing, packaging and shipping
- Setup MIRAN, initial calibration
- Setup ORSAT
- Check out ports for sampling brewing activities
- Meteorology equipment set up
- Assignments for Monday testing

EMISSION TEST PLAN

DATE: November 1, 1993

Monday AM & PM

BREWHOUSE/HOTSIDE TESTS Location: Roof of Brewhouse

- Two (2) modified VOST tests were performed at the Lauter Tun, Mash Tun and Kettle at 0.5 (L/min)
- Velocity traverse and flow rates were established at each location during testing.
- Temperatures and pressures were recorded for each location both stack and ambient.

OTHER TESTS

- Three (3) ethanol tests were performed at Packaging vent B-13 (EF2) onto charcoal tubes.
- MIRAN and ORSAT calibrations were performed.
- Collected condensate vial for VOC sample from the steam vent on the 6th floor of the brewhouse.

Notes:

- VOST train consisted of 2 charcoal traps in series; knock out impinger is located in front of the two traps.

EMISSION TEST PLAN

DATE: November 2, 1993
Tuesday (all day) and into Wednesday AM

BREWHOUSE/HOTSIDE TESTS (Concluded)

- One (1) modified VOST test was performed at Lauter Tun, Mash Tun and Kettle with corresponding flows.
- Three (3) modified VOST tests were performed at the Cereal Cooker stack with corresponding flows.
- Sodium hydroxide NIOSH testing was performed at the Kettle during a CIP process.

VERTICAL FERMENTER ETHANOL TESTS

- Tested for venting to atmosphere at base of B-3 fermenter.
- Sample bags purged 3X, then on collect for 20 minutes.
- Loaded charcoal traps based on MIRAN test.
- Performed ORSAT, as necessary.
- Repeated 9 times during 21 hour venting to atmosphere cycle.

VERTICAL FERMENTATION CIP TESTS

Established a point for sampling (B-1 fermenter).
CIP - sodium hydroxide (3) 15 minute samples were collected during caustic rinse (filtered 1 L/min).
- chlorine rinse (1) sample was collected during rinse cycle (wet impinger 1 L/min for 15 min).

EMISSION TEST PLAN

November 2, 1993
(Continued)

HEAT WHEEL TEST (24 hour test)

Test #1	30 minute sample for ethanol was collected for both inlet & outlet vents.
Remaining Tests	Sampled at 0.5 L/min for 30 minutes at inlet & outlet every 3 hours.

CARBON BED REGENERATION TEST (24 hour test)

- 15 minute bag samples collected every three hours, screened with the MIRAN and appropriate sample volumes were then transferred onto charcoal traps.
- Temperature and exit velocity measured.
- Process data for the regeneration cycle was collected.

KEG/BOTTLE WASH

- Installed sampling equipment. Tests for sodium hydroxide isokinetically on following day.

EMISSION TEST PLAN

DATE: <u>November 3, 1993</u>

Wednesday AM & PM

(Completion of Fermentation, Heat Wheel and Carbon Bed Regeneration Tests)

BREWHOUSE

- Sampled hot wort tank during fill cycle. A 6 minute sample for VOC's at 1 L/min. sample rate was collected.

KEGWASH

- Ran three 1-hour Method 5 isokinetic tests for hydroxide ion (3 point traverse).

OTHER TESTS

- Spent Yeast Tank - One (1) sample collected from vent line #34 and evaluated for ethanol. Time of collection depended on filling cycle. Screened w/MIRAN and metered onto charcoal trap.
- Ceramic Cold Filter Trap - One (1) bag sample collected from vent line #25 and evaluated for ethanol w/MIRAN and metered onto charcoal trap.
- Package Release - Collected bag sample for ethanol, analyzed with MIRAN and loaded charcoal trap accordingly.
- Fermenter Purge - Collected 1 liter sample from vent line #44 directly onto charocal traps (performed on 11/2/93)
- CO_2 Purge Primary Filter - Collected 2 liter sample from vent line #7 directly onto charcoal traps (performed on 11/2/93)
- Utility Exhaust Fans - Collected samples for ethanol directly onto charcoal traps from two of the exhaust fans in utilities.

EMISSION TEST PLAN

DATE: November 4, 1993

Thursday - AM & PM

PACKAGING

- o Non-Pasteurized Lines
  - Sampled for ethanol at a rate of 0.5 L/min for 30 minutes directly onto charcoal tubes
  - Three (3) ethanol samples from Line #B5 vent
  - Collect chlorine bubbler three (3) samples (30 minutes each)

- o Pasteurized Lines
  - Sampled for ethanol at a rate 0.5 l/min for 30 minutes directly on charcoal tubes
  - Three (3) samples were taken at each of the following locations:

Line # B13 A/B vent locations
Line # B4 A/B vent locations
Line # C9 A/B vent locations

WASTEWATER TREATMENT PLANT

- o Ambient VOST tests were run with concurrent meteorology
- o Three (3) samples for ethanol from four (4) locations, one background sample
- o Wind directions for testing (south through west)
- o Meteorology unit set for 15 minute sampling intervals

UTILITIES

- o Collected chlorine bubbler samples (3 total) 30 minutes each at 1 L/min
- o Collected four (4) ammonia traps for 30 minutes at 0.2 L/min.

BOTTLE WASH

Ran three 1-hour Method 5 isokinetic tests for hydroxide ion. Selected vent for the bottle wash line that was operating (3 point traverse).

ANNEX

- o Collected six (6) ethanol samples inside the annex area at 0.5 L/min for 30 minutes.

EMISSION TEST PLAN

November 4, 1993
(Continued)

OTHER TESTS

- o Fermenter C-8 Test - Collected two supplemental ethanol samples. Collected bag samples, screened with MIRAN and loaded charcoal traps.
- o Formaldehyde Samples - Collected three (3) detector tubes from packaging area exhaust vent at 0.5 L/min for twenty minutes. (Vent EF-29)

EMISSION TEST PLAN

DATE: November 5, 1993

Fridav AM & PM

BEER DUMP

- o 8 AM - 10 AM only. Collected three (3) ethanol samples. (30 minutes each 0.5 L/min)

PACKAGING

- o Pasteurized Line
- Collected chlorine bubbler samples (2) 30 minutes each at 1 L/min from vent on line B13.
- Collected three (3) ethanol samples for 30 minutes at 0.5 L/min from Vent EF29.

FUGITIVE/STORAGE

- o Collected two ethanol samples in storage area at 0.5 L/min for 30 minutes.

VERTICAL FERMENTER

- o While on collect took bag samples from B-3, ran Draeger Tube and loaded trap, accordingly.

OTHER TESTS

- o Collected ethanol and VOC samples from 2X2 duct over cold services for 30 minutes at 1 L/min directly onto charcoal traps.
- o Carbon dioxide storage tank ethanol samples - collected bag samples, analyzed for ethanol and loaded traps accordingly.

SITE DEMOBILIZATION

- o Demobilized and left site at 3 PM.

EMISSION TEST PLAN

DAILY ACTIVITIES SHEET

1. SCHEDULE REVIEW OF DAY'S ACTIVITIES
2. ASSIGNMENT OF STAFF
3. ASSIGNMENT OF EQUIPMENT/SUPPLIES
4. ASSIGNMENT OF RESPONSIBILITIES, REVIEW OF TASKS AND CHECKLIST
5. HOURLY SCHEDULING AND ADJUSTMENTS
6. CONTACT POINTS/INDIVIDUALS AT MILLER AND TEST TEAM
7. EMERGENCY PROCEDURES AND TROUBLESHOOTING PROCEDURES
8. CHECK-IN AND FIELD REPORT @ 12 NOON AND 3 PM
9. STAFFING ASSIGNMENTS FOR EVENING AND FOLLOWING DAY SHIFTS
10. EQUIPMENT/SUPPLIES REQUIREMENTS FOR EVENING AND NEXT DAY CHARGING/CALIBRATION, ETC.
11. CHECK LIST REVIEW AT THE CONCLUSION OF EACH ACTIVITY

APPENDIX B
TEST PROTOCOLS AND ANALYTICAL METHODS

Miller Brewing Company
Fulton, New York

EMISSION INVENTORY REPORT

JANUARY 1994

GENERAL TEST PROTOCOL REQUIREMENTS

1. Fill in check list before going to a sample site location when returning.
2. Record flows and check flow directions through all collection tubes.
3. Record notes on all process operations.
4. Keep accurate time on/off records for all activities.
5. Before you leave a location make sure all sample data sheets are fully completed.
6. Use your sample gloves (white nylon) when handling traps or connections.
7. Reconfirm all labelling on all sample traps.
8. Do not leave any equipment materials new or old a sample site locations.

APPENDIX B

Miller Brewing Company
Fulton, New York

TEST PROTOCOLS AND ANALYTICAL METHODS*

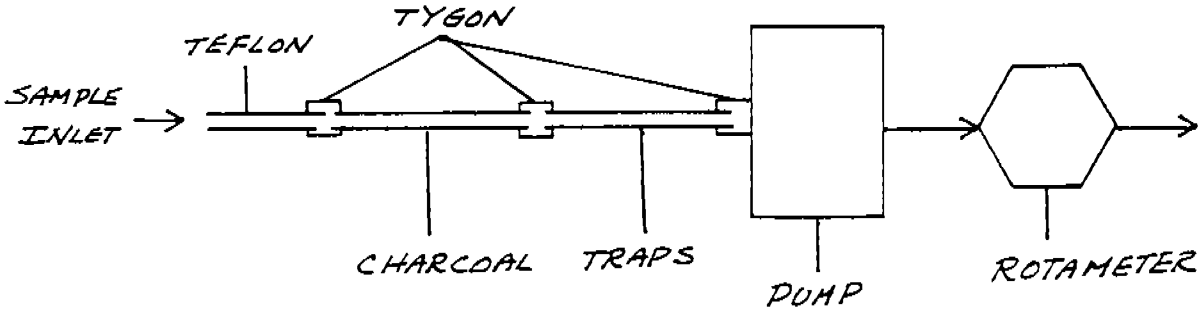
Summary of Compounds and Methods:

Compound	**Test Method**
Ethanol	Charcoal tubes for GC FID analysis Tedlar bags for MIRAN analysis Tedlar bags for Draeger Tube analysis
Volatile Organic Compound	Charcoal tubes for GC FID analysis
Sodium Hydroxide	EPA Method 5 train and impregnated filter cassettes for CIP activities. Analysis by NIOSH P&CAM 127
Chlorine	Mini impinger, analysis via OSHA 101
Ammonia	OSHA Method S347 Modified NIOSH P&CAM 205
Formaldehyde	EPA T011

*Note: Excerpts on specific analysis methods have been attached.

TEST PROTOCOL FOR ETHANOL:
LOW MOISTURE/LOW CONCENTRATION

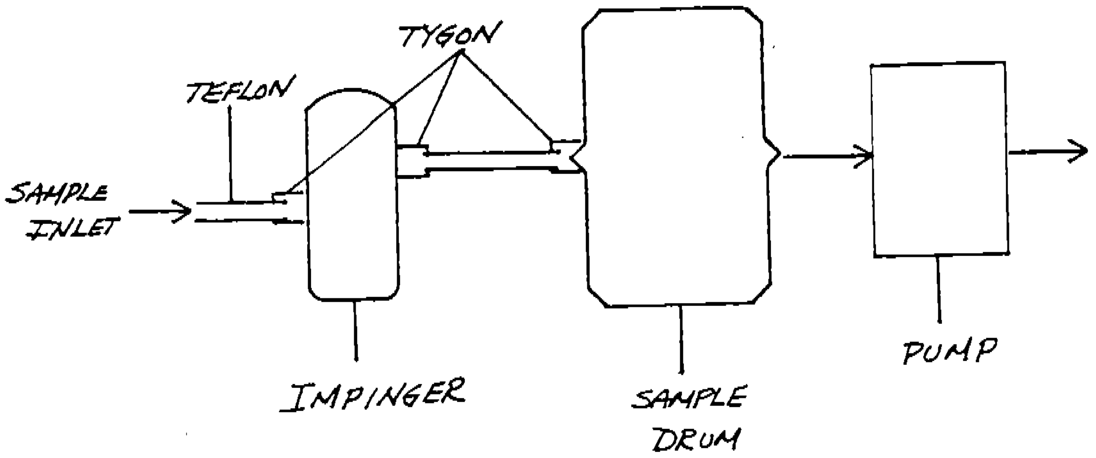
Sampling Train



1. Take sampling train to sampling location and check process operations.
2. Assemble train (Note flow direction on traps).
3. Record data on sample data sheets: time, location, personnel, temperature, rotameter, pump, etc.
4. Run train for 30 minutes at 1/2 L/min recording sample flowsat start and end of run.
5. Recover traps cap, log, label.
6. Remove equipment form site and forward samples to laboratory for analysis.

TEST PROTOCOL FOR ETHANOL: HIGH MOISTURE/HIGH CONCENTRATION

Sampling Train



Notes:

- Impinger must be cool. Put in 1 gallon baggy with ice.
- Obtain a bag volume at end of sample.

1. Take sampling train to sampling location and check process operations.
2. Assemble train position inlet open valve to bag.
3. Run 3 purges. 5 L/min for 4 minutes each.
4. Discard impinger fluid (impinger optional if condensate in bag is not present).
5. Reassemble train complete sample data sheet and run test.
6. Set at 20-30 minutes for 3-4 L/min rate. Occasionally, observe bag filling.
7. Stop sample at near full bag, close bag, pull out stop valve and tighten set and screw.
8. Measure volume in bag by squashing bag into drum and approximate volume. Get to nearest 1/8 cu ft.

TEST PROTOCOL FOR ETHANOL: HIGH MOISTURE/HIGH CONCENTRATION

(Continued)

9. Collect impinger sample note volume in VOA vial, top off with DDI and log, label and store.

10. Mark level, label bag and take to staging area for recovery.

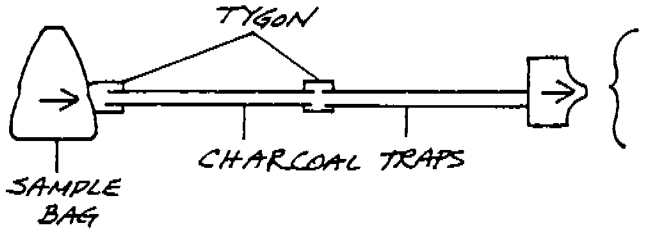
11. Use MSA tube or syringe to pull sample into MIRAN or direct inject into MIRAN.

12. Record MIRAN reading if over scale, pull a Draeger tube and record result.

13. Calculate loading based on bag concentration.

14. Load charcoal traps using syringe or VOST module or calibrated pump. Use the collection train configurations illustrated below.

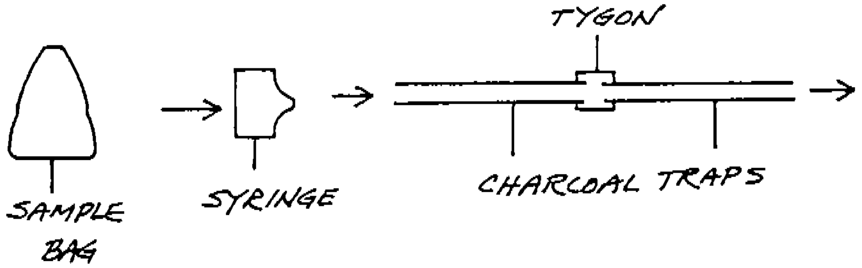
Collection Train: (>20 ml sample)



<20 ml of sample direct inject
20-500 ml pull syringe
500 + ml use VOST module

Note: For less than 20 ml sample it is important direct inject with syringe. *Use this method Perform in clean room.

Collection Train (<20 ml sample)

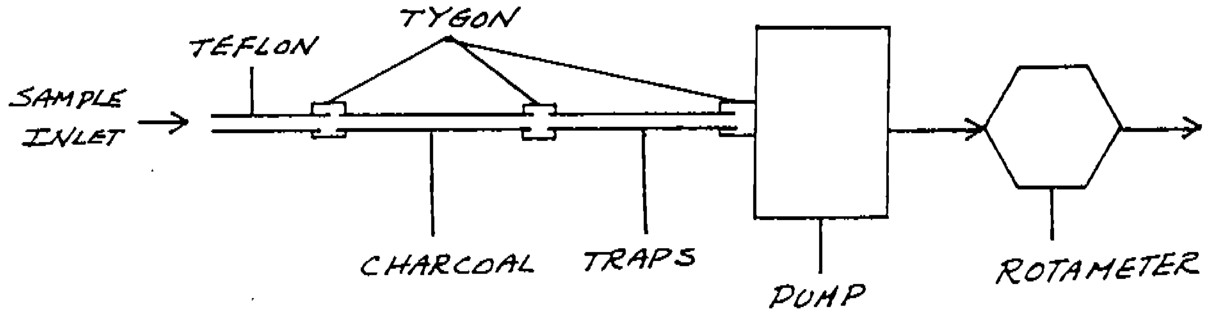


Note: Condition syringe flush 2-3 times before collecting sample.

15. Perform ORSAT analysis on bag constituents.
    - o Use method 3 data sheets
    - o Need O_2 and CO_2 values for each sample remainder N_2.
    - o Record data on sample data sheets.

TEST PROTOCOL FOR VOLATILE ORGANIC COMPOUNDS

Sampling Train



1. Take sampling train to sampling location and check process operation.

2. Assemble train noting flow directions for tubes, pumps, etc. TIME (ON/OFF)

3. Do a velocity traverse at start and end of test. Perform ▲p checks at std traverse points.

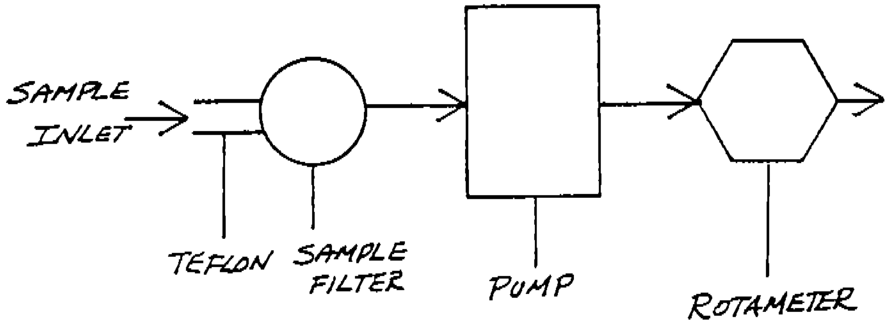
4. Run for full cereal cooker/masher Tun/Lauter Tun/Kettle cycles. Each operation is different check with Brewhouse for start/stop times.

5. Recover impinger if any fluid flush onto first trap if it can fit. If too much, recover in VOA vial mark amount and top off with HPLC.

6. Recover traps cap, label, log, store, complete sample data sheet and ship samples to laboratory for analysis.

TEST PROTOCOL FOR SODIUM HYDROXIDE: CIP ONLY

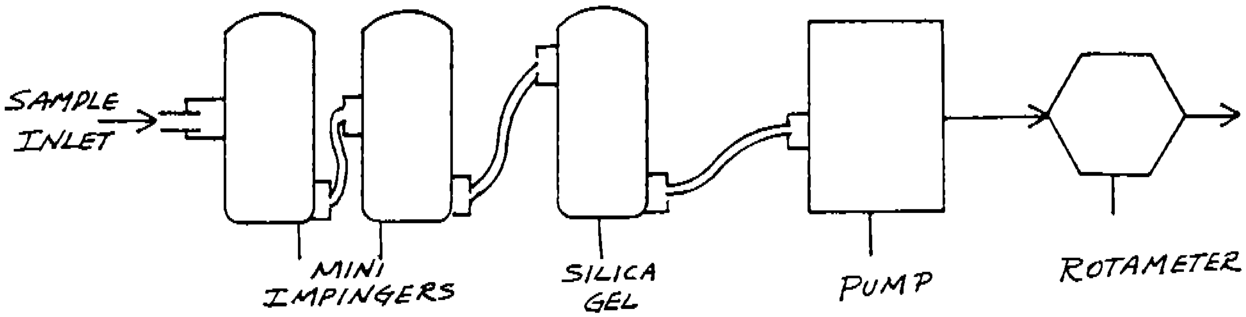
Sampling Train



1. Take sampling train to sampling location and check process operations.
2. Assemble sample train.
3. Fill in data sheet with required information.
4. Set flow at 1 L/minute maximum for estimated CIP cycle time.
5. Remove replace caps on cassette with filter, label logs, store, and ship samples to a laboratory for analysis.

TEST PROTOCOL FOR CHLORINE

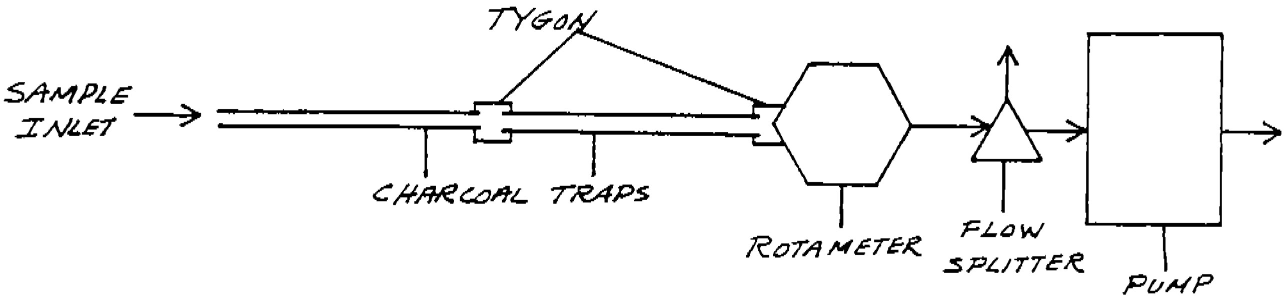
Sampling Train



1. Assemble unit 2 impingers in series. With 10 ml of 0.1% sulfonic acid sol.
    - Prep on impingers. Clean with water and rinse with 0.1% acid as final rinse using squeeze bottle.
    - Use stop code grease to attach impingers to lines.
2. Take sampling equipment to sampling location and check process operations.
3. Record sampling data on sample sheets: time, location, personnel, etc.
4. Run sample
    - Recording initial impinger volumes prior to start
    - Pump's ID, rotameter ID, location, weather conditions, temperature, etc.
5. End of sample: record rotameter readings, temperatures etc.
6. Remove equipment and transport to staging area for recovery.
7. Recovery
    - Recovery from 1st and 2nd impinger is in separate vials. Recover impinger solutions into 30 ml bottles provided.
    - Check impinger level and record here as well.
    - Mark level on label of bottle of solution for lab use.
    - Mark front/back halves of the train.
    - Rinse impinger with tap water.
    - Keep samples cool, log, store, and forward to laboratory for analysis.

TEST PROTOCOL FOR AMMONIA

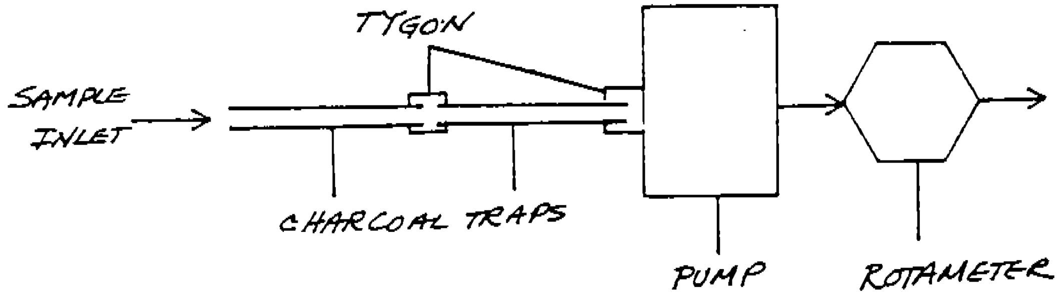
Sampling Train



1. Take sampling equipment to sampling location and check process operations.
2. Assemble unit. Note flow direction on traps.
3. Record data: times, location, personnel, temperatures pump ID's, rotameter ID's, etc.
4. Set initial flow at 0.2 L/min for 30 min. and position sampling inlet and secure equipment.
5. Start pump and collect sample for appropriate time and other sampling data.
6. Stop/record flows and collect trap.
7. Cap traps label, store, record data and remove equipment.
8. Log and ship samples to laboratory for analysis.

TEST PROTOCOL FOR FORMALDEHYDE

Sampling Train



1. Take sampling train to sampling location and check process operations.
2. Assemble train and record data on sample data sheet.
3. Set flow rate at 1/2 L/min for maximum run time of 20 minutes.
4. Start test noting times, etc. on data sheet and at end of test repeat.
5. Recover traps, cap, label, log, store and ship samples to laboratory for analysis.

NIOSH Method P&CAM127 (Excerpt): Organic Solvents in Air Analytical Method

Analyte:	Organic Solvents (See Table 1)	**Method No.:**	P&CAM 127
Matrix:	Air	**Range:**	For the specific compound, refer to Table 1
Procedure:	Adsorption on charcoal desorption with carbon disulfide, GC		
Date Issued:	9/15/72	**Precision:**	10.5% RSD
Date Revised:	2/15/77	**Classification:**	See Table 1

1. Principle of the Method

1.1 A known volume of air is drawn through a charcoal tube to trap the organic vapors present.

1.2 The charcoal in the tube is transferred to a small, graduated test tube and desorbed with carbon disulfide.

1.3 An aliquot of the desorbed sample is injected into a gas chromatograph.

1.4 The area of the resulting peak is determined and compared with areas obtained from the injection of standards.

2. Range and Sensitivity

The lower limit in mg/sample for the specific compound at 16 × 1 attenuation on a gas chromatograph fitted with a 10:1 splitter is shown in Table 1. This value can be lowered by reducing the attenuation or by eliminating the 10:1 splitter.

3. Interferences

3.1 When the amount of water in the air is so great that condensation actually occurs in the tube, organic vapors will not be trapped. Preliminary experiments indicate that high humidity severely decreases the breakthrough volume.

3.2 When two or more solvents are known or suspected to be present in the air, such information (including their suspected identities), should be transmitted with the sample, since with differences in polarity, one may displace another from the charcoal.

3.3 It must be emphasized that any compound which has the same retention time as the specific compound under study at the operating conditions described in this method is an interference. Hence, retention time data on a single column, or even on a number of columns, cannot be considered as proof of chemical identity. For this reason it is important that a sample of the bulk solvent(s) be submitted at the same time so that identity(ies) can be established by other means.

OSHA Method ID-121 (Excerpt): Metal and Metalloid Particulates in Workplace Atmospheres (atomic Absorption)

Method Number:	ID-121
Matrix:	Air, Wipes, or Bulks
OSHA Permissible Exposure Limits:	See Table 1
Collection Procedure:	Personal air samples are collected on mixed-cellulose ester filters using a calibrated sampling pump. Wipe or bulk samples are collected using grab sampling techniques.
Recommended Sampling Rate:	2 L/min
Recommended Air Volumes	
Time Weighted Average Samples:	480 to 960 L
Short-Term Exposure Limit Samples:	30 L
Ceiling Samples:	10 L*
Analytical Procedure:	Samples are desorbed or digested using water extractions or mineral acid digestions. Elemental analysis of the prepared sample solutions is performed by atomic absorption or emission spectroscopy.
Detection Limits:	See Table 2
Precision and Accuracy:	See Table 3
Method Classification:	Validated Analytical Method
Date (Date Revised):	1985 (June, 1991)

* Alternate air volumes may be necessary to achieve good analytical sensitivity.

NIOSH Method 7401 (Excerpt): Sodium Hydroxide (Cassette)

FORMULA: NaOH, KOH, LiOH, and basic salts

M.W.: 40.00 (NaOH); 56.11 (KOH)

ALKALINE DUSTS
METHOD: 7401
ISSUED: 2/15/84
REVISION #1: 8/15/87

OSHA: 2 mg/m^3 (NaOH)
NIOSH: 2 mg/m^3/15 min (NaOH) [1]
ACGIH: C 2 mg/m^3 (NaOH)

PROPERTIES: basic, hygroscopic, caustic solids and aerosols; VP not significant

SYNONYMS: alkali; caustic soda; lye; sodium hydroxide (CAS #1310-73-2); potassium hydroxide (CAS #1310-58-3)

SAMPLING

SAMPLER: FILTER
(1-μm PTFE membrane)

FLOW RATE: 1 to 4 L/min

VOL-MIN: 70 L @ 2 mg/m^3
-MAX: 1000 L

SHIPMENT: routine

SAMPLE STABILITY: at least 7 days @ 25 °C [2]

BLANKS: 10% of samples

ACCURACY

RANGE STUDIED: 0.76 to 3.9 mg/m^3 [2]
(360-L samples)

BIAS: not significant [2]

OVERALL PRECISION (s_r): 0.062 [2]

MEASUREMENT

TECHNIQUE: ACID-BASE TITRATION

ANALYTE: OH^- (alkalinity)

EXTRACTION: 5.00 mL 0.01 N HCl, 15 min under nitrogen with stirring

TITRATION: 0.01 N NaOH under nitrogen, endpoint by pH electrode

CALIBRATION: 0.01 N NaOH standardized with 0.01 N HCl

RANGE: 0.14 to 1.9 mg per sample [2]

ESTIMATED LOD: 0.03 mg per sample (as NaOH) [2]
(7×10^{-4} mmoles of alkalinity)

PRECISION (s_r): 0.033 @ 0.38 to 1.5 mg NaOH per sample [2]

APPLICABILITY: The working range is 0.4 to 5.4 mg/m^3 for a 360-L air sample. The method measures total alkalinity due to alkali hydroxides, carbonates, borates, silicates, phosphates, and other basic salts, expressed as equivalents of NaOH.

INTERFERENCES: None identified. Carbon dioxide in the air may react with alkali on the filter to produce carbonates but does not interfere when titrated. The carbonates will produce the equivalent amount of strong alkali that was consumed on the filter [2].

OTHER METHODS: This revises Methods S381 [3],7401 (dated 2/15/84), and P&CAM 241 [4].

Date Revised 10/92

Modified NIOSH P&CAM 205 (Excerpt): Ammonia Analytical Method

Analyte: Ammonia

Range: 0.1 ppm - 100 ppm

Reference Method: Modified NIOSH P&CAM 205

Precision: Undetermined

Type Analysis: Colorimetric, 1 cm cell
440 mm, k=1.4382

Interferences: Ammonia salts give positive interferences (filtration of air before it passes into the impinger may remove these salts).

Sampling Method: Sample with 10ml of 0.1N H_2SO_4 in a midget impinger at a flow rate of 1 lpm for at least 60 minutes.

Reagents: Deionized water: Use for all dilutions and solutions.

Impinging Solution (only needed for sample collection).
0.1N Sulfuric Acid: Add 2.66 ml of H_2SO_4 into 1 liter of distilled H_2O.

Nessler Reagent: From Fisher Scientific Company. Note: A slight sediment which occasionally forms in this solution should be removed by filtration or decantation before using. Warning: Nessler reagent should be handled with caution because of its toxicity and corrosive properties.

Standard Ammonium Sulfate Solution (A): Dissolve 0.07760 g of ammonium sulfate in deionized water and make up to 1000ml. 1.0 ml of this solution contains 20ug ammonia. Discard solution after 1 week.
Standard Ammonium Sulfate Solution for tubes only (B): Dissolve 0.7760 g of ammonium sulfate in 50 mL of DI water. Dilute up to 100 mL with DI water = 2000 ug/mL.

Equipment: Pipets, plastic centrifuge tubes, 1 cm cells.

Quality Control: With each group of samples where will be a standard curve slope check and a spiked collection medium for percent recovery.

1) Standard curve slope check:

   a) Prepare a fresh standard curve using the standard ammonia solution and a reagent blank.
   b) Plot absorbance vs NH_3 and draw a straight line through the points, if possible.
   c) Choose two easily read points from the linear portion of the curve, one each from the higher and lower absorbance portions of the curve.
   d) Subtract the value of the lower absorbance point from that of the higher absorbance point and record the difference.
   e) Divide the absorbance difference by the mg difference (the ug difference divided by 1000).
   f) Record the appropriate data and plot slope on the work sheet and QC book.
   g) If this value is within limits, the standard curve may be used to quantitate the samples. If not, consult the QC coordinator and prepare a fresh standard curve.

OSHA Method S347 (Excerpt): Ammonia Collection Method

Analyte: Ammonia

Matrix: Air

OSHA Standard: 50 ppm (35 mg/cu m)

Procedure: Adsorption on sulfuric acid-treated silica gel, desorption with 0.1 N sulfuric acid, ammonia specific electrode

Method No.: S347

Range: 17-68 mg/cu m

Precision ($\overline{CV}_T$): 0.062

Validation Date: 11/25/77

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1. Principle of the Method

1.1 A known volume of air is drawn through a glass tube containing sulfuric acid-treated silica gel to trap ammonia vapors. The sampling tube is connected in series to a prefilter to collect particulate ammonium salts.

1.2 Ammonia is desorbed from the silica gel with 0.1 N sulfuric acid, and the sample is analyzed using an ammonia specific electrode.

2. Range and Sensitivity

2.1 This method was validated over the range of 16.9-67.6 mg/cu m at an atmospheric temperature of 24°C and atmospheric pressure of 759 mm Hg, using a 30-liter sample. This sample size is based on the capacity of the sulfuric acid-treated silica gel to collect vapors of ammonia in air at high relative humidity. The method is capable of measuring much smaller amounts if the desorption efficiency is adequate. Desorption efficiency must be determined over the range used.

2.2 The upper limit of the range of the method is dependent on the adsorptive capacity of the sulfuric acid-treated silica gel. This capacity varies with the concentrations of ammonia and other substances in the air. Breakthrough is defined as the time that the effluent concentration from the collection tube (containing 200 mg of sulfuric acid-treated silica gel) reaches 5% of the concentration in the test gas mixture. Breakthrough was not observed after 310 minutes at an average sampling rate of 0.209 liter/minute and relative humidity of 85% and temperature of 25°C. The breakthrough test was conducted at an average concentration of 68.6 mg/cu m.

OSHA Method 101 (Excerpt): CHLORINE

CHLORINE IN WORKPLACE ATMOSPHERES

Method No.: ID 101

Matrix: Air

OSHA Standard: 1 ppm

Collection Procedure: A known volume of air is drawn through an impinger containing 10 mL of 0.1% Sulfamic acid solution.

Recommended air volume: Ceiling, 15 liters
TWA, 300 liters (sufficient samples to determine TWA)

Recommended Sampling Rate: 1 liter per minute

Analytical Procedure: An aliquot of the sample is reacted with acidic potassium iodide. Chlorine reacts with the potassium iodide to form iodine which is measured with an ion specific electrode.

Detection Limit: 0.4 mg/m^3 for a 15 liter air volume.

Precision: $(CV_T) = 0.03$

Status of Method: Sampling and analytical method which has been subjected to the established evaluation procedures of the Inorganic Method Evaluation Branch.

Date Revised: December 2, 1988

NIOSH Method 1400 (Excerpt): ETHANOL

ALCOHOLS I

FORMULA: Table 1

M.W.: Table 1

METHOD: 1400
ISSUED: 2/15/84

OSHA/NIOSH/ACGIH: Table 1

PROPERTIES: Table 1

COMPOUNDS AND SYNONYMS:
(1) ethanol: [ethyl alcohol; CAS #64-17-5];
(2) isopropyl alcohol: [2-propanol; CAS #67-63-0]; and
(3) tert-butyl alcohol: [2-methyl-2-propanol; CAS #75-65-0].

SAMPLING

SAMPLER: SOLID SORBENT TUBE
(coconut shell charcoal, 100 mg/50 mg)

FLOW RATE: 0.01 to 0.2 L/min
(0.05 L/min for ethyl alcohol)

	(1)	(2)	(3)
VOL-MIN:	0.1 L	0.2 L	0.5 L
-MAX:	1 L	3 L	10 L

SHIPMENT: refrigerated

SAMPLE STABILITY: store in freezer; analyze as sooh as possible

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: see EVALUATION OF METHOD

BIAS: not significant [1]

OVERALL PRECISION (s_r): see EVALUATION OF METHOD

MEASUREMENT

TECHNIQUE: GAS CHROMATOGRAPHY, FID

ANALYTE: compounds above

DESORPTION: 1 mL 1% 2-butanol in CS_2

INJECTION VOLUME: 5 µL

TEMPERATURE-INJECTION: 200 °C
-DETECTOR: 250 - 300 °C
-COLUMN: 65 - 70 °C

CARRIER GAS: N_2 or He, 30 mL/min

COLUMN: glass, 2 m x 4 mm ID, 0.2% Carbowax 1500 on 60/80 Carbopack C or equivalent

CALIBRATION: solutions of analyte in eluent with internal standard

RANGE AND PRECISION: see EVALUATION OF METHOD

ESTIMATED LOD: 0.01 mg per sample [4]

APPLICABILITY: This method employs a simple desorption and may be used to determine two or more analytes simultaneously by varying GC conditions (e.g., temperature programming).

INTERFERENCES: High humidity reduces sampling efficiency. The methods were validated using a 3 m x 3 mm stainless steel column packed with 10% FFAP on Chromosorb W-AW; other columns with equal or better resolution (e.g., capillary) may be used. Less volatile compounds may displace more volatile compounds on the charcoal.

OTHER METHODS: This method combines and replaces Methods S56, S65 and S63 [3].

Table 1. General information.

Compound	OSHA NIOSH ACGIH (ppm)	Formula	mg/m³ = 1 ppm @ NTP	M.W.	Density @ 20 °C (g/mL)	BP (°C)	VP @ 20 °C, kPa (mm Hg)
Ethanol	1000 — 1000	CH_3CH_2OH; C_2H_6O	1.883	46.07	0.789	78.5	5.6 (42)
Isopropyl alcohol	400 400 500	$CH_3CH(OH)CH_3$; C_3H_8O	2.46	60.09	0.785	82.5	4.4 (33)
tert-Butyl alcohol	100 100 150	$(CH_3)_3COH$; $C_4H_{10}O$	3.03	74.12	0.786	82.4; MP = 25.6 °C	4.1 (31)

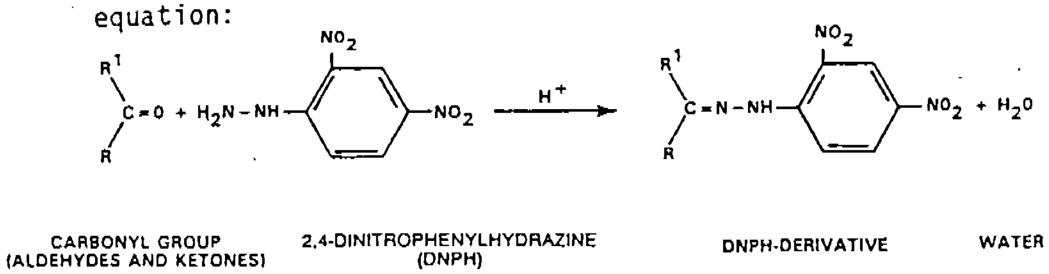
EPA Method TO11 (Excerpt): FORMALDEHYDE

METHOD FOR THE DETERMINATION OF FORMALDEHYDE IN AMBIENT AIR USING ADSORBENT CARTRIDGE FOLLOWED BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)

1. Scope

1.1 This document describes a method for the determination of formaldehyde in ambient air utilizing solid adsorbent followed by high performance liquid chromatographic detection. Formaldehyde has been found to be a major promoter in the formation of photochemical ozone. In particular, short term exposure to formaldehyde and other specific aldehydes (acetaldehyde, acrolein, crotonaldehyde) is known to cause irritation of the eyes, skin, and mucous membranes of the upper respiratory tract.

1.2 Compendium Method TO5, "Method For the Determination of Aldehydes and Ketones in Ambient Air Using High Performance Liquid Chromatography (HPLC)" involves drawing ambient air through a midget impinger sampling train containing 10 mL of 2N HCl/0.05% 2,4-dinitrophenylhydrazine (DNPH) reagent. Aldehydes and ketones readily form a stable derivative with the DNPH reagent, and the DNPH derivative is analyzed for aldehydes and ketones utilizing HPLC. Method TO11 modifies the sampling procedures outlined in Method TO5 by introducing a coated adsorbent for sampling formaldehyde. This current method is based on the specific reaction of organic carbonyl compounds (aldehydes and ketones) with DNPH-coated cartridges in the presence of an acid to form stable derivatives according to the following equation:



where R and R' are organic alkyl or aromatic group (ketones) or either substituent is a hydrogen (aldehydes).

MIRAN 1B2 Analyzer Standard Specifications

GENERAL DESCRIPTION

The MIRAN 1B2 is a single-beam infrared spetrophotometer It consists of a portable gas analyzer and a separate ac/dc converter as shown in Figure 1. Analyzer portability is provided by an internal nickel-cadmium battery pack. The ac/dc converter allows the analyzer to be powered from an ac supply. It is also used to recharge the battery pack.

The gas analyzer monitors the air in workplace environments to warn personnel if toxic gases are present. It is pre-programmed to measure many of these gases. The analyzer is also user-programmable to measure other gases. Pre-programmed gases are in the analyzer's "fixed library"; user-programmed gases are in the analyzer's "user library".

A microprocessor automatically controls the spectrophotometer, averages the measurement signal, and calculates absorbance values. Analysis results are displayed either in parts per million (ppm) or absorbance units (AU).

****
* WARNING *
****

The MIRAN 1B2 Analyzer is not designed for use in a hazardous area. For monitoring air in such areas, use a MIRAN 1BX Analyzer.

STANDARD SPECIFICATIONS

Materials of Construction
  Enclosure: Noryl Structural Foam
  Sample Line: Corrugated Polyethylene
  Gas Cell: Teflon-Lined Aluminum
  Lenses: Silver Bromide (AgBr)
  Valve: Polyethylene
Dimensions: Appoximately 706 mm (27.8 in) long by 229 mm (9 in) wide by 279 mm (11 in) high.
Mass: Approximately 13.6 kg (30 lb).
Measurement Range
  Concentration: 0 to 99 999 ppm
  Absorbance: 0.000 to 2.000 AU
Measurable Gases
  Fixed Library: See Appendix
  User Library: User-programmable to measure up to 10 additional gases.
Output: Digital readout of concentration (ppm), absorbance (AU), or analysis parameters. A connector is provided for 0 to 10 V analog readout of wavelength scan.
Operator Error Alarm: Single beep
Concentration Alarm(1): Upper-limit mode or Geiger-counter mode, as selected.
Power Requirements (ac/dc Converter):
  120 V, +10%, -15% at 60 ±3 Hz; or
  220 V, +10%, -15% at 50 ±3 Hz
Power Consumption: 70 W maximum

Battery Pack
  Type: Nickel-cadmium
  Operating Time: Up to 4 hours
  Recharge Time: Between 14 and 16 hours after complete discharge
Pump Flow Rate: 25 to 30 L/min (0.88 to 1.06 cfm) with no blockage in sampling hose.
Operating Conditions: See table below.

INFLUENCE	REFERENCE OPERATING CONDITIONS	NORMAL OPERATING CONDITION LIMITS
Ambient Temperature	23 ±2°C (73 ±4°F)	5 and 40°C (40 and 110°F)
Relative Humidity	50 ±10%	5 and 95% at 30°C (87°F)
Supply Voltages	120 or 220 V, ±5%	120 or 220 V, +10, -15%
Supply Frequency	50 or 60 Hz, ±0.5%	50 or 60 Hz, ±3%

Storage Limits: Ambient temperature limits of -10 and +55°C(14 and 131°F); Relative humidity limits of 0 and 95% at 35°C (95°F).
Accuracy: ±15% of reading between five times minimum detectable concentration and the upper range value of each gas in the fixed compound library. (User-calibrated gases can have better accuracy.) This specification applies within the temperature range between 15 and 35°C (59 and 95°F) when analyzer is zeroed within these limits. For operation outside these limits, between 5 and 15°C or 35 and 40°C (40 and 59°F or 95 and 110°F), analyzer must be rezeroed to maintain the specified accuracy.
Noise: Maximum of 0.004 absorbance units (AU) with 20.25 m pathlength at 12.0μm wavelength, and with AgBr lenses at 23°C (73°F) operating temperature
Drift: Maximum of 0.004 AU per 8 hours with conditions as specified for noise level above.

INSTRUMENT CHECKOUT

Unpacking

Remove instrument from its shipping container and check it for visible damage. If instrument has been damaged, notify the carrier immediately and request an inspection report. Obtain a signed copy of report from the carrier. Check contents of the shipping package against Table 1; there should be one of each item. Immediately report any shortages to Foxboro.

****
* CAUTION *
****

To avoid damaging the MIRAN 1B2 Analyzer during transportation, use original packing. Package all components in same manner as they were when shipped from factory.

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(1) In upper-limit mode, a series of beeps of constant frequency will be sounded when alarm set point is exceeded. In Geiger-counter mode, beeps of increasing frequency are sounded as alarm set point is approached; beeps of constant maximum frequency are sounded when set point has been exceeded.

APPENDIX C
FIELD DATA SHEETS

Miller Brewing Company
Fulton, New York

EMISSION INVENTORY REPORT

JANUARY 1994

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co. **Site:** Brewhouse Stacks @ Roof

Weather: 32°, Heavy Snow Fall, ~20 mi/hr **Operator:** KSG, MB, MK, ED **Date:** 11/1/93

2-8mm Charcoal Traps per each sampling event.

Temp in Stack	Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	EDT Sampling Period			Rotameter Information			
									Readings		
					Start	End	Total	ID	Pre.	Post	clos Ab Tip
117°F	BRHVOC K.1(F+B)	LOT 120	R1	KETTLE STACK #1, WEST SIDE	0817	0945	88 min	⟨R1⟩	110 113	112	✓
	BRHVOC K.2(F+B)	LOT 120	R1	Kettle Stack #1, West Side	1230	1358	88 min	⟨R1⟩	116 116	119	✓
	VOC BRH LT.1(F+B)	LOT 120	R3	Lauter Tun Stack, West Side.	0930	1100	90 min	⟨R3⟩	109	109	✓ .24
	VOC BRH LT.2(F+B)	LOT 120	R3	Lauter Tun Stack, West Side	1200	1330	90 min	⟨R3⟩	105	105	✓ 0.48
	VOC BRH MT.1(F+B)	LOT 120	R2	Mash Tun Stack, #10 West	1030	1130	60 min	⟨R2⟩	90	90	✓ 0.47
	VOC BRH MT.2(F+B)	LOT 120	R2	Mash Tun Stack #10 West	1247	1345	58 min	⟨R2⟩	90	90	✓ .5
	CONDGTE VENT FB	B2058 010		Brewhouse VOC Condensate Field Blank DI.	1100	1100					✓
	BRHVOC K.1-C	B2059010	R1	Kettle Stack #1 West	817	0945	88	⟨R1⟩	110 113	112	✓
	VOCBRH L2-C	B2261010	R3	Lauter Tun Stack, West	1200	1330	90	⟨R3⟩	105	65	✓
	VOC-BRH DI-TRIP	B2058010			1430	1430					✓
	VOC-BRH LT.1-C	B2058010		Lauter Tun Stack, West	0930	1100	90	⟨R3⟩	109	109	✓
	VOC-BRH-FB-DI	B20580 10			1430	1430					✓

Remarks: Stacks were intermittent

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co. **Site:** Packaging Roof Vent.

Weather: 32°F Heavy Snow, ~20 mi/hr winds. **Operator:** KSS **Date:** 11/1/93

Front
Back

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Pump I.D. ~~Rotameter Information~~		
				Start	End	Total	ID	Readings	
								Pre.	Post
EE-P -EF2.1	LOT 120	D	VENT EF2 Packaging Roof	1200	1230	30 min	D	1LPM	1LPM
EE-P EF2.2	LOT 120	D	↓	1240	1310	30 min	D	1LPM	1LPM
EEP EF2.3	LOT 120	D	↓	1315	1345	30 min	D	1LPM	1LPM
VOC-BRH -FB-F1	LOT 120	/	Brewhouse outside stairwell	1430	→	/	/	/	/
VOC-BRH -FB-B1	LOT 120	/	↓	1430	→	/	/	/	/

BB

Remarks:

11/1/93 P - Packaging; @ EF2, Miller Lite on Line 13 + Sharps on Line 12; Pump D, → 1LPM to be verified by Calibration.

Smb Trap xls

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co.

Site: Brewhouse Roof Vents.

Weather: Sunny, 0-5 mi winds, 38-40°F High Cirrus

Operator: KJG, MB

Date: 11/2/93

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
								Readings	
				Start	End	Total	ID	Pre.	Post
VOC-BRH-LT.3	LOT 120	~~LOT 120~~ R3	Lauter Tun Stack West Side	0830	1000	90 min	R3	110 109	110 110 112 111 111
VOC-BRH MT.3		R1	Mash Tun Stack #10 West	0945	1045	60 min	R1	116 117	118
VOC-BRH K.3		R2	Kettle Stack #1 West	1122	1252	90 min	R2	81 83	82
VOC-BRH -C.1		R1	Cooker Stack West	0900	0934	~20 min	R1	115 119	119
VOC-BRH -C.2		R1		1130	1150	20 min	R1	120	121
VOC-BRH -C.3		R1		1400	1420	20 min	R1	120	114
VOC-BRH -C.1-C	B2058010	R1		0900	934	~20 min	R1	115 119	118
VOC-BRH -C.2-C	B2261010	R1		1130	1150	20 min	R1	120	121
VOC-BRH -C.3-C	B2261010	R1		1400	1420	20 min	R1	100	114
VOC-BRH -LT.3-C	B2261010	R3	Lauter Tun Stack #10 West	0830	1000	90 min	R3	110 109	110 112 111
VOC-BRH -K.3-C	B2261010	R2	Kettle Stack #1 West	1122	1252	90 min	R2	81 83	82

Remarks: VOC-BRH-C.1 ; Train found to be disconnected @ 0925; began again and stopped. ≈ 20 min run time.

Sorb Trap.xls

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM

Site: Brewhouse Roof + Fermenter B1

Weather: 40° in walkway

Operator: KJS / KG

Date: 11/2/93

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
								Readings	
				Start	End	Total	ID	Pre.	Post
NABH K.1	PTFE627	#1	Kettle during CIP	1245	1315	30 min	R2	113	113
NACS FB1.1	PTFE623	E	Fermenter B1 @ CIP	1905	1920	15 min	↓	120	120
NACS FB1.2	↓	↓	very strong gusts of	1925	1940	15 min	↓	120	120
NACS FB1.3	↓	↓	Air exit door 10-15-30 seconds apart.	1942	1957	15 min	↓	120	120
NAFB.1	PTFE626	–	Blank Field	1405	1406	1 min.			
NATB.1	PTFE615	–	Trip Blank						
CL-CS B3.1			Chlorine sample impingers	2030	2045	15 min.	R2	120	120
			→ @ fermenter CIP						

NEED Flow

NEED EST Flow.

Need flow

Remarks: Cupola very humid 60°-70°F

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM
Site: Utilities Roof - Carbon Drier Vent Regen
Weather: ~ 38 - 40°F, light Drizzle
Operator:
Date: 11/2/93 – 11/3/93

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information			MIRAN
								Readings		
				Start	End	Total	ID	Pre.	Post	
E-U-CREGN.1		C	Carbon drier vent Regen Stack west. #4 4 l/min	2130	2140	10 min	n/a	load trap	4 l	→ 40ppm
" .2		↓	3 l/min	2330	2345	15 min	↓	loade trap	4 l	→ 36ppm
" .3		↓	Amb. 36°F Stack 85°F	0605	0620	15 min	↓	"	6 l	72ppm
" .4		↓	Flow = 1800 FPM Amb 46°F Stack 168°F)	0902	0917	15 min	↓	"	6 l	15ppm
.5		↓		1203	1218	15 min	↓	"	6 l	36 ppm
.6		4	Stack T = 199°F Flow = 1350 FPM	1515	1530	15 min	↓	"	6 l	21ppm
.7		4	T = 209°F Flow = 2350 FPM	1814	1829	15 min	↓	"	6 l	13ppm

Remarks: Post Cal → Pump C @ 2.75 LPM
Pump 4 @ 3.0 LPM

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co. **Site:** CS

Weather: CLEAR COOL **Operator:** BUTLER, GOOHS **Date:** 11/2/93

ECSPFII.1

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
								Readings	
				Start	End	Total	ID	Pre.	Post
ECS HW1	LCT 120	6	HEAT WHEEL ROOF CS	1337	1407	30	3	38	31
ECS IV 1	"	4	HW INLET VENT ROOF CS	1337	1407	30	3	68	68
ECS PFII-1		A	30°F CS ROOF (CO2 Purge From Primary Filter. #7)	1355	1357	2 MIN + 5 SECS		1LPM	1LPM
ECS FC.1		4	60°F CS ROOF (Source ~~[illegible]~~ 44 CO2 Discharge Ferment [illegible])	1150	1152	2		.5LPM	.5LPM
ECSHW2	LCT 120	D	ROOF	1630	1700	30	3	70 72	~~70~~ 72
ECSIV2		4	ROOF	1630	1700	30	3	69 72	~~7~~ 72
FIELD BLANK 1			LOOSE IN CONTAINER		(MEASURE	FOR	POSSIBLE		
FIELD BLANK			"			SWITCH	WITH	IV2-BACK)	
ECS HW3		D		1930	2000	30	3	71 72	71
ECS IV 3		4		1930	2000	30	3	71 71	71
ECSHW4		D		2236	2306	30	3	71 71	72
ECS IV 4		4		2231	2301	30	3	69 69	68

Remarks: LOST ECS HW 4 BACK-TRAP (BREAKAGE) RUN WITH FRONT TRAP ONLY

FC. 2-hr vent prior to CIP

Sorb Trap xls

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM

Weather:

Site: Cold Services Roof @ Heatwheel

Operator: MK, EN

Date: 11/3/93

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
								Readings	
				Start	End	Total	ID	Pre.	Post
ECS HW.5	LOT 120	D	HEAT WHEEL ROOF	0750	0820	30min	R3	70	70
ECS IV.5		4	INLET VE ROOF	0750	0820	30min		70	70
ECS HW.6		D		1032	1102			70	70
ECS IV.6		4		1032	1102			70	70
ECS HW.7		D		1124	1154			70	70
ECS IV.7		4		1124	1154			70	70
ECS HW.8	BAG	A	BAG taken @ Heat wheel Roof	1250	1300	10min	Pump	5LPM	5LPM
VOC CS WT.1	LOT 120	A	@ HOT WATER TANK	1344	1350	6MIN	Pump	1LPM	1LPM
			* TOO WET TO DRAW off 10 LITRES OF AIR						

Remarks: TEST #6 SCRATCHED DUE TO broken TUBE of BACK HALF.

Amb. TEMP = 39°F

INLET VENT = 38°F

@0805 Exhaust = 40°F Flow = 900-1190 ft/min

@1032 EXHAUST = 41°F " = 1000-1210 FPM

Sorb Trap.xls

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co. **Site:** Various

Weather: N.A. **Operator:** E.P.N. **Date:** 11/3/93

Sample ID	Lab Cartridge ID	Pump ID	MIRAN AMOUNT ~~Sampling Location~~	Sampling Period			Rotameter Information		
							E1 MG ~~ID~~	Readings	
				Start	End	Total		Pre.	Post
EWREWI.3	120	E	7.2 ppm (2180 ppm at 11:30)	3 min at	2 lpm	6l	0.08	SKC Actflow	2 lpm calib
EWREWI.4	120	E	15.0 ppm	3 min at	2 lpm	6l	0.17		
EWREWI.5	120	E	36 ppm	3 min at	2 lpm	6l	0.41		
EWREWI.6	120	E	21 ppm	3 min at	2 lpm	6l	0.24		
EWREWI.7	120	E	13 ppm	3 min at	2 lpm	6l	0.15		
EPR [illegible] headspace	120	E	530 ppm	1 min at	2 lpm	2l	2.03		
ECS Ant.8	120	E	7.4 ppm	4.5 min at	2 lpm	9l	0.13		
ECS CFT 25.1	120	E	112 ppm 28°F	2 min at	2 lpm	4l	0.86		
ECS SST 34.1	120	E	120 ppm (20:1) dilution 45°F	2 min at	2 lpm	4l	0.92		

ASixcs

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Remarks:

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM
Site: Utilities Roof
Weather: ~42°F, Rainy
Operator: KSG
Date: 11/3/93

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
								Readings	
				Start	End	Total	ID	Pre.	Post
E-4 EXH-C9.1	120	C	Exhaust Fan #689|C9	1430	1500	30min	R32	75	75
E-4 EXH-C2.1	120	C	" " #689|C2	1512	1542	30min	R32	75	74

Remarks:

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co. **Site:** Roof of the Annex

Weather: Cloudy, 15 mph, ~42° F, Temp inside was 79°F **Operator:** Ed Nawlak **Date:** 11/4/93

Temp.

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
								Readings	
				Start	End	Total	ID	Pre.	Post
EACW1	120	C	Catwalk of the Annex (79°F)	16:57	17:27	30	R3 R2	78	81
EAIB91	120	E	I-Beam #9 in the Annex (71°)	17:01	17:31	30	~~R3~~ R2	75	79
EACW2	120	C	Catwalk of the Annex (80°F)	17:28	17:58	30	~~R3~~ R2	82	82
EAIB92	120	E	I-Beam #9 in the Annex (78°F)	17:32	18:02	30	R3 R2	81	79
EACW3	120	C	Catwalk of the Annex (80°F)	18:00	18:30	30	R3 R2	82	82
EAIB93	120	E	I-Beam #9 in the Annex (71°F)	18:04	18:34	30	~~R3~~ R2	79	81

Remarks:

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM **Site:** Packaging Roof over Bottle + Can Lines

Weather: ⑩ ~~8~~ mph winds, SE, overcast ~50°F **Operator:** KJG **Date:** 11/4/13

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
								Readings	
				Start	End	Total	ID	Pre.	Post
E-P-B4A.1	120	B	Pasteurize Packageline B4A	0915	0945	30 min	R1	120	125
EPB4B.1	120	D	B4B	0930	1000	30 min	R1	120	123
E-P-B4A.2	120	B	B4A	0948 952	1040 1106	30	R1	123-125 125	130
E-P-B4A.3	120	B	B4A	1110	1140	30	R1	130	130
CL-P B5.1		4	B5 Clean Air Test ~Chlorine	1020	1050	30	R1	150	max 1LPM
E-P B5.1	120	D	" ~Ethanol	1040	1112	32 min	R1	123	125
CL-P B5.2		4	" ~Chlorine	1110	1140	30	R1	149	150
E-P B5.2	120	D	" ~Ethanol	1345	1419	34	R1	113	111
* CL-P B5.3		4	~Chlorine	1340	1410	30	R1	150	155
E-P B4B.2	120	B	Pasteurize Packageline B4B	1357	1424	30 min	R1	114	115
E-P B5.3	120	D	Clean Air Test Ethanol	1420	1450	30	R1	111	110
E-P B4B.3	120	B	Pasteurize line Ethanol	1431	1501	30	R1	113	112

Remarks: EPB4B.1 73 F 1900 FPM | B4A.3 72°F 2400 FPM B4A.1 -> 70°/2400 FPM B4A.2 -> 68F/2400 FPM

EPB4B.2 75°/1500 FPM

EPB5.2 1850 FPM @55°F + CLPB5.3 D = 26" × 18" ∴ Duct Diameter 48"

* CL-P-B5.1 + B5.2 recovered incorrectly -> detector is lowered. ∴ (B5.3) best sample.

↳ ≈ 11 ml then filled 12 ml

Sorb Trap xls

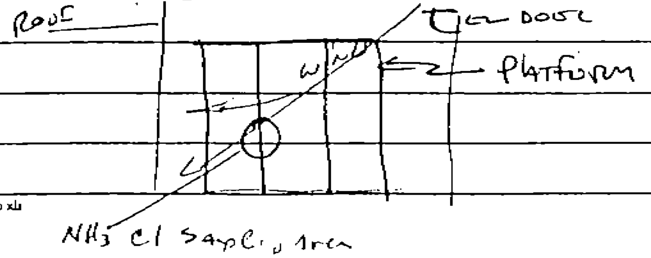
SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM **Site:** ~~F~~ Utilities Roof Cooling Tower Platform

Weather: 50° Light Rain 10mph winds **Operator:** KG **Date:** 11/4/93

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information			ABOVE ROOF
				Start	End	Total	ID	Readings		
								Pre.	Post	
NH3 U.1	N/A	#1	Cooling Tower Platform Utilities	1552	1622	30min	R3	105	104	13'
U.2				1638	1708			104	105	
U.3				1716	1746			105	108	
U.4				1805	1835			104	104	10'
CL U.1			11 ml	1655	1725		R1	150	155	11'
U.2			12 ml	1740	1810			145	146	
U.3			11 ml	1820	1850			144	146	
				F						

Remarks: NH_3 U.4 -> 7' below 1-5 + 6-11 NH_3 COMP DISC Relief ; possible biased sample.



<NH_3 sampling set for 0.2LPM>

Sorb Trap xls

Lee Champion's Hoff line
Packaging EPA

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

C = Cans
B = Bottles
A or B (Beakers)
= Test

Project: SBEM : Miller Brewing Co.
Site: Miller Brewing (Trenton; Packaging (EP)
Weather: Partly Cloudy, ~40°F, S-W Wind ~10 mph
Operator: CJ Novak + Kevin Grubs
Date: 11/4/93

Rotameter number

29.55"

Temp.	Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information			flow (5pts)
									Readings		
					Start	End	Total	ID	Pre.	Post	
78°	EPB13,B,1	120	~~R8~~ E	Exhaust fan Line 13 - Bottles	09:05	09:35	30	R32	75	75	~800
76	EPB13A,1	120	C	Exhaust fan Line 13 Bottles	09:08	09:38	30	R32	75	75	~1500
79°	EPB13B,2	120	E 29.51	" "	09:44	10:14	30	R32	75	75	850
79°	EPB13A,2	120	C	" "	09:48	10:18	30	R32	75	75	1700
78	EPC9A,1	120	E	Exhaust fan Line 9, Cans 29.51	11:18	11:48	30	R32	75	78	No Measurement
78	EPC9A,2	120	E	Exhaust fan line 9, Cans 29.50	13:47	14:17	30	R32	75	75	1600
78°	EPC9B,1	120	C	" " 29.50	13:55	14:25	30	R32	77	78	1800
77°	EPC9A3	120	E	" " 29.50	14:22	14:52	30	R32	75	75	1700
79	EPC9B,2	120	C	" " 29.49	14:28	14:58	30	R32	78	78	1900

Remarks: Line B13 B duct had a 30" diameter. A duct 48" diameter. All ducts are 48"

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co. **Site:** MBC Fulton

Weather: OVC. w/ SW-10 T=50°F **Operator:** KB/MB **Date:** 11/4/93

FORMALDEHYDE RUNS ON ROTAMETER R2 .72 SETTING ✓

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
								Readings	
				Start	End	Total	ID	Pre.	Post
F-P.1	FRONT		FP~~E~~.1 EF29 Next Reg unit (~~E~~/75')	1600	1620	20 mi	R2	.72	
	BACK								
F.P.2F		#5	FP.2 EF29	1625	1645	20		.72	
F.P.2B			FP.2 ↓	1625	1645	20		.72	
F.P.3F F.P.3B			FP.3 EF29 FP.3 ↓	1650 1650	1710 1710	20 20		.72 .72	
FP FB FP TB			FIELD BLANK EF29 TRIP BLANK ↓	1712 1712					

Remarks: NOTE: VOST GLOVES USED IN HANDLING FORMALDEHYDE SAMPLES

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co. **Site:** B3 Fermenter

Weather: N/A. **Operator:** EJS **Date:** 11/4/93

FERMENTER GASES → TRAPS.

	Sample ID	Lab Cartridge ID	Pump ID	Sampling Location (fermenter not filling)	Sampling Period			Rotameter Information		
					Start	End	Total	ID	Readings	
									Pre.	Post
NOV 4	ECSFC8.1	120	5	ECS Ferm C8. low flow 11/4/93 Miran 41	15⁰⁰	15¹⁰	10 min	SKC Aci	flow 1 lpm	calc.
	ECSFC8.2	120	5	.... fermenter filling 56% full Miran 57 good flow out	15²⁵	15³⁵	10			
NOV. 2	ECSFermB3.1	120	E	MIRAN = 62 ppm	No tube taken			Pr6	SKC Aciflow	at 2 lpm calib
	ECSFermB3.2	120	E	MIRAN = 59 ppm	2 min at	2 lpm	4 l	0.45		
	ECSFermB3.3	120	E	MIRAN = 46 ppm	"	"	4 l	0.35		
	ECSFermB3.4	120	E	MIRAN = 92 ppm	"	"	4 l	0.70		
	ECSFermB3.5	120	E	MIRAN = 101 ppm	"	"	4 l	0.77		
NOV. 3	ECSFermB3.6	120	E	MIRAN = 132 ppm.	"	"	4 l	1.01		
	ECSFermB3.7	120	E	MIRAN = 236 ppm	1.95 min at	2 lpm	3.9 l	1.76		
	ECSFermB3.8	120	E	MIRAN = 270 ppm.	1.5 min	at 2 lpm	3.0 l	1.55		
	ECSFermB3.9	120	E	MIRAN = 330 ppm	1.5 min	at 2 lpm	3.0 l	1.90		
NOV. 5	ECSFermB3.10	120	4	Plugged tube w/ disruption on collect; taking out 10:20	(1.x) 0.5 min	at 1 lpm	0.5 l	2.90	SKC Aciflow	at 1 lpm calib

1 l sample ↓

Remarks:

	CO_2	O_2
ECS B3.3	.028	.13
.7	.50	.086
.9	.97	—

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co. **Site:** Roof of packaging

Weather: Cloudy, occasional rain, 45°F 10mph west wind **Operator:** E, RN **Date:** 11/5/93

Trap.	Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period Start	Sampling Period End	Sampling Period Total	Rotameter Information ID	Readings Pre.	Readings Post	Flow
56°	EPBD13.1	120	(	Beer Dump G13C7 (#13 on the side)	8:25	8:55	30	RX2	80	82	220 fpm
59°	EPBD13.2	120	(	Beer Dump G13C7 (#13 on the side)	9:16	9:46	30	RX2	80	82	86 fpm
56°	EPBD13.3	120	(	Beer Dump G13C7 (#13 on the side)	10:13	10:35	22	RX2	82	82	140 fpm
				.75 hP			tube went out of vent				
				1725 RPM							
				~1060 cfm							
				"							

Remarks: Beer Dump had #13 written on the side, EPBD13.2 was done while beer dump was draining for the first five minutes.

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

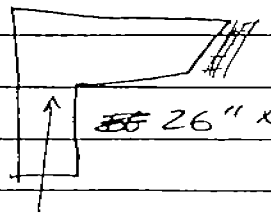
Project: SBEM **Site:** CS 2x2 Duct

Weather: 29.92 BP T = 51°F **Operator:** MK **Date:** 11/5/93

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
								Readings	
				Start	End	Total	ID	Pre.	Post
E-CS 2x2.1	120	E	2x2 Duct CS	1141	1211	30	R3	120	120
E-CS 2x2.1	120	5	"	1142	1212	30	R3	120	120
E-P RC.1		E	Rail Car Catwalk	0854	0924	30	R32	79	82
E-PRC.2		E	" #0512	0925	0955	30	R32	82	82

Remarks: Flow 51°F

1150 FPM



EPCR1 - Ben Dump Running

EPCR2 - No Ben Dump

Open Doors

Rail Cars - INOUT

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co. Site: Beer Dump

Operator: Date: 11/5/93

Weather:

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
								Readings	
			OBSERVATION START	Start	End	Total	ID	Pre.	Post
		BEER DUMP	0840	II			~~NO BEER~~ 11	GLASS	
			0852					ONLY	
600 CASES									
PER HOPPER									
~60 CASES									
PER INDIVIDUAL									
DUMPSTER									
			TOTAL 13 Dump -	60 CASES EACH					
			830 1023AM						
			Brown - 8						
			WhiteGreen 5						

Remarks: WILL START ABOUT 0930

Sorb Trap.xls

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co.
Site: MBC Fulton

Weather: NA
Operator: KJS
Date: 11/5/93

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information			
								Readings		
				Start	End	Total	ID	Pre.	Post	Miran
✓ EU CO2S.1	120	4	grab sample from supply line.	9AM -	3 min →	grab	Accuflow @ 1lpm		42 single	83 ppm
✓ EU CO2S2.0	120	4	Grab sample from Tank #2 line	9 40 AM	grab	2 min	Accu			83 ppm
✓ EU CO2STT.1	120	4	grab sample Top of Tank #1 head space	9:46 AM	grab	2 min				82 ppm
✓ EU CO2S3.1			grab sample Tank #3 line	9 42	"	"				82 ppm
✓ EU CO2S1.1			" " Tank #1 line	9 44	"	"		post = 1lpm		[illegible] ppm
✓ ESFerm 12.7	120	4	Grab sample Fermenter 12 ½ full	0.5 min at	(12:02) 1lpm	0.5 l				Drager 2500
✓ ECS Field										
✓ ECS Trip										

Remarks: CO2 supply from utilities goes to outside storage tank 1,2,3,4

Samples were taken

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co. **Site:**

Weather: RAIN **Operator:** BUTLER **Date:** 11/5/93

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
								Readings	
				Start	End	Total	ID	Pre.	Post
VOC-BCH-FB ~~VOC-BCH~~			BRH ROOF FIELD BLANK	0930	0932	2			
VOC-BCH -TB			BRH ROOF TRIP BLANK	0930					
E-CS -HW-FB		CS	ROOF 4 NR HEAT WHEEL FIELD BLANK	0948	0950	2			
E-CS- HW-TB		CS	ROOF 4 NR HEAT WHEEL TRIP BLANK	0950					
VOC-U- FB			NEAR MARLEY CT FIELD BLANK	1013	1015	2			
VOC-U TB			NR MARLEY CT T.P.	1015					
~~E-PB-FB~~ EP-FB			EF29 BTRY CHG EX FIELD BLANK	1058	1100	2			
E-P-TB			EF 29 BTRY CHG EX TRIP BLANK	1100					
E-P-BD-FB			BEER DUMP FIELD BLANK	1110	1112	2			
E-P-BD-TB			BEER DUMP TRIP BLANK	1112					

2 Joe Kor.

Remarks:

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM : Miller Brewing Co. Site:

Weather: OVCST Operator: BUTLER Date: 11/5/93

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
							ID	Readings	
				Start	End	Total		Pre.	Post
NH3-U-FB			NEAR F.B. MARLEY COOLING TOWERS	1148	1150	2			
NH3-U-TB			NEAR TB MARLEY COOLING TOWERS	1150					

Remarks:

SORBENT TRAP AND WET IMPINGMENT SAMPLING DATA SHEET

Project: SBEM
Site: Packaging Roof
Weather: 45- 50°F, Light Rain
Operator: KG, E N
Date: 11/5/93

Sample ID	Lab Cartridge ID	Pump ID	Sampling Location	Sampling Period			Rotameter Information		
								Readings	
				Start	End	Total	ID	Pre.	Post
CL PB13	N/A	A	Line B13 (*)	835	905	30	R1	145	155
EPEF29.1	120	D	Keg WasH INLET	857	927	30	R3	72	74
CL-P B13.2		A	Line B13 (*)	1033	1103	30	R1	144	146
E-P EF29.2	120	D	Keg Wash	933	1003	30	R3	72	72
E-P EF29.3	120	D	Keg Wash	1005	1035	30	R3	72	72

Remarks: * LINE 12 IS RUNNING NOT 13 Imp #1 = 12.5 ml Imp #2: 12.5 ml

Temp = 77°F Velocity = 1700 FPM D = 48"

CL-P-B13.1 Imp. #1 (15 ml) Imp #2 (14 ml)

E-P-EF29 Flows T = 71°F Vel - 2100 fpm, 1050

CL-P-B13.2 74°F 1900 fpm

Sorb Trap.xls

APPENDIX D
CHAIN OF CUSTODY

Miller Brewing Company
Fulton, New York

EMISSION INVENTORY REPORT

JANUARY 1994

BREWHOUSE

CHAIN OF CUSTODY RECORD - WEST SIDE BREW HOUSE

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature) K. J. Good

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	Total VOC A	Report Breakthrough VOC B	HOLD C	Remarks
VOC	VOC-BRH-MT.1-F	11/1/93	1030	Mash Tun					
	VOC-BRH-MT.1-B	↓	1030	↓					
	VOC-BRH-MT.2-F		1247						
	VOC-BRH-MT.2-B		1247						
	VOC-BRH-MT.3-F	11/2/93	0945						
	VOC-BRH-MT.3-B	11/2/93	0945						
	VOC-BRH-LT.1-F	11/1/93	0930	Lauter Ton					
	VOC-BRH-LT.1-B	↓	0930	Lauter Tun					
	VOC-BRH-LT.1-C		0930	↓		X			
	VOC-BRH-LT.2-F		1200				X		Possible Breakthrough
	VOC-BRH-LT.2-B		1200				X		
	VOC-BRH-LT.2-C		1200			X			
	VOC-BRH-LT.3-F	11/2/93	0830						
	VOC-BRH-LT.3-B	11/2/93	0830						
	VOC-BRH-LT.3-C	11/2/93	0830			X			
	VOC-BRH-6FCV-C	11/1/93	1100	6th Floor Cond Vent		X			
	VOC-BRH-DF-TB	11/1/93	1430	6TH Floor.				X	HOLD

Relinquished by: (Signature) Kevin J. Good | Date/Time: 11/1/93 13:00 | Received By: (Signature) | Date/Time:

Relinquished by: (Signature) | Date/Time: | Received By: (Signature) | Date/Time:

Remarks:

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(516)333-4526

b:\Chain.xls

CHAIN OF CUSTODY RECORD : WEST SIDE BREWHOUSE

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature) Kevin J. Hooks

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	TOTAL VOC A	Report BREAKTHROUGH VOC B	C	Remarks
VOC	VOC-BRH-K.1-F	11/1/93	817	#1 KETTLE STACK: WEST		X			
	VOC-BRH-K.1-B	↓	817	↓		X			
	VOC-BRH-K.2-F	↓	1230	↓		X			
	VOC-BRH-K2-B	↓	1230	↓		X			
	VOC-BRH-K.3-F	11/2/93	1122	↓					
	VOC-BRH-K.3-B	11/2/93	1122	↓			X		} Expected
	VOC-BRH-K.1-C	11/1/93	817	↓			X		} Breakthrough
	VOC-BRH-K.3-C	11/2/93	1122	↓		X			
	VOC-BRH-C.1-F	↓	900	Cooker Stack West		X			
	VOC-BRH-C.1-B	↓	900	↓		X			
	VOC-BRH-C.2-F	↓	1130	↓		X			
	VOC-BRH-C.2-B	↓	1130	↓		X			
	VOC-BRH-C.3-F	↓	1400	↓		X			
	VOC-BRH-C.3-B	↓	1400	↓		X			
	VOC-BRH-C.1-C	↓	900	↓		X			
	VOC-BRH-C.2-C	↓	1130	↓		X			
	VOC-BRH-C.3-C	↓	1400	↓		X			
						X			

Relinquished by: (Signature) Date/Time: 11/11/93 1300 Received By: (Signature) Date/Time:

Relinquished by: (Signature) Date/Time: Received By: (Signature) Date/Time:

Remarks:

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CHAIN OF CUSTODY RECORD

WEST SIDE BREWHOUSE

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature)

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	TOTAL VOC	AA NAOH	HOLD	Remarks
						A	B	C	
	VOC-BRH-FB-DI.	11/1/93	1430	6th Floor Stairway.		X			
	VOC-BRH-FB-F1.	11/1/93	1430			X			
	VOC-BRH-FB-B1	11/1/93	1430	↓				X	
	VOC-~~BRH~~ CS-WT1	11/3/93	1344	Hot Wort Tank		X			
	NA-BH-K.1	11/2/93	1245	Kettle CIP			X		
AA	NA-FB.1.	11/2/93	1405	Kettle CIP			X		Sent Separately
AA	NA-TB.1	11/2/93	1405	↓				X	
	VOC-BRH-FB	11/5/93	930	Brewhouse Roof				☒	
	VOC-BRH-TB	11/5/93	930	"					

Relinquished by: (Signature)

Date/Time: 11/11/93 1300

Received By: (Signature)

Date/Time:

Relinquished by: (Signature)

Date/Time:

Received By: (Signature)

Date/Time:

Remarks:

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b:\Chain xls

COLD SERVICES

CHAIN OF CUSTODY RECORD : COLD SERVICES

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature) Kevin J. Brooks

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	A Ethanol	B Chlorine	C A.A. NaOH	Remarks
E NA	NA-CS-FB1.1	11/2/93	1905	CIP FERMENTER Door				X	
	NA-CS-FB1.2	↓	1925	↓				X	
	NA-CS-EB1.3		2030					X	
	NA-FB.1		'					X	
	NA-TB.1					←			HOLD *
	CL-CS-B3.1-B	11/2/93	2030				X		} Run Breakthrough
	CL-CS-B3.1-F	↓	2030				X		} For PAIR
	ECSHW.1-F		1337	ColoServices HeatWheel		X			
	ECS HW.1-B		1337	+ Inlet Vent		X			
	ECS HW.2-F		1630	↓		X			
	ECS HW.2-B		1630			X			
	ECSHW.3-F		1930			X			
	ECS HW.3-B		1930			X			
	ECS HW.4-F		2236			X			
	ECS IV.1-F	11/2/93	1337			X			
	ECS IV.1-B	↓	1337			X			
	ECS IV.2-F		1630			X	←		AS PAIR w/ ECS IV.2-B

See next page

Relinquished by: (Signature)

Date/Time: 11/11/93 1300

Received By: (Signature)

Date/Time:

Relinquished by: (Signature)

Date/Time:

Received By: (Signature)

Date/Time:

Remarks:

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[illegible]

CHAIN OF CUSTODY RECORD Colo Struct.

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature)

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	A ETHANOL	B BREAK THROUGH ETHANOL	C	Remarks
	ECS IV.2-B	11/2/93	1630	ColoSev. HeatWheel					
	ECS IV.3-F		1930	+ Inlet Vent					AS PAIR W/ECSIV.2-F
	ECS IV.3-B		1930						
	ECS IV.4-F		2231						
	ECS IV.4-B		2231						
	~~ECS HW.5-F~~								
	~~ECS HW.5-B~~								
	ECS PFII.1-F		1355	CO2 Purge Primary Filt			X		
	ECS PFII.1-B		1355				X		
	ECS FC.1-F		1150	SEC#55 CO2 Discharge			X		
	ECS FC.1-B		1150	From Fermentn Tank.			X		
E-	FIELD BLANK 1		1630	INLET VENT		X			
E-	FIELD BLANK 2		1630	INLET VENT		X			
	ECS HW5-F	11/3/93	750	HEATWheel			X		Report Breakthrough
	ECS HW5-B		750				X		
	ECS HW7-F		1124						
	ECS HW7-B		1124						

Relinquished by: (Signature)

Date/Time: 11/11/93 1300

Received By: (Signature)

Date/Time:

Relinquished by: (Signature)

Date/Time:

Received By: (Signature)

Date/Time:

Remarks:

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CHAIN OF CUS,ODY RECORD CCDSRVCS

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature)

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	A Ethanol	B ETHANOL w/ BLANK TUBE	C	Remarks
	ECS IV.5-F	11/3/93	750	IN VENT			X		
	ECS IV.5-B	11/3/93	750	↓			X		
	ECS IV.7-F	11/3/93	1124			X			
	ECS IV.7-B	11/3/93	1124			X			
	ECS HW.8	〃	N/A	Traploaded w/ source		X			
	ECS CFT 25.1	〃	↓	Bag in supply		X			
	ECS SYT 34.1	〃		room @ mill		X			
	ECS FC8.1	11/4/93	1500	↓		X			
	ECS FC8.2	11/4/93	1525			X			
	~~ECS FERM B3.1~~	~~11/2/93~~	~~N/A~~						~~Missing~~
	ECS FERM B3.2	↓	↓			X			
	ECS FERM B3.3					X			
	ECS FERM B3.4					X			
	ECS FERM B3.5					X			
	ECS FERM B3.6	11/3				X			
	ECS FERM B3.7	↓				X			
	ECS FERM B3.8					X			

Relinquished by: (Signature)

Date/Time: 11/11/93 1300

Received By: (Signature)

Date/Time:

Relinquished by: (Signature)

Date/Time:

Received By: (Signature)

Date/Time:

Remarks: * Charcoal tube NOT TAKEN FOR FB3.1

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CHAIN OF CUSTODY RECORD ColdSRng

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature)

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	A ETHANOL	B	C HOLD	Remarks
	ECS - FERM B3.9	11/3/93	N/A	{Transducers w/ BASS}		X			
	ECS - FERM B3.10	11/4/93	N/A	{in Room .}		X			
	E-CS-HW-FB .	11/5/93	↓	↓		X			
	E-CS-HW-TB	11/5/93	↓					X	
	E-CS FERM C2.1	11/5/93	N/A	↓		X			
	E-CS 2x2.1	11/5/93				X			
	VOC-CS 2x2.1	↓				X			

Relinquished by: (Signature)	Date/Time: 11/11/93 1300	Received By: (Signature)	Date/Time:
Relinquished by: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:

Remarks:

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b:\Chain

PACKAGING

CHAIN OF CUSTODY RECORD Prekas ey

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature)

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	Ethanol A	Formaldehyde B	Formaldehyde [illegible] C	Remarks
	EPR TANK HeadSpace	11/3/93	N/A	Next to KegWash EF29		X			
formaldehyde	F-P.1-F	11/4/93	1600				X		
	F-P.1-B		"						
	F-P.2-F		1625					X	}
	F-P.2-B		"					X	
	~~F-P.2~~								
	F-P.3-F		1650				X		
	F-P.3-B		"						
	F-P FB ×		1712				x		
	F-P TB		"				←		HOLD
	E-P-FB	11/5/93	1058			X			
	E-P-TB		1100				←		HOLD
	E-P-BD-FB		1110			X			
	E-P-BD-TB		1112				←		HOLD
	~~CL-P-B13.1~~		~~835~~	~~B13 VENT~~					
	~~CL-P-B13.2~~		~~1032~~	~~"~~					
	E-P-EF29.1		8:57	Kegwash Vent. EF29					missing

Relinquished by: (Signature)	Date/Time: 11/11/93	Received By: (Signature)	Date/Time:
Relinquished by: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:

Remarks:

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CHAIN OF CUSTODY RECORD : Packaging.

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature) Ken J. Grob

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	A Ethanol	B Ethanol w/ Break Thru	C	Remarks
	EE-P-EF2.1-F	11/1/93	1200	Packaging Roof Vent			X		
	EE-P-EF2.1-B		1200				X		
	EE-P-EF2.2-F		1240						
	EE-P-EF2.2-B		1240						
	EE-P-EF2.3-F		1315						
	EE-P-EF2.3-B	↓	1315	↓					
	EPB13.B.1	11/4/93	905	Exhaust Fan Line 13 Bottle		X			
	EPB13A.1		908			X			
	EPB13B.2		944			X			
	EPB13A.2		948	↓		X			
	EPC9 A.1		1118	Exh. Fan Line 9, Cans		X			
	EPC9 A.2		1347			X			
	EPC9 B.1		1355			X			
	EPC9 A.3		1422			X			
	EPC9 B.2	↓	1428	↓		X			

Relinquished by: (Signature) KJG

Date/Time: 11/11/93 1300

Received By: (Signature)

Date/Time:

Relinquished by: (Signature)

Date/Time:

Received By: (Signature)

Date/Time:

Remarks:

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CHAIN OF CUSTODY RECORD PACKAGING

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature)

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	A	B	C	Remarks
	E-P-B4A.1	11/4/93	915	Pasteurizis Line B4A/B		X			
	E-P-B4B1		930			X			
	E-P-B4A.2		~~948~~ 1040			X			
	E-P-B4A.3		1110			X			
	E-P-B4B.2		1357			X			
	E-P-B4B.3		1431	↓		X			
	~~CL-P-B5.1~~		~~1020~~	B5 Clean Air Test		X			
	~~CL-P-B5.2~~		~~1100~~			X			
	~~CL-P-B5.3~~		~~1340~~			X			
	E-P-B5.1		1040			X			
	E-P-B5.2		13~~45~~			X			
	E-P-B5.3	↓	1420	↓		X			
	E-P BD 13.1	11/5/93	825	Bean Dump G13		X			
	E-P BD 13.2		916			X			
	E-P-BD 13.3		1013	↓		X			
	E-P-RC.1		954	Rail Car Collect/C		X			
	E-P-RC.2	↓	925	"		X			

Relinquished by: (Signature)	Date/Time: 11/11/93 1300	Received By: (Signature)	Date/Time:
Relinquished by: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:

Remarks:

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CHAIN OF CUSTODY RECORD PAC/Assly

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature)

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	A Chlorine	B Chlorine Breakthru	C	Remarks
	E-P-EF29.2	11/5/93	933	VENT EF29 NEAR Keg Wash					} missing
	E-P-EF29.3	11/5/93	1005	"					
	CL-P-B5.1-F	11/4/93	1020	B5 Clean Run Test		X			
	CL-P-B5.1-B		1020						
	CL-P-B5.2-F		1100			X			
	CL-P-B5.2-B		1100						
	CL-P-B5.3-F		1340				X		
	CL-P-B5.3-B		1340				X		
	CL-P-B13.1-F	11/5/93	835	VENT B13			X		
	CL-P-B13.1-B		835				X		
	CL-P-B13.2-F		1033			X			
	CL-P-B13.2-B		1033						

Relinquished by: (Signature)	Date/Time: 11/11/93 1300	Received By: (Signature)	Date/Time:
Relinquished by: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:

Remarks:

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UTILITIES

CHAIN OF CUSTODY RECORD : UTILITIES

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature)

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	Ethanol A	Ammonia B	Ammonia Breakthru * C	Remarks
	EUCREGN.1	11/2/93	~~7:30~~ 2130	CARBON Drier VENT REGN		x			
	EUCREGN.2	11/2/93	~~450~~ 2330	WEST / (using by		x			
	EU CREGN.3	11/3/93	0605	BAG.		x			
	EUCREGN.4	11/3/93	0902	↓		x			
	EU CREGN.5	11/3/93	1203			x			
	EU CREGN.6	11/3/93	1515			x			
	EU CREGN.7	11/3/93	1814			x			
	EU EXH C9.1-F	11/3/93	1430	Exhaust FAN #689 C9		X	→	→	Breakthru *
	EU EXH C9.1-B	11/3/93	1430	"		X			
	~~EU EXH C2.2-F~~			~~Exhaust Fan #689 C2~~					
	~~EU EXH C9.2-B~~								
	EU EXH C2.1-F	11/3/93	1512	Exhaust Fan #689 C2		X	→	→	Breakthru *
	E-U EXH C2.1-B	11/3/93	1512	↓		X			
	NH_3-U.1-F	11/4/93	1552	Cooling Tower Platform			X		
	NH_3-U.1-B		1552				X		
	NH_3-U.2-F		1638					X	
	NH_3-U.2-B	↓	1638	↓				X	

Relinquished by: (Signature)	Date/Time: 4/11/93 1300	Received By: (Signature)	Date/Time:
Relinquished by: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:

Remarks:

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CHAIN OF COUSTODY RECORD Utilities

Project ID: SBEM				Project Name: SBEM		Ethanol	Chlorine	Ammonia	
Samplers: (Signature)									
Test ID	**Sample ID**	**Date**	**Time**	**Sampling Location**	**Number of Containers**	**A**	**B**	**C**	**Remarks**
	NH_3-U.3-F	11/4/93	~~1820~~ 1716	Utilities Cooling Tower Platform				X	
	NH_3-U.3-B	11/4/93	~~1820~~ 1716					X	
	NH_3-U.4-F	11/4/93	1805					X	} Breakthrough *
	NH_3-U.4-B	11/4/93	1805	↓				X	
	CL-U-1-F		1655				X		
	CL U.1-B		1655				X		
	CL U.2-F		1740				X		} Breakthrough *
	CL U.2-B		1740				X		
	CL U.3-F		1820				X		
	CL U.3-B	↓	1820	↓			X		
	EU CO2 S.1	11/5/93	0900	GRAB Supply line		X			
	EU CO2 S2.1		0940	TANK #2 line		X			
	EU CO2 STT.1		0946	TANK #1 HERO Line		X			
	EU CO2 S3.1		0942	TANK #3 line		X			
	EU CO2 S1.1	↓	0944	↓ TANK #1 line					
	VOC-U-FB		1013	Cooling Tower Platform			←		TEST for VOC
	VOC-U-TB	↓	1015	↓			←		HOLD

Relinquished by: (Signature)	Date/Time: 11/11/93 1300	Received By: (Signature)	Date/Time:
Relinquished by: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:

Remarks:

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CHAIN OF CUSTODY RECORD Utilities

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature)

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	VOC A	Ammonia B	Hold C	Remarks
	NH_3-U-FB	11/5/93	1148	Cooling Tower Platform			X		
	NH_3-U-TB	1/5/93	1150	"				X	
	(VOC-U-CREGN.1)					X			

Relinquished by: (Signature)	Date/Time: 11/11/23 1300	Received By: (Signature)	Date/Time:
Relinquished by: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:

Remarks:

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ANNEX

CHAIN OF CUSTODY RECORD

ANNEX

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature)

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	A	B	C	Remarks
	E A CW.1	11/4/93	1657	ANNEX CATWALK		X			
	E A IB9.1		1701	IBEAM#9 in ANNEX		X			
	E A CW.2		1728	ANNEX CATWALK		X			
	EA CW.3		1800	〃		X			
	EA IB9.2		1732	IBEAM#9 ANNEX		X			
	EA IB9.3		1804	〃		X			

Relinquished by: (Signature)	Date/Time: 11/4/93 1300	Received By: (Signature)	Date/Time:
Relinquished by: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:

Remarks:

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WASTEWATER TREATMENT

CHAIN OF CUSTODY RECORD WWT

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature)

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	A Ethanol	B	C	Remarks
	~~EWWT 1-F~~	11/4/93				X			
	~~EWWT 1-B~~								
	EWWT 1.1 - F		815	N Equalization Basin.					
	EWWT 1.1 - B		815						
	EWWT 1.2 - F		900						
	EWWT 1.2 - B		900						
	EWWT 1.3 - F		945						
	EWWT 1.3 - B		945						
	EWWT 2.1		815	Primary Settling					
	EWWT 2.2		900						
	EWWT 2.3		945						
	EWWT 3.1		815	Aeration Basin #1					
	EWWT 3.2		900						
	EWWT 3.3		945						
	EWWT 3.4		1030						
	EWWT 4.1		415	Aeration Basin #3					
	EWWT 4.2		900	~~ABC~~					

Relinquished by: (Signature) KJG

Date/Time: 11/11/93 1300

Received By: (Signature)

Date/Time:

Relinquished by: (Signature)

Date/Time:

Received By: (Signature)

Date/Time:

Remarks:

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CHAIN OF CUSTODY RECORD WWT.

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature) Kur J Hool

Test ID	Sample ID	Date	Time	Sampling Location	Number of Containers	Ethanol A	B	Hold C	Remarks
	EWWT 4.3	11/4/93	945	Aeration Basin #3		X			
	EWWT 5.4	11/4/93	1030	W Settling Basin #2		X			
	EWWT FB.1	↓				X		X	
	EWWT TB-1								

Relinquished by: (Signature) KJG	Date/Time: 11/11/93 1300	Received By: (Signature)	Date/Time:
Relinquished by: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:

Remarks:

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SAMPLED BY METHOD 5
AT KEG WASH AND BOTTLE WASH

CHAIN OF CUSTODY RECORD

Project ID: SBEM

Project Name: SBEM

Samplers: (Signature)

						NaOH			
Test ID	**Sample ID**	**Date**	**Time**	**Sampling Location**	**Number of Containers**	**A**	**B**	**C**	**Remarks**
	OH-KW.1-F	11/3/93		Keg Wash Method 5		X			
	OH-KW.1-B								
	OH-KW.2-F								
	OH-KW.2-B								
	OH-KW.3-F								
	OH-KW.3-B								
	OH-BW.1-F	11/4/93		Bottlewash Method 5					
	OH-BW.1-B								
	OH-BW.2-F								
	OH-BW.2-B								
	OH-BW-3-F								
	OH-BW-3-B								
	OH-BW-DI Blank								

Relinquished by: (Signature)	Date/Time: 11/4/93 1300	Received By: (Signature)	Date/Time:
Relinquished by: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:

Remarks: *TITRATION FOR OH Report as NaOH !!

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APPENDIX E
ANALYTICAL RESULTS

Miller Brewing Company
Fulton, New York

EMISSION INVENTORY REPORT

JANUARY 1994

LABORATORY ANALYSIS REPORT

Environmental Health Laboratory
a division of CIGNA Loss Control Services, Inc.

100 Sebethe Drive, Suite A-5
Cromwell, CT 06416
(800) 243-4903
Cromwell (203) 635-6475
Laboratories in Macon, GA and Cromwell, CT

CIGNA

To: Kevin J. Goohs
RTP Environmental Associates, Inc.
400 Post Ave. Suite 302
Westbury, NY 11590

Report No.: 93K1080
P. O. No.:
Date Received: 11/10/93
Date Reported: 11/22/93

Analysis: Ammonia
Analytical Method: Colorimetric; Modified NIOSH P&CAM 205

Sample Number	mg Ammonia
NH_3 U.1-F&B	0.0026
NH_3 U.2-F&B	<0.0025
NH_3 U.3-F&B	0.0047
NH_4 U.4-F&B	0.0028
Field Blank	<0.0025 mg

Analysis: Sodium Hydroxide
Analytical Method: Atomic Emission Spectrophotometry; Modified OSHA ID #121

Sample Number	mg NaOH
Na-BH-K-1	0.00068
Na-CS-FB-1.1	0.010
Na-CS-FB-1.2	0.012
Na-CS-FB-1.3	0.0027
Na-FB-1-Blank	<0.00044

Marjorie Luzzi FDR
Analyst: Marjorie Luzzi

Date: 11/22/93

< = Less than

CP-1H21b Printed in U.S.A.

LABORATORY ANALYSIS REPORT (continued)

Analysis: Formaldehyde
Analytical Method: High Performance Liquid Chromatography; EPA TO11

Sample Number	mg Formaldehyde
F-P-1	<0.000040
F-P-2	<0.000040
F-P-3	<0.000040
Field Blank	0.00013

The samples for analysis by high performance liquid chromatography were quantitated by matching the retention times of the sample peaks with those of known compounds; however, a matching retention time is not proof of chemical identity

Analytical results have been corrected for the blank.

Analyst Ron Schleicher /D.T.
Ron Schleicher
Date: 11/22/93

Analysis: Sodium Hydroxide
Analytical Method: Potentiometric Titration; Modified NIOSH 7401

Sample Number	Total mg Alkaline Dusts as Sodium Hydroxide	mg Front	mg Back
*OH-BW.1 F&B	66	30.7	35.5
*OH-BW.2 F&B	38	18.5	19.3
*OH-BW.3 F&B	30	15.7	14.1
OH-KW.1 F&B	<1.0	0.809	<0.226
OH-KW.2 F&B	<0.68	<0.424	<0.254
OH-KW.3 F&B	<0.69	0.429	<0.263
Blank H_2O	<0.0019 mg/ml	——	——

*The sodium hydroxide breakthrough to the backup impinger section was in excess of 25%. Therefore, the actual levels may be higher than reported.

Analysis: Chlorine
Analytical Method: Ion Specific Electrode; OSHA ID #101

Sample Number	mg Chlorine
CL-CS-B3.1 F&B	<0.066
CL-P-B13.1 F&B	<0.026
CL-P-B5.1 F&B	<0.066
CL-P-B5.2 F&B	<0.066
CL-P-B5.3 F&B	<0.019
CL-P-B13.2 F&B	<0.022
CL-U.1 F&B	<0.022
CL-U.2 F&B	<0.021
CL-U.3 F&B	<0.019
Train Blank	<0.0020 mg/ml

Analyst Marjorie Luzzi

Reissued: 1/05/94
Date: 11/22/93

LABORATORY ANALYSIS REPORT (continued)

Analysis: Solvents by Gas Chromatography
Analytical Method: NIOSH P&CAM #127.

Sample Number	mg Ethanol
ECS HW.1	0.32
ECS HW.2	0.10
ECS HW.3	0.085
ECS HW.4	0.085
ECS IV.1	0.0061
ECS IV.2	<0.0039
ECS IV.3	0.0054
ECS IV.4	0.082
ECS PFII.1	0.19
ECS E Field Blank 1	<0.0039
ECS E Field Blank	<0.0039
ECS HW.5	0.080
ECS HW.7	<0.0039
ECS IV.5	<0.0039
ECS IV.7	<0.0039
ECS HW.8	0.046
ECS CFT25.1	0.53
ECS S4T-34.1	0.61
ECS FC 8.1	0.38
ECS FC 8.2	0.20
ECS FERM B3.2	0.62
ECS FERM B3.3	0.44
ECS FERM B3.4	0.010
ECS FERM B3.5	0.55
ECS FERM B3.6	0.70
ECS FC.1	0.0063

Analyst Dave Torzillo Date: 11/22/93

Report No.: 93K1080

LABORATORY ANALYSIS REPORT (continued)

Page 5 of 7

Sample Number	mg Ethanol
ECS FERM B3.7	0.81
ECS FERM B3.8	0.81
ECS FERM B3.9	0.94
ECS FERM B3.10	<0.0039
ECS HW-FB	<0.0039
ECS FERM C2.1	1.3
ECS 2x2.1	0.017
ECS FERM B3FB	<0.0039
EE-P-EF 2.1	0.18
EE-P-EF 2.2	0.39
EE-P-EF 2.3	0.30
EPB 13 B.1	0.32
EPB 13 A.1	0.54
EPB 13 B.2	0.41
EPB 13 A.2	0.57
EP C9 A.1	0.85
EP C9 A.2	0.81
EP C9 B.1	0.27
EP C9 A.3	1.0
EP C9 B.2	0.28
E-P-B4 A.1	0.11
E-P-B4 B.1	0.072
E-P-B4 A.2	0.11
E-P-B4 A.3	0.11
E-P-B4 B.2	0.081
E-P-B4 B.3	0.057
E-P-B5.1	1.1
E-P-B5.2	0.66
E-P-B5.3	0.60
E-P-BD 13.1	<0.0039
E-P-BD 13.2	<0.0039
E-P-BD 13.3	<0.0039
E-P-RC.1	0.10
E-P-RC.2	0.069
EPR Tank Headspace	1.1
EP-FB	<0.0039
EP-BD FB	<0.0039
E-P-EF 29.1	0.030
E-P-EF 29.2	0.026
E-P-EF 29.3	0.020
EVCREGN.1	0.069
EVCREGN.2	0.081
EVCREGN.3	0.052
EVCREGN.4	0.081
EVCREGN.5	0.090
EVCREGN.6	0.094

David Torzillo

Analyst Dave Torzillo Date: 11/22/93

LABORATORY ANALYSIS REPORT (continued)

Report No.: 93K1080

Sample Number	mg Ethanol
EVCREGN.7	0.092
EUEXH C9.1	0.18
EUEXH C2.1	0.13
EUCO$_2$ S.1	<0.0039
EUCO$_2$ ST 2.1	<0.0039
EUCO$_2$ STT.1	<0.0039
EUCO$_2$ S3.1	<0.0039
EUCO$_2$ S1.1	<0.0039
EA CW.1	0.072
EA IB 9.1	0.11
EA CW 2	0.076
EA CW 3	0.070
EA IB 9.2	0.099
EA IB 9.3	0.11
EWWT 1.1	<0.0039
EWWT 1.2	0.0095
EWWT 1.3	<0.0039
EWWT 2.1	0.015
EWWT 2.2	0.015
EWWT 2.3	0.011
EWWT 3.1	<0.0039
EWWT 3.2	<0.0039
EWWT 3.3	<0.0039
EWWT 3.4	<0.0039
EWWT 4.1	<0.0039
EWWT 4.2	<0.0039
EWWT 4.3	<0.0039
EWWT 5.4	<0.0039
EWWT FB	<0.0039

On samples ECSIV4 and ECS PF II.1, all the ethanol was found in the backup tube indicating possible tube reversal during sampling.

Analyst Dave Torzillo

Date: 11/22/93

Report No.: 93K1080

LABORATORY ANALYSIS REPORT (continued)

Page 7 of 7

Sample Number	mg Total Hydrocarbons as n-Hexane
VOC-BHR-FB-F1	<0.014
VOC-CS-WT 1	0.52
VOC-BHR-K1	0.034
VOC-BHR-K2	0.064
VOC-BHR-K3	0.015
VOC-BHR-C1	0.14
VOC-BHR-C2	0.18
VOC-BHR-C3	0.35
VOC-BHR-MT1	2.1
VOC-BHR-MT2	1.9
VOC-BHR-MT3	1.2
VOC-BHR-LT 1	0.11
VOC-BHR-LT 2	0.059
VOC-BHR-LT 3	0.12
VOC-CS 2x2.1	<0.014
VOC-U FB	<0.014
VOC-UCREGN 1	<0.014

MW Hexane = 86.18

MW Toluene = 92.14

Sample Number	ug Total Hydrocarbons as Toluene/ml
VOC-BRH-FB-DI	<3.2
VOC-BRH-K1 C	5.2
VOC-BRH-K3C	<3.2
VOC-BRH-C1C	9.8
VOC-BRH-C2C	<3.2
VOC-BRH-C3C	<3.2
VOC-BRH-LT1C	<3.2
VOC-BRH-LT2C	<3.2
VOC-BRH-LT3C	<3.2
VOC-BRH-GFVC	<3.2

ug = micrograms

mg/ml = ppm

Samples analyzed by gas chromatography are quantitated by matching the retention times of sample peaks with those of known compounds. A matching retention time is not proof of chemical identity.

On all solid sorbent tubes and 3M 3520 organic vapor monitors the front and backup sections were analyzed separately. Unless indicated, significant breakthrough was not detected.

Analyst David Torzillo Dave Torzillo Date: 11/22/93

APPENDIX F
METEOROLOGICAL DATA

Miller Brewing Company
Fulton, New York

EMISSION INVENTORY REPORT

JANUARY 1994

METEOROLOGICAL DATA OUTPUT ARRAY DEFINITIONS

01 = Output Execution I.D.
02 = Julian Date
03 = Time (HH:MM)
04 = Mean Wind Speed (MPH)
05 = Mean Wind Vector Direction (Degrees)
06 = Standard Deviation of Wind Direction (Degrees)
07 = Standard Deviation of Vertical Direction (Radian)
08 = Average Air Temperature (Degrees F)
09 = Average Relative Humidity (Percent)
10 = Average Barometric Pressure (Inches of HG)
11 = Total Precipitation (Inches)
12 = Average Battery Voltage (VDC)

```
09+101.3  10+29.17  11+0.000  12+12.66
01+0121.  02+0304.  03+2300.  04+6.066  05+19.64  06+15.37  07+0.003  08+33.96
09+101.2  10+29.18  11+0.020  12+12.67
01+0109.  02+0304.  03+2315.  04+6.389  05+16.15  06+18.54  07+0.002  08+34.21
09+101.3  10+29.17  11+0.010  12+12.66
01+0109.  02+0304.  03+2330.  04+5.724  05+17.55  06+16.97  07+0.003  08+34.26
09+101.3  10+29.17  11+0.000  12+12.66
01+0109.  02+0304.  03+2345.  04+6.047  05+17.14  06+15.76  07+0.002  08+34.28
09+101.1  10+29.16  11+0.000  12+12.66
01+0109.  02+0304.  03+2400.  04+6.506  05+16.05  06+16.92  07+0.002  08+34.28
09+101.1  10+29.15  11+0.000  12+12.66
01+0121.  02+0304.  03+2400.  04+6.166  05+16.72  06+17.08  07+0.002  08+34.25
09+101.2  10+29.16  11+0.010  12+12.66
```

```
01+0109.  02+0305.  03+0015.  04+6.043  05+13.81  06+17.30  07+0.002  08+34.14
09+100.9  10+29.15  11+0.000  12+12.66
01+0109.  02+0305.  03+0030.  04+6.968  05+15.91  06+15.39  07+0.002  08+33.95
09+100.8  10+29.14  11+0.000  12+12.66
01+0109.  02+0305.  03+0045.  04+6.277  05+17.75  06+19.46  07+0.002  08+33.77
09+100.7  10+29.14  11+0.010  12+12.66
01+0109.  02+0305.  03+0100.  04+6.813  05+14.80  06+17.44  07+0.002  08+33.41
09+100.8  10+29.14  11+0.010  12+12.66
01+0121.  02+0305.  03+0100.  04+6.525  05+15.56  06+17.51  07+0.002  08+33.82
09+100.8  10+29.14  11+0.020  12+12.66
01+0109.  02+0305.  03+0115.  04+07.12  05+13.89  06+17.53  07+0.002  08+33.22
09+101.0  10+29.14  11+0.010  12+12.65
01+0109.  02+0305.  03+0130.  04+6.567  05+15.48  06+15.31  07+0.002  08+33.07
09+101.2  10+29.14  11+0.000  12+12.65
01+0109.  02+0305.  03+0145.  04+6.688  05+13.87  06+17.64  07+0.002  08+32.93
09+101.4  10+29.14  11+0.010  12+12.65
01+0109.  02+0305.  03+0200.  04+6.292  05+12.64  06+16.51  07+0.002  08+32.84
09+101.6  10+29.14  11+0.000  12+12.65
01+0121.  02+0305.  03+0200.  04+6.668  05+13.97  06+16.80  07+0.002  08+33.01
09+101.3  10+29.14  11+0.020  12+12.65
01+0109.  02+0305.  03+0215.  04+6.564  05+14.29  06+16.94  07+0.002  08+32.81
09+101.8  10+29.14  11+0.000  12+12.65
01+0109.  02+0305.  03+0230.  04+07.17  05+16.50  06+16.13  07+0.002  08+32.77
09+101.9  10+29.14  11+0.000  12+12.64
01+0109.  02+0305.  03+0245.  04+6.966  05+13.54  06+16.47  07+0.002  08+32.75
09+102.0  10+29.14  11+0.000  12+12.64
01+0109.  02+0305.  03+0300.  04+6.827  05+15.86  06+17.32  07+0.002  08+32.68
09+102.2  10+29.14  11+0.000  12+12.64
01+0121.  02+0305.  03+0300.  04+6.881  05+15.05  06+16.76  07+0.002  08+32.75
09+102.0  10+29.14  11+0.000  12+12.64
01+0109.  02+0305.  03+0315.  04+6.555  05+11.03  06+17.82  07+0.003  08+32.64
09+102.2  10+29.14  11+0.000  12+12.64
01+0109.  02+0305.  03+0330.  04+6.025  05+08.49  06+19.60  07+0.003  08+32.62
09+102.4  10+29.14  11+0.000  12+12.64
01+0109.  02+0305.  03+0345.  04+6.592  05+09.36  06+17.22  07+0.002  08+32.57
09+102.4  10+29.14  11+0.000  12+12.64
01+0109.  02+0305.  03+0400.  04+07.35  05+10.68  06+16.32  07+0.002  08+32.47
09+102.5  10+29.14  11+0.000  12+12.64
01+0121.  02+0305.  03+0400.  04+6.631  05+09.90  06+17.80  07+0.002  08+32.58
09+102.4  10+29.14  11+0.000  12+12.64
01+0109.  02+0305.  03+0415.  04+6.803  05+12.27  06+17.99  07+0.003  08+32.38
09+102.6  10+29.14  11+0.000  12+12.63
01+0109.  02+0305.  03+0430.  04+07.00  05+12.05  06+18.02  07+0.002  08+32.28
09+102.6  10+29.14  11+0.000  12+12.63
01+0109.  02+0305.  03+0445.  04+07.46  05+10.24  06+16.29  07+0.002  08+32.12
09+102.8  10+29.14  11+0.000  12+12.63
01+0109.  02+0305.  03+0500.  04+07.21  05+09.74  06+15.34  07+0.002  08+32.03
```

Meteorological Data for
11/1/93 - 11/5/93

Add one hour to correct
for daylight savings.

```
09+102.8  10+29.14  11+0.000  12+12.63
01+0121.  02+0305.  03+0500.  04+07.12  05+11.07  06+16.98  07+0.003  08+32.20
09+102.7  10+29.14  11+0.000  12+12.63
01+0109.  02+0305.  03+0515.  04+6.640  05+08.20  06+16.51  07+0.002  08+32.03
09+102.8  10+29.14  11+0.000  12+12.63
01+0109.  02+0305.  03+0530.  04+6.528  05+11.44  06+16.90  07+0.003  08+32.03
09+102.9  10+29.15  11+0.000  12+12.63
01+0109.  02+0305.  03+0545.  04+07.28  05+07.80  06+16.40  07+0.002  08+32.03
09+103.0  10+29.15  11+0.000  12+12.63
01+0109.  02+0305.  03+0600.  04+08.09  05+07.80  06+18.24  07+0.002  08+32.01
09+103.1  10+29.15  11+0.000  12+12.62
01+0121.  02+0305.  03+0600.  04+07.13  05+08.81  06+17.09  07+0.002  08+32.02
09+102.9  10+29.15  11+0.000  12+12.63
01+0109.  02+0305.  03+0615.  04+07.03  05+5.572  06+15.17  07+0.002  08+32.03
09+103.2  10+29.16  11+0.000  12+12.62
01+0109.  02+0305.  03+0630.  04+07.89  05+08.34  06+17.22  07+0.002  08+32.04
09+103.2  10+29.16  11+0.000  12+12.62
01+0109.  02+0305.  03+0645.  04+07.12  05+5.093  06+15.23  07+0.002  08+32.12
09+103.4  10+29.17  11+0.000  12+12.62
01+0109.  02+0305.  03+0700.  04+07.50  05+5.885  06+18.27  07+0.002  08+32.12
09+103.4  10+29.17  11+0.000  12+12.62
01+0121.  02+0305.  03+0700.  04+07.38  05+6.219  06+16.57  07+0.002  08+32.08
09+103.3  10+29.17  11+0.000  12+12.62
01+0109.  02+0305.  03+0715.  04+08.22  05+3.891  06+17.39  07+0.002  08+32.18
09+103.4  10+29.18  11+0.000  12+12.62
01+0109.  02+0305.  03+0730.  04+08.21  05+1.903  06+18.44  07+0.002  08+32.23
09+103.5  10+29.19  11+0.000  12+12.62
01+0109.  02+0305.  03+0745.  04+09.15  05+2.179  06+16.94  07+0.002  08+32.23
09+103.5  10+29.19  11+0.000  12+12.62
01+0109.  02+0305.  03+0800.  04+09.59  05+0.943  06+16.81  07+0.002  08+32.23
09+103.6  10+29.20  11+0.000  12+12.62
01+0121.  02+0305.  03+0800.  04+08.79  05+2.228  06+17.44  07+0.003  08+32.22
09+103.5  10+29.19  11+0.000  12+12.62
01+0109.  02+0305.  03+0815.  04+09.08  05+1.351  06+17.80  07+0.002  08+32.27
09+103.7  10+29.21  11+0.000  12+12.62
01+0109.  02+0305.  03+0830.  04+07.81  05+358.0  06+19.46  07+0.002  08+32.17
09+103.7  10+29.22  11+0.000  12+12.62
01+0109.  02+0305.  03+0845.  04+09.49  05+359.3  06+19.10  07+0.002  08+32.12
09+103.8  10+29.22  11+0.000  12+12.61
01+0109.  02+0305.  03+0900.  04+08.68  05+359.8  06+19.54  07+0.002  08+32.11
09+103.9  10+29.23  11+0.000  12+12.61
01+0121.  02+0305.  03+0900.  04+08.76  05+359.6  06+19.02  07+0.002  08+32.17
09+103.8  10+29.22  11+0.000  12+12.62
01+0109.  02+0305.  03+0915.  04+09.47  05+358.1  06+17.90  07+0.002  08+32.12
09+103.9  10+29.24  11+0.000  12+12.61
01+0109.  02+0305.  03+0930.  04+08.58  05+357.4  06+18.40  07+0.002  08+32.11
09+104.1  10+29.24  11+0.000  12+12.61
01+0109.  02+0305.  03+0945.  04+09.00  05+357.2  06+16.70  07+0.002  08+32.12
09+104.1  10+29.25  11+0.000  12+12.61
01+0109.  02+0305.  03+1000.  04+09.20  05+356.7  06+21.07  07+0.002  08+32.12
09+104.1  10+29.26  11+0.000  12+12.61
01+0121.  02+0305.  03+1000.  04+09.06  05+357.4  06+18.59  07+0.002  08+32.12
09+104.1  10+29.25  11+0.000  12+12.61
01+0109.  02+0305.  03+1015.  04+08.79  05+359.1  06+18.12  07+0.002  08+32.12
09+104.1  10+29.26  11+0.000  12+12.60
01+0109.  02+0305.  03+1030.  04+07.98  05+358.8  06+17.61  07+0.002  08+32.12
09+104.2  10+29.27  11+0.000  12+12.60
01+0109.  02+0305.  03+1045.  04+09.18  05+354.1  06+18.28  07+0.002  08+32.12
09+104.3  10+29.28  11+0.000  12+12.61
01+0109.  02+0305.  03+1100.  04+08.78  05+356.4  06+19.96  07+0.002  08+32.14
```

```
09+104.3  10+29.28  11+0.000  12+12.61
01+0121.  02+0305.  03+1100.  04+08.68  05+357.1  06+18.62  07+0.002  08+32.12
09+104.2  10+29.27  11+0.000  12+12.61
01+0109.  02+0305.  03+1115.  04+08.11  05+359.6  06+18.42  07+0.002  08+32.34
09+104.3  10+29.29  11+0.000  12+12.60
01+0109.  02+0305.  03+1130.  04+08.57  05+355.0  06+16.85  07+0.002  08+32.73
09+104.4  10+29.30  11+0.010  12+12.60
01+0109.  02+0305.  03+1145.  04+09.95  05+354.8  06+17.54  07+0.001  08+32.88
09+104.5  10+29.30  11+0.000  12+12.60
01+0109.  02+0305.  03+1200.  04+09.38  05+354.4  06+18.92  07+0.002  08+32.75
09+104.5  10+29.31  11+0.000  12+12.60
01+0121.  02+0305.  03+1200.  04+09.00  05+356.0  06+18.07  07+0.002  08+32.68
09+104.4  10+29.30  11+0.010  12+12.60
01+0109.  02+0305.  03+1215.  04+07.44  05+355.6  06+16.49  07+0.002  08+32.80
09+104.5  10+29.32  11+0.000  12+12.60
01+0109.  02+0305.  03+1230.  04+6.605  05+350.8  06+19.88  07+0.002  08+32.96
09+104.5  10+29.32  11+0.000  12+12.60
01+0109.  02+0305.  03+1245.  04+07.36  05+347.6  06+22.41  07+0.002  08+32.82
09+104.6  10+29.32  11+0.000  12+12.60
01+0109.  02+0305.  03+1300.  04+08.49  05+348.0  06+19.45  07+0.002  08+32.83
09+104.7  10+29.32  11+0.010  12+12.60
01+0121.  02+0305.  03+1300.  04+07.47  05+350.5  06+19.91  07+0.002  08+32.85
09+104.6  10+29.32  11+0.010  12+12.60
01+0109.  02+0305.  03+1315.  04+07.15  05+346.5  06+19.20  07+0.002  08+33.03
09+104.7  10+29.33  11+0.020  12+12.60
01+0109.  02+0305.  03+1330.  04+07.28  05+346.3  06+23.16  07+0.002  08+33.09
09+104.7  10+29.33  11+0.010  12+12.59
01+0109.  02+0305.  03+1345.  04+08.05  05+343.3  06+21.26  07+0.002  08+33.02
09+104.7  10+29.34  11+0.020  12+12.59
01+0109.  02+0305.  03+1400.  04+08.32  05+346.6  06+20.72  07+0.002  08+33.17
09+104.7  10+29.35  11+0.030  12+12.59
01+0121.  02+0305.  03+1400.  04+07.70  05+345.7  06+21.17  07+0.002  08+33.08
09+104.7  10+29.34  11+0.080  12+12.59
01+0109.  02+0305.  03+1415.  04+08.46  05+349.2  06+19.46  07+0.002  08+32.96
09+104.8  10+29.35  11+0.020  12+12.59
01+0109.  02+0305.  03+1430.  04+07.59  05+346.4  06+23.58  07+0.002  08+32.91
09+104.9  10+29.36  11+0.030  12+12.59
01+0109.  02+0305.  03+1445.  04+07.15  05+336.7  06+22.65  07+0.003  08+32.79
09+104.9  10+29.37  11+0.020  12+12.59
01+0109.  02+0305.  03+1500.  04+07.01  05+332.6  06+26.76  07+0.002  08+32.77
09+104.9  10+29.38  11+0.020  12+12.59
01+0121.  02+0305.  03+1500.  04+07.55  05+341.3  06+24.20  07+0.003  08+32.86
09+104.9  10+29.36  11+0.090  12+12.59
01+0109.  02+0305.  03+1515.  04+07.24  05+335.3  06+28.75  07+0.002  08+32.85
09+105.0  10+29.39  11+0.030  12+12.59
01+0109.  02+0305.  03+1530.  04+07.67  05+329.3  06+29.57  07+0.002  08+32.55
09+105.0  10+29.40  11+0.010  12+12.59
01+0109.  02+0305.  03+1545.  04+5.725  05+332.2  06+31.90  07+0.003  08+32.52
09+105.0  10+29.41  11+0.010  12+12.59
01+0109.  02+0305.  03+1600.  04+07.44  05+332.0  06+31.25  07+0.002  08+32.28
09+105.0  10+29.42  11+0.000  12+12.58
01+0121.  02+0305.  03+1600.  04+07.02  05+332.2  06+30.46  07+0.002  08+32.55
09+105.0  10+29.40  11+0.050  12+12.59
01+0109.  02+0305.  03+1615.  04+6.388  05+330.0  06+31.65  07+0.003  08+32.28
09+105.0  10+29.43  11+0.010  12+12.58
01+0109.  02+0305.  03+1630.  04+6.394  05+326.3  06+36.36  07+0.003  08+32.16
09+105.0  10+29.44  11+0.010  12+12.58
01+0109.  02+0305.  03+1645.  04+5.441  05+325.2  06+35.30  07+0.003  08+32.13
09+105.0  10+29.45  11+0.000  12+12.58
01+0109.  02+0305.  03+1700.  04+5.947  05+328.4  06+37.05  07+0.003  08+32.12
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```
09+105.2  10+29.45  11+0.000  12+12.58
01+0121.  02+0305.  03+1700.  04+6.043  05+327.5  06+35.18  07+0.003  08+32.17
09+105.1  10+29.44  11+0.020  12+12.58
01+0109.  02+0305.  03+1715.  04+4.662  05+325.3  06+34.52  07+0.003  08+32.10
09+105.2  10+29.46  11+0.000  12+12.58
01+0109.  02+0305.  03+1730.  04+4.884  05+322.9  06+36.61  07+0.003  08+32.10
09+105.2  10+29.47  11+0.000  12+12.58
01+0109.  02+0305.  03+1745.  04+5.440  05+334.1  06+27.55  07+0.003  08+32.19
09+105.2  10+29.48  11+0.000  12+12.57
01+0109.  02+0305.  03+1800.  04+6.412  05+339.4  06+21.09  07+0.004  08+32.30
09+105.2  10+29.49  11+0.000  12+12.57
01+0121.  02+0305.  03+1800.  04+5.350  05+330.8  06+31.11  07+0.004  08+32.17
09+105.2  10+29.48  11+0.000  12+12.58
01+0109.  02+0305.  03+1815.  04+5.381  05+345.2  06+19.00  07+0.003  08+32.49
09+105.2  10+29.50  11+0.000  12+12.57
01+0109.  02+0305.  03+1830.  04+4.545  05+346.1  06+26.32  07+0.005  08+32.71
09+105.2  10+29.51  11+0.000  12+12.57
01+0109.  02+0305.  03+1845.  04+4.936  05+336.4  06+25.99  07+0.005  08+32.95
09+105.3  10+29.52  11+0.000  12+12.57
01+0109.  02+0305.  03+1900.  04+4.254  05+334.5  06+33.27  07+0.005  08+32.97
09+105.3  10+29.54  11+0.000  12+12.57
01+0121.  02+0305.  03+1900.  04+4.779  05+340.7  06+27.01  07+0.005  08+32.78
09+105.3  10+29.52  11+0.000  12+12.57
01+0109.  02+0305.  03+1915.  04+4.679  05+333.3  06+31.72  07+0.004  08+33.04
09+105.3  10+29.54  11+0.000  12+12.57
01+0109.  02+0305.  03+1930.  04+5.210  05+349.7  06+18.77  07+0.003  08+33.41
09+105.3  10+29.55  11+0.000  12+12.57
01+0109.  02+0305.  03+1945.  04+4.391  05+357.5  06+17.51  07+0.004  08+33.47
09+105.3  10+29.55  11+0.010  12+12.57
01+0109.  02+0305.  03+2000.  04+4.019  05+356.6  06+17.32  07+0.004  08+33.68
09+105.0  10+29.56  11+0.010  12+12.57
01+0121.  02+0305.  03+2000.  04+4.575  05+349.7  06+23.95  07+0.004  08+33.40
09+105.2  10+29.55  11+0.020  12+12.57
01+0109.  02+0305.  03+2015.  04+4.450  05+358.1  06+16.91  07+0.004  08+34.01
09+104.6  10+29.56  11+0.010  12+12.57
01+0109.  02+0305.  03+2030.  04+3.429  05+349.6  06+19.52  07+0.005  08+34.33
09+103.9  10+29.57  11+0.010  12+12.57
01+0109.  02+0305.  03+2045.  04+2.332  05+329.6  06+38.54  07+0.007  08+34.12
09+103.0  10+29.58  11+0.010  12+12.57
01+0109.  02+0305.  03+2100.  04+2.888  05+282.1  06+33.59  07+0.006  08+34.47
09+101.9  10+29.59  11+0.010  12+12.57
01+0121.  02+0305.  03+2100.  04+3.275  05+332.6  06+40.86  07+0.005  08+34.23
09+103.4  10+29.58  11+0.040  12+12.57
01+0109.  02+0305.  03+2115.  04+3.027  05+298.0  06+40.43  07+0.005  08+34.72
09+100.1  10+29.60  11+0.000  12+12.57
01+0109.  02+0305.  03+2130.  04+3.567  05+330.8  06+32.08  07+0.004  08+35.01
09+097.2  10+29.61  11+0.000  12+12.56
01+0109.  02+0305.  03+2145.  04+4.621  05+337.4  06+27.45  07+0.003  08+35.32
09+093.3  10+29.62  11+0.010  12+12.56
01+0109.  02+0305.  03+2200.  04+4.477  05+340.9  06+22.68  07+0.003  08+35.15
09+089.4  10+29.63  11+0.000  12+12.56
01+0121.  02+0305.  03+2200.  04+3.923  05+328.1  06+35.21  07+0.004  08+35.05
09+095.0  10+29.62  11+0.010  12+12.56
01+0109.  02+0305.  03+2215.  04+5.943  05+356.8  06+18.39  07+0.002  08+34.92
09+086.8  10+29.64  11+0.000  12+12.56
01+0109.  02+0305.  03+2230.  04+5.800  05+355.8  06+18.75  07+0.003  08+34.92
09+084.1  10+29.64  11+0.000  12+12.56
01+0109.  02+0305.  03+2245.  04+5.342  05+357.1  06+16.92  07+0.003  08+34.61
09+082.3  10+29.65  11+0.000  12+12.56
01+0109.  02+0305.  03+2300.  04+5.135  05+355.7  06+16.01  07+0.003  08+34.39
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09+081.1  10+29.66  11+0.000  12+12.56
01+0121.  02+0305.  03+2300.  04+5.555  05+356.4  06+17.56  07+0.003  08+34.71
09+083.6  10+29.65  11+0.000  12+12.56
01+0109.  02+0305.  03+2315.  04+5.172  05+0.005  06+17.67  07+0.003  08+34.09
09+079.5  10+29.67  11+0.000  12+12.56
01+0109.  02+0305.  03+2330.  04+4.490  05+355.0  06+18.23  07+0.004  08+34.18
09+078.6  10+29.67  11+0.000  12+12.55
01+0109.  02+0305.  03+2345.  04+3.042  05+354.9  06+33.12  07+0.005  08+33.60
09+079.2  10+29.68  11+0.000  12+12.55
01+0109.  02+0305.  03+2400.  04+3.525  05+318.8  06+39.55  07+0.005  08+33.69
09+079.0  10+29.68  11+0.000  12+12.55
01+0121.  02+0305.  03+2400.  04+4.057  05+348.5  06+32.48  07+0.004  08+33.89
09+079.1  10+29.68  11+0.000  12+12.55
01+0109.  02+0306.  03+0015.  04+3.957  05+325.5  06+39.76  07+0.004  08+33.40
09+077.7  10+29.69  11+0.000  12+12.55
01+0109.  02+0306.  03+0030.  04+3.249  05+310.1  06+39.25  07+0.005  08+33.11
09+076.8  10+29.70  11+0.000  12+12.55
01+0109.  02+0306.  03+0045.  04+2.875  05+309.0  06+46.01  07+0.006  08+32.66
09+076.6  10+29.71  11+0.000  12+12.55
01+0109.  02+0306.  03+0100.  04+3.501  05+332.1  06+32.73  07+0.005  08+32.66
09+076.6  10+29.72  11+0.000  12+12.55
01+0121.  02+0306.  03+0100.  04+3.395  05+319.6  06+40.82  07+0.005  08+32.96
09+076.9  10+29.71  11+0.000  12+12.55
01+0109.  02+0306.  03+0115.  04+3.550  05+324.2  06+34.82  07+0.005  08+32.77
09+076.2  10+29.72  11+0.000  12+12.55
01+0109.  02+0306.  03+0130.  04+2.901  05+297.9  06+42.04  07+0.005  08+32.18
09+076.4  10+29.73  11+0.000  12+12.55
01+0109.  02+0306.  03+0145.  04+2.248  05+303.9  06+39.73  07+0.006  08+31.63
09+076.9  10+29.74  11+0.000  12+12.55
01+0109.  02+0306.  03+0200.  04+2.249  05+284.6  06+32.20  07+0.007  08+31.31
09+078.1  10+29.74  11+0.000  12+12.54
01+0121.  02+0306.  03+0200.  04+2.737  05+302.6  06+40.04  07+0.006  08+31.97
09+076.9  10+29.73  11+0.000  12+12.55
01+0109.  02+0306.  03+0215.  04+2.699  05+303.9  06+44.65  07+0.005  08+31.40
09+078.1  10+29.75  11+0.000  12+12.54
01+0109.  02+0306.  03+0230.  04+2.299  05+283.6  06+41.66  07+0.007  08+31.08
09+077.9  10+29.76  11+0.000  12+12.54
01+0109.  02+0306.  03+0245.  04+2.260  05+267.0  06+22.50  07+0.008  08+30.70
09+078.7  10+29.77  11+0.000  12+12.54
01+0109.  02+0306.  03+0300.  04+1.994  05+265.8  06+24.29  07+0.012  08+30.49
09+079.8  10+29.77  11+0.000  12+12.54
01+0121.  02+0306.  03+0300.  04+2.313  05+278.5  06+37.43  07+0.010  08+30.91
09+078.6  10+29.76  11+0.000  12+12.54
01+0109.  02+0306.  03+0315.  04+2.541  05+250.3  06+19.18  07+0.009  08+30.54
09+080.2  10+29.78  11+0.000  12+12.53
01+0109.  02+0306.  03+0330.  04+2.489  05+263.2  06+23.81  07+0.007  08+30.42
09+081.1  10+29.79  11+0.000  12+12.53
01+0109.  02+0306.  03+0345.  04+1.714  05+248.1  06+26.36  07+0.009  08+29.54
09+081.5  10+29.79  11+0.000  12+12.53
01+0109.  02+0306.  03+0400.  04+1.134  05+221.0  06+37.80  07+0.014  08+28.32
09+084.5  10+29.80  11+0.000  12+12.53
01+0121.  02+0306.  03+0400.  04+1.969  05+246.6  06+31.20  07+0.009  08+29.71
09+081.8  10+29.79  11+0.000  12+12.53
01+0109.  02+0306.  03+0415.  04+0.994  05+272.4  06+33.11  07+0.017  08+27.60
09+087.7  10+29.80  11+0.000  12+12.53
01+0109.  02+0306.  03+0430.  04+1.067  05+313.4  06+32.08  07+0.015  08+27.52
09+090.3  10+29.81  11+0.000  12+12.53
01+0109.  02+0306.  03+0445.  04+1.072  05+268.3  06+39.45  07+0.015  08+27.47
09+091.4  10+29.81  11+0.000  12+12.53
01+0109.  02+0306.  03+0500.  04+1.974  05+184.7  06+28.02  07+0.008  08+26.75
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09+092.7  10+29.82  11+0.000  12+12.52
01+0121.  02+0306.  03+0500.  04+1.277  05+263.0  06+58.65  07+0.013  08+27.34
09+090.5  10+29.81  11+0.000  12+12.53
01+0109.  02+0306.  03+0515.  04+2.265  05+211.2  06+24.17  07+0.007  08+26.71
09+094.2  10+29.83  11+0.000  12+12.52
01+0109.  02+0306.  03+0530.  04+2.422  05+220.9  06+21.79  07+0.006  08+26.72
09+095.2  10+29.84  11+0.000  12+12.52
01+0109.  02+0306.  03+0545.  04+2.898  05+201.6  06+12.60  07+0.006  08+26.63
09+095.6  10+29.84  11+0.000  12+12.52
01+0109.  02+0306.  03+0600.  04+1.851  05+176.5  06+35.05  07+0.009  08+25.84
09+095.8  10+29.85  11+0.000  12+12.52
01+0121.  02+0306.  03+0600.  04+2.359  05+203.4  06+29.27  07+0.007  08+26.48
09+095.2  10+29.84  11+0.000  12+12.52
01+0109.  02+0306.  03+0615.  04+2.763  05+201.3  06+11.39  07+0.006  08+25.72
09+096.3  10+29.86  11+0.000  12+12.52
01+0109.  02+0306.  03+0630.  04+2.376  05+201.9  06+08.74  07+0.007  08+25.89
09+096.9  10+29.86  11+0.000  12+12.51
01+0109.  02+0306.  03+0645.  04+2.464  05+197.8  06+10.95  07+0.007  08+25.56
09+097.3  10+29.87  11+0.000  12+12.51
01+0109.  02+0306.  03+0700.  04+2.021  05+194.5  06+25.93  07+0.008  08+25.50
09+097.9  10+29.88  11+0.000  12+12.51
01+0121.  02+0306.  03+0700.  04+2.406  05+199.0  06+15.93  07+0.007  08+25.67
09+097.1  10+29.87  11+0.000  12+12.51
01+0109.  02+0306.  03+0715.  04+1.742  05+190.0  06+51.29  07+0.013  08+24.65
09+098.2  10+29.88  11+0.000  12+12.51
01+0109.  02+0306.  03+0730.  04+2.784  05+207.7  06+11.34  07+0.007  08+25.36
09+098.7  10+29.89  11+0.000  12+12.51
01+0109.  02+0306.  03+0745.  04+2.448  05+209.1  06+16.10  07+0.009  08+25.54
09+099.0  10+29.90  11+0.000  12+12.51
01+0109.  02+0306.  03+0800.  04+1.903  05+205.6  06+45.38  07+0.013  08+25.26
09+099.2  10+29.90  11+0.000  12+12.51
01+0121.  02+0306.  03+0800.  04+2.219  05+204.1  06+35.07  07+0.010  08+25.20
09+098.8  10+29.90  11+0.000  12+12.51
01+0109.  02+0306.  03+0815.  04+2.834  05+208.5  06+12.45  07+0.006  08+25.86
09+099.5  10+29.91  11+0.000  12+12.50
01+0109.  02+0306.  03+0830.  04+2.396  05+223.2  06+27.40  07+0.007  08+26.17
09+099.7  10+29.91  11+0.000  12+12.50
01+0109.  02+0306.  03+0845.  04+3.808  05+241.8  06+15.41  07+0.004  08+26.95
09+099.9  10+29.93  11+0.000  12+12.50
01+0109.  02+0306.  03+0900.  04+4.218  05+232.2  06+18.72  07+0.004  08+28.34
09+100.0  10+29.94  11+0.000  12+12.50
01+0121.  02+0306.  03+0900.  04+3.314  05+226.4  06+22.86  07+0.005  08+26.83
09+099.7  10+29.92  11+0.000  12+12.50
01+0109.  02+0306.  03+0915.  04+3.784  05+238.7  06+18.55  07+0.006  08+29.82
09+099.1  10+29.94  11+0.000  12+12.50
01+0109.  02+0306.  03+0930.  04+4.645  05+243.3  06+14.47  07+0.006  08+30.78
09+097.0  10+29.95  11+0.010  12+12.50
01+0109.  02+0306.  03+0945.  04+4.215  05+240.7  06+14.44  07+0.005  08+31.76
09+094.6  10+29.96  11+0.000  12+12.50
01+0109.  02+0306.  03+1000.  04+3.332  05+237.1  06+20.91  07+0.005  08+32.97
09+092.0  10+29.96  11+0.000  12+12.50
01+0121.  02+0306.  03+1000.  04+3.994  05+240.0  06+17.45  07+0.006  08+31.33
09+095.7  10+29.95  11+0.010  12+12.50
01+0109.  02+0306.  03+1015.  04+3.739  05+233.1  06+17.88  07+0.004  08+34.03
09+089.1  10+29.97  11+0.010  12+12.50
01+0109.  02+0306.  03+1030.  04+3.143  05+225.5  06+23.33  07+0.005  08+35.10
09+086.2  10+29.97  11+0.010  12+12.51
01+0109.  02+0306.  03+1045.  04+4.138  05+224.1  06+17.22  07+0.004  08+35.81
09+083.4  10+29.97  11+0.020  12+12.51
01+0109.  02+0306.  03+1100.  04+4.762  05+229.6  06+19.04  07+0.003  08+36.13
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09+082.3  10+29.98  11+0.020  12+12.52
01+0121.  02+0306.  03+1100.  04+3.945  05+228.1  06+19.81  07+0.004  08+35.27
09+085.3  10+29.97  11+0.060  12+12.51
01+0109.  02+0306.  03+1115.  04+4.296  05+248.4  06+13.41  07+0.005  08+37.30
09+081.1  10+29.98  11+0.020  12+12.52
01+0109.  02+0306.  03+1130.  04+3.811  05+247.6  06+20.03  07+0.005  08+38.57
09+078.9  10+29.98  11+0.020  12+12.52
01+0109.  02+0306.  03+1145.  04+5.136  05+244.9  06+16.15  07+0.004  08+38.78
09+076.7  10+29.98  11+0.020  12+12.53
01+0109.  02+0306.  03+1200.  04+3.934  05+251.7  06+29.19  07+0.004  08+39.85
09+075.7  10+29.98  11+0.020  12+12.53
01+0121.  02+0306.  03+1200.  04+4.294  05+248.1  06+20.59  07+0.005  08+38.62
09+078.1  10+29.98  11+0.080  12+12.52
01+0109.  02+0306.  03+1215.  04+4.086  05+252.4  06+21.39  07+0.004  08+40.69
09+073.1  10+29.98  11+0.030  12+12.53
01+0109.  02+0306.  03+1230.  04+2.770  05+273.5  06+46.41  07+0.006  08+41.98
09+070.4  10+29.97  11+0.030  12+12.53
01+0109.  02+0306.  03+1245.  04+3.299  05+265.9  06+33.91  07+0.004  08+42.51
09+67.37  10+29.97  11+0.020  12+12.53
01+0109.  02+0306.  03+1300.  04+4.597  05+275.8  06+46.89  07+0.002  08+42.35
09+65.15  10+29.97  11+0.000  12+12.54
01+0121.  02+0306.  03+1300.  04+3.688  05+265.9  06+39.20  07+0.004  08+41.88
09+69.01  10+29.97  11+0.080  12+12.53
01+0109.  02+0306.  03+1315.  04+4.352  05+245.5  06+23.11  07+0.003  08+42.57
09+64.83  10+29.96  11+0.000  12+12.54
01+0109.  02+0306.  03+1330.  04+4.703  05+259.9  06+26.35  07+0.003  08+43.32
09+59.22  10+29.96  11+0.000  12+12.54
01+0109.  02+0306.  03+1345.  04+4.205  05+282.7  06+44.83  07+0.004  08+43.14
09+54.85  10+29.95  11+0.000  12+12.54
01+0109.  02+0306.  03+1400.  04+4.323  05+269.8  06+32.70  07+0.004  08+43.54
09+52.90  10+29.95  11+0.000  12+12.54
01+0121.  02+0306.  03+1400.  04+4.396  05+263.4  06+35.11  07+0.004  08+43.14
09+57.95  10+29.96  11+0.000  12+12.54
01+0109.  02+0306.  03+1415.  04+3.927  05+280.8  06+39.65  07+0.004  08+43.58
09+51.36  10+29.95  11+0.000  12+12.55
01+0109.  02+0306.  03+1430.  04+4.396  05+299.9  06+49.54  07+0.004  08+43.19
09+51.63  10+29.95  11+0.000  12+12.55
01+0109.  02+0306.  03+1445.  04+4.000  05+309.4  06+40.85  07+0.004  08+43.43
09+51.56  10+29.95  11+0.000  12+12.55
01+0109.  02+0306.  03+1500.  04+4.228  05+265.6  06+36.24  07+0.004  08+42.89
09+53.05  10+29.95  11+0.000  12+12.55
01+0121.  02+0306.  03+1500.  04+4.138  05+288.3  06+45.10  07+0.004  08+43.27
09+51.90  10+29.95  11+0.000  12+12.55
01+0109.  02+0306.  03+1515.  04+3.597  05+287.2  06+40.53  07+0.004  08+41.84
09+54.69  10+29.95  11+0.000  12+12.55
01+0109.  02+0306.  03+1530.  04+4.125  05+247.3  06+20.73  07+0.004  08+42.35
09+55.87  10+29.95  11+0.000  12+12.54
01+0109.  02+0306.  03+1545.  04+5.073  05+242.7  06+14.88  07+0.003  08+42.32
09+56.64  10+29.96  11+0.000  12+12.55
01+0109.  02+0306.  03+1600.  04+4.225  05+244.0  06+15.17  07+0.004  08+42.46
09+56.60  10+29.95  11+0.000  12+12.55
01+0121.  02+0306.  03+1600.  04+4.255  05+253.3  06+30.14  07+0.004  08+42.24
09+55.95  10+29.95  11+0.000  12+12.55
01+0109.  02+0306.  03+1615.  04+2.700  05+271.6  06+31.76  07+0.006  08+42.42
09+56.09  10+29.94  11+0.000  12+12.55
01+0109.  02+0306.  03+1630.  04+2.763  05+253.8  06+19.41  07+0.006  08+42.08
09+55.82  10+29.94  11+0.000  12+12.54
01+0109.  02+0306.  03+1645.  04+1.900  05+263.0  06+34.14  07+0.009  08+41.19
09+56.53  10+29.93  11+0.000  12+12.54
01+0109.  02+0306.  03+1700.  04+1.771  05+239.5  06+34.34  07+0.009  08+40.89
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09+57.54  10+29.92  11+0.000  12+12.54
01+0121.  02+0306.  03+1700.  04+2.284  05+257.0  06+32.57  07+0.007  08+41.64
09+56.50  10+29.93  11+0.000  12+12.54
01+0109.  02+0306.  03+1715.  04+2.245  05+158.2  06+34.61  07+0.007  08+40.36
09+58.54  10+29.91  11+0.000  12+12.54
01+0109.  02+0306.  03+1730.  04+2.293  05+180.4  06+30.30  07+0.005  08+39.62
09+60.52  10+29.91  11+0.000  12+12.53
01+0109.  02+0306.  03+1745.  04+2.425  05+180.2  06+42.52  07+0.007  08+38.85
09+62.59  10+29.91  11+0.000  12+12.53
01+0109.  02+0306.  03+1800.  04+2.485  05+197.7  06+27.94  07+0.006  08+38.47
09+65.36  10+29.91  11+0.000  12+12.53
01+0121.  02+0306.  03+1800.  04+2.362  05+179.5  06+36.94  07+0.007  08+39.32
09+61.75  10+29.91  11+0.000  12+12.53
01+0109.  02+0306.  03+1815.  04+1.954  05+131.8  06+34.29  07+0.008  08+37.74
09+67.18  10+29.91  11+0.000  12+12.52
01+0109.  02+0306.  03+1830.  04+1.887  05+154.9  06+30.56  07+0.009  08+37.42
09+69.03  10+29.91  11+0.000  12+12.52
01+0109.  02+0306.  03+1845.  04+2.141  05+137.6  06+39.69  07+0.008  08+37.24
09+070.7  10+29.90  11+0.000  12+12.52
01+0109.  02+0306.  03+1900.  04+2.103  05+170.3  06+38.35  07+0.008  08+37.04
09+071.4  10+29.90  11+0.000  12+12.51
01+0121.  02+0306.  03+1900.  04+2.021  05+148.6  06+38.86  07+0.009  08+37.36
09+69.57  10+29.90  11+0.000  12+12.52
01+0109.  02+0306.  03+1915.  04+2.211  05+176.5  06+45.08  07+0.009  08+36.73
09+072.1  10+29.90  11+0.000  12+12.51
01+0109.  02+0306.  03+1930.  04+2.652  05+194.7  06+25.67  07+0.008  08+36.58
09+073.2  10+29.90  11+0.000  12+12.51
01+0109.  02+0306.  03+1945.  04+2.001  05+141.7  06+40.24  07+0.010  08+36.09
09+073.9  10+29.90  11+0.000  12+12.51
01+0109.  02+0306.  03+2000.  04+2.272  05+102.8  06+31.99  07+0.007  08+35.72
09+073.4  10+29.88  11+0.000  12+12.50
01+0121.  02+0306.  03+2000.  04+2.284  05+154.8  06+51.48  07+0.009  08+36.28
09+073.2  10+29.90  11+0.000  12+12.51
01+0109.  02+0306.  03+2015.  04+1.835  05+130.5  06+59.54  07+0.009  08+35.11
09+073.7  10+29.88  11+0.000  12+12.50
01+0109.  02+0306.  03+2030.  04+1.726  05+157.1  06+27.95  07+0.009  08+35.13
09+075.3  10+29.88  11+0.000  12+12.50
01+0109.  02+0306.  03+2045.  04+1.645  05+148.8  06+36.44  07+0.010  08+34.83
09+075.6  10+29.88  11+0.000  12+12.49
01+0109.  02+0306.  03+2100.  04+2.083  05+131.2  06+43.39  07+0.008  08+34.73
09+076.1  10+29.87  11+0.000  12+12.49
01+0121.  02+0306.  03+2100.  04+1.822  05+143.4  06+44.12  07+0.009  08+34.95
09+075.2  10+29.88  11+0.000  12+12.50
01+0109.  02+0306.  03+2115.  04+2.032  05+113.0  06+34.93  07+0.007  08+34.74
09+075.4  10+29.87  11+0.000  12+12.49
01+0109.  02+0306.  03+2130.  04+2.667  05+085.6  06+36.82  07+0.006  08+34.19
09+075.3  10+29.85  11+0.000  12+12.49
01+0109.  02+0306.  03+2145.  04+2.291  05+63.93  06+34.95  07+0.007  08+33.38
09+076.8  10+29.84  11+0.000  12+12.48
01+0109.  02+0306.  03+2200.  04+2.283  05+66.33  06+41.17  07+0.007  08+32.94
09+078.3  10+29.83  11+0.000  12+12.48
01+0121.  02+0306.  03+2200.  04+2.318  05+082.3  06+41.99  07+0.007  08+33.81
09+076.4  10+29.85  11+0.000  12+12.48
01+0109.  02+0306.  03+2215.  04+2.475  05+085.8  06+54.19  07+0.007  08+32.70
09+079.7  10+29.83  11+0.000  12+12.48
01+0109.  02+0306.  03+2230.  04+1.966  05+088.0  06+51.47  07+0.008  08+32.38
09+081.1  10+29.83  11+0.000  12+12.48
01+0109.  02+0306.  03+2245.  04+1.960  05+100.0  06+57.91  07+0.008  08+32.25
09+082.2  10+29.83  11+0.000  12+12.47
01+0109.  02+0306.  03+2300.  04+1.877  05+116.3  06+38.25  07+0.009  08+32.31
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09+083.1  10+29.82  11+0.000  12+12.47
01+0121.  02+0306.  03+2300.  04+2.069  05+098.5  06+52.20  07+0.008  08+32.41
09+081.5  10+29.83  11+0.000  12+12.48
01+0109.  02+0306.  03+2315.  04+2.074  05+093.6  06+27.82  07+0.008  08+32.16
09+083.4  10+29.82  11+0.000  12+12.47
01+0109.  02+0306.  03+2330.  04+1.814  05+65.95  06+58.82  07+0.009  08+31.49
09+084.0  10+29.80  11+0.000  12+12.47
01+0109.  02+0306.  03+2345.  04+2.786  05+084.0  06+51.12  07+0.006  08+31.63
09+084.8  10+29.79  11+0.000  12+12.47
01+0109.  02+0306.  03+2400.  04+2.156  05+070.6  06+67.21  07+0.008  08+31.84
09+085.0  10+29.79  11+0.000  12+12.47
01+0121.  02+0306.  03+2400.  04+2.207  05+080.7  06+53.38  07+0.007  08+31.78
09+084.3  10+29.80  11+0.000  12+12.47
01+0109.  02+0307.  03+0015.  04+2.456  05+123.2  06+53.63  07+0.006  08+32.26
09+084.9  10+29.79  11+0.000  12+12.47
01+0109.  02+0307.  03+0030.  04+2.897  05+125.0  06+60.06  07+0.006  08+32.63
09+084.3  10+29.79  11+0.000  12+12.46
01+0109.  02+0307.  03+0045.  04+2.218  05+141.0  06+087.5  07+0.008  08+32.81
09+083.5  10+29.78  11+0.000  12+12.46
01+0109.  02+0307.  03+0100.  04+1.896  05+134.9  06+084.5  07+0.009  08+32.91
09+083.1  10+29.77  11+0.000  12+12.46
01+0121.  02+0307.  03+0100.  04+2.367  05+128.0  06+072.2  07+0.008  08+32.65
09+083.9  10+29.78  11+0.000  12+12.46
01+0109.  02+0307.  03+0115.  04+2.564  05+146.3  06+50.14  07+0.005  08+33.20
09+082.6  10+29.77  11+0.000  12+12.46
01+0109.  02+0307.  03+0130.  04+3.115  05+137.2  06+48.67  07+0.005  08+33.33
09+082.0  10+29.76  11+0.000  12+12.46
01+0109.  02+0307.  03+0145.  04+2.719  05+145.8  06+57.41  07+0.006  08+33.50
09+081.4  10+29.76  11+0.000  12+12.46
01+0109.  02+0307.  03+0200.  04+2.321  05+126.8  06+39.65  07+0.007  08+33.52
09+080.7  10+29.75  11+0.000  12+12.46
01+0121.  02+0307.  03+0200.  04+2.680  05+138.4  06+49.79  07+0.006  08+33.39
09+081.7  10+29.76  11+0.000  12+12.46
01+0109.  02+0307.  03+0215.  04+2.786  05+127.8  06+51.43  07+0.006  08+33.38
09+080.4  10+29.74  11+0.000  12+12.46
01+0109.  02+0307.  03+0230.  04+2.099  05+134.4  06+59.68  07+0.008  08+33.40
09+080.1  10+29.73  11+0.000  12+12.46
01+0109.  02+0307.  03+0245.  04+2.519  05+124.6  06+61.59  07+0.006  08+33.36
09+079.5  10+29.72  11+0.000  12+12.46
01+0109.  02+0307.  03+0300.  04+2.610  05+142.7  06+56.13  07+0.006  08+33.59
09+078.9  10+29.71  11+0.000  12+12.46
01+0121.  02+0307.  03+0300.  04+2.504  05+132.5  06+57.65  07+0.007  08+33.43
09+079.7  10+29.72  11+0.000  12+12.46
01+0109.  02+0307.  03+0315.  04+2.987  05+150.4  06+48.16  07+0.006  08+34.32
09+077.9  10+29.71  11+0.000  12+12.46
01+0109.  02+0307.  03+0330.  04+1.774  05+100.2  06+41.26  07+0.009  08+33.90
09+077.0  10+29.71  11+0.000  12+12.46
01+0109.  02+0307.  03+0345.  04+3.171  05+070.2  06+46.31  07+0.005  08+33.20
09+077.7  10+29.70  11+0.000  12+12.46
01+0109.  02+0307.  03+0400.  04+2.728  05+121.0  06+66.02  07+0.006  08+33.21
09+078.0  10+29.70  11+0.000  12+12.45
01+0121.  02+0307.  03+0400.  04+2.665  05+109.0  06+58.77  07+0.006  08+33.66
09+077.7  10+29.71  11+0.000  12+12.46
01+0109.  02+0307.  03+0415.  04+2.463  05+152.9  06+57.24  07+0.006  08+33.55
09+078.5  10+29.70  11+0.000  12+12.45
01+0109.  02+0307.  03+0430.  04+2.197  05+178.9  06+082.5  07+0.010  08+33.69
09+078.7  10+29.70  11+0.000  12+12.45
01+0109.  02+0307.  03+0445.  04+2.430  05+134.2  06+58.67  07+0.007  08+33.78
09+078.4  10+29.69  11+0.000  12+12.45
01+0109.  02+0307.  03+0500.  04+2.415  05+083.4  06+56.20  07+0.007  08+33.60
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09+078.1  10+29.69  11+0.000  12+12.45
01+0121.  02+0307.  03+0500.  04+2.376  05+131.8  06+071.2  07+0.009  08+33.66
09+078.4  10+29.69  11+0.000  12+12.45
01+0109.  02+0307.  03+0515.  04+3.035  05+071.8  06+61.09  07+0.006  08+33.26
09+078.7  10+29.67  11+0.000  12+12.45
01+0109.  02+0307.  03+0530.  04+2.725  05+100.1  06+43.79  07+0.006  08+33.38
09+079.0  10+29.67  11+0.000  12+12.45
01+0109.  02+0307.  03+0545.  04+3.548  05+099.4  06+32.90  07+0.005  08+33.39
09+079.0  10+29.67  11+0.000  12+12.45
01+0109.  02+0307.  03+0600.  04+2.783  05+109.3  06+53.09  07+0.006  08+33.24
09+079.0  10+29.66  11+0.000  12+12.45
01+0121.  02+0307.  03+0600.  04+3.023  05+096.5  06+49.89  07+0.006  08+33.32
09+078.9  10+29.67  11+0.000  12+12.45
01+0109.  02+0307.  03+0615.  04+3.410  05+080.2  06+51.61  07+0.005  08+33.49
09+079.4  10+29.65  11+0.000  12+12.45
01+0109.  02+0307.  03+0630.  04+2.964  05+081.0  06+50.86  07+0.005  08+32.98
09+079.6  10+29.64  11+0.000  12+12.44
01+0109.  02+0307.  03+0645.  04+3.147  05+078.7  06+36.17  07+0.005  08+33.20
09+079.9  10+29.64  11+0.000  12+12.44
01+0109.  02+0307.  03+0700.  04+3.463  05+094.2  06+30.85  07+0.005  08+33.69
09+079.6  10+29.63  11+0.000  12+12.44
01+0121.  02+0307.  03+0700.  04+3.246  05+084.0  06+43.35  07+0.005  08+33.34
09+079.6  10+29.64  11+0.000  12+12.44
01+0109.  02+0307.  03+0715.  04+3.437  05+075.9  06+34.57  07+0.005  08+33.83
09+079.1  10+29.62  11+0.000  12+12.44
01+0109.  02+0307.  03+0730.  04+3.383  05+095.0  06+22.90  07+0.005  08+34.68
09+078.8  10+29.63  11+0.000  12+12.44
01+0109.  02+0307.  03+0745.  04+3.574  05+086.8  06+22.87  07+0.005  08+34.74
09+077.9  10+29.62  11+0.000  12+12.44
01+0109.  02+0307.  03+0800.  04+2.782  05+100.6  06+24.10  07+0.006  08+35.53
09+077.3  10+29.61  11+0.000  12+12.44
01+0121.  02+0307.  03+0800.  04+3.294  05+089.9  06+27.97  07+0.005  08+34.70
09+078.3  10+29.62  11+0.000  12+12.44
01+0109.  02+0307.  03+0815.  04+2.511  05+094.0  06+22.80  07+0.009  08+35.67
09+076.5  10+29.62  11+0.000  12+12.44
01+0109.  02+0307.  03+0830.  04+2.479  05+128.0  06+41.20  07+0.007  08+36.53
09+076.1  10+29.61  11+0.000  12+12.44
01+0109.  02+0307.  03+0845.  04+2.901  05+139.2  06+29.16  07+0.006  08+37.65
09+074.8  10+29.61  11+0.000  12+12.44
01+0109.  02+0307.  03+0900.  04+2.672  05+154.9  06+46.61  07+0.006  08+37.87
09+073.8  10+29.60  11+0.000  12+12.44
01+0121.  02+0307.  03+0900.  04+2.641  05+127.6  06+42.39  07+0.007  08+36.93
09+075.3  10+29.61  11+0.000  12+12.44
01+0109.  02+0307.  03+0915.  04+3.831  05+186.4  06+38.09  07+0.004  08+39.33
09+072.8  10+29.60  11+0.000  12+12.44
01+0109.  02+0307.  03+0930.  04+5.180  05+201.8  06+21.27  07+0.003  08+40.43
09+070.6  10+29.59  11+0.000  12+12.44
01+0109.  02+0307.  03+0945.  04+5.812  05+199.4  06+23.03  07+0.003  08+40.93
09+68.77  10+29.59  11+0.000  12+12.44
01+0109.  02+0307.  03+1000.  04+6.589  05+207.3  06+21.63  07+0.002  08+41.41
09+66.97  10+29.59  11+0.000  12+12.45
01+0121.  02+0307.  03+1000.  04+5.353  05+199.2  06+27.69  07+0.003  08+40.52
09+69.77  10+29.60  11+0.000  12+12.44
01+0109.  02+0307.  03+1015.  04+5.594  05+205.3  06+23.02  07+0.003  08+41.92
09+65.65  10+29.59  11+0.000  12+12.45
01+0109.  02+0307.  03+1030.  04+6.493  05+206.2  06+22.90  07+0.003  08+42.34
09+64.54  10+29.58  11+0.000  12+12.45
01+0109.  02+0307.  03+1045.  04+08.06  05+209.7  06+19.34  07+0.002  08+42.34
09+63.66  10+29.58  11+0.000  12+12.45
01+0109.  02+0307.  03+1100.  04+07.84  05+216.8  06+18.91  07+0.002  08+42.44
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09+63.31  10+29.58  11+0.000  12+12.45
01+0121.  02+0307.  03+1100.  04+6.997  05+209.6  06+21.59  07+0.002  08+42.26
09+64.29  10+29.58  11+0.000  12+12.45
01+0109.  02+0307.  03+1115.  04+08.60  05+213.0  06+18.94  07+0.002  08+42.20
09+63.00  10+29.58  11+0.000  12+12.45
01+0109.  02+0307.  03+1130.  04+08.42  05+210.1  06+20.64  07+0.002  08+42.17
09+62.83  10+29.58  11+0.000  12+12.45
01+0109.  02+0307.  03+1145.  04+10.43  05+214.0  06+20.24  07+0.002  08+41.75
09+63.39  10+29.59  11+0.000  12+12.46
01+0109.  02+0307.  03+1200.  04+08.77  05+215.2  06+20.28  07+0.002  08+39.49
09+69.35  10+29.59  11+0.020  12+12.46
01+0121.  02+0307.  03+1200.  04+09.05  05+213.1  06+20.12  07+0.002  08+41.40
09+64.64  10+29.58  11+0.020  12+12.46
01+0109.  02+0307.  03+1215.  04+08.03  05+198.3  06+20.66  07+0.003  08+38.46
09+076.7  10+29.58  11+0.020  12+12.46
01+0109.  02+0307.  03+1230.  04+5.803  05+202.7  06+23.22  07+0.003  08+38.48
09+080.8  10+29.56  11+0.000  12+12.45
01+0109.  02+0307.  03+1245.  04+5.647  05+215.8  06+17.39  07+0.003  08+39.18
09+082.8  10+29.55  11+0.000  12+12.45
01+0109.  02+0307.  03+1300.  04+6.547  05+216.8  06+18.87  07+0.003  08+39.80
09+082.1  10+29.54  11+0.010  12+12.45
01+0121.  02+0307.  03+1300.  04+6.508  05+208.5  06+21.69  07+0.003  08+38.98
09+080.6  10+29.56  11+0.030  12+12.45
01+0109.  02+0307.  03+1315.  04+07.15  05+209.0  06+21.46  07+0.002  08+39.91
09+081.2  10+29.53  11+0.000  12+12.45
01+0109.  02+0307.  03+1330.  04+08.37  05+208.4  06+21.90  07+0.002  08+39.50
09+081.8  10+29.52  11+0.010  12+12.45
01+0109.  02+0307.  03+1345.  04+08.05  05+208.1  06+21.65  07+0.002  08+38.99
09+083.7  10+29.52  11+0.010  12+12.45
01+0109.  02+0307.  03+1400.  04+07.08  05+205.0  06+23.78  07+0.002  08+38.54
09+085.7  10+29.51  11+0.010  12+12.45
01+0121.  02+0307.  03+1400.  04+07.66  05+207.6  06+22.26  07+0.002  08+39.23
09+083.1  10+29.52  11+0.030  12+12.45
01+0109.  02+0307.  03+1415.  04+07.07  05+196.3  06+23.07  07+0.002  08+37.89
09+087.4  10+29.51  11+0.000  12+12.45
01+0109.  02+0307.  03+1430.  04+6.028  05+204.7  06+22.19  07+0.002  08+37.72
09+088.9  10+29.50  11+0.010  12+12.45
01+0109.  02+0307.  03+1445.  04+5.117  05+191.0  06+23.99  07+0.003  08+38.00
09+090.3  10+29.50  11+0.000  12+12.45
01+0109.  02+0307.  03+1500.  04+5.449  05+200.0  06+20.27  07+0.003  08+38.31
09+091.4  10+29.50  11+0.010  12+12.45
01+0121.  02+0307.  03+1500.  04+5.916  05+198.0  06+22.96  07+0.003  08+37.98
09+089.5  10+29.50  11+0.020  12+12.45
01+0109.  02+0307.  03+1515.  04+6.811  05+199.5  06+20.10  07+0.002  08+38.44
09+092.0  10+29.49  11+0.000  12+12.45
01+0109.  02+0307.  03+1530.  04+6.820  05+207.6  06+21.72  07+0.002  08+38.71
09+092.2  10+29.49  11+0.010  12+12.45
01+0109.  02+0307.  03+1545.  04+6.401  05+214.6  06+18.44  07+0.003  08+38.82
09+092.3  10+29.49  11+0.000  12+12.45
01+0109.  02+0307.  03+1600.  04+6.641  05+211.2  06+18.82  07+0.002  08+38.77
09+092.6  10+29.49  11+0.010  12+12.45
01+0121.  02+0307.  03+1600.  04+6.668  05+208.2  06+20.58  07+0.002  08+38.69
09+092.3  10+29.49  11+0.020  12+12.45
01+0109.  02+0307.  03+1615.  04+6.692  05+212.2  06+18.94  07+0.003  08+38.61
09+093.1  10+29.49  11+0.000  12+12.44
01+0109.  02+0307.  03+1630.  04+6.437  05+207.6  06+20.92  07+0.003  08+38.55
09+093.5  10+29.49  11+0.000  12+12.44
01+0109.  02+0307.  03+1645.  04+5.285  05+211.9  06+19.94  07+0.004  08+38.49
09+094.0  10+29.49  11+0.000  12+12.44
01+0109.  02+0307.  03+1700.  04+4.715  05+211.1  06+16.03  07+0.003  08+38.47
```

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09+094.5  10+29.49  11+0.000  12+12.44
01+0121.  02+0307.  03+1700.  04+5.782  05+210.7  06+19.12  07+0.003  08+38.53
09+093.8  10+29.49  11+0.000  12+12.44
01+0109.  02+0307.  03+1715.  04+4.989  05+212.4  06+18.12  07+0.002  08+38.48
09+094.9  10+29.49  11+0.000  12+12.44
01+0109.  02+0307.  03+1730.  04+4.974  05+212.8  06+16.07  07+0.004  08+38.70
09+095.2  10+29.49  11+0.010  12+12.44
01+0109.  02+0307.  03+1745.  04+5.689  05+217.4  06+18.73  07+0.003  08+38.93
09+095.5  10+29.50  11+0.000  12+12.44
01+0109.  02+0307.  03+1800.  04+6.221  05+219.5  06+18.91  07+0.002  08+39.14
09+095.7  10+29.50  11+0.000  12+12.43
01+0121.  02+0307.  03+1800.  04+5.468  05+215.5  06+18.24  07+0.003  08+38.81
09+095.3  10+29.49  11+0.010  12+12.44
01+0109.  02+0307.  03+1815.  04+6.232  05+216.1  06+17.82  07+0.002  08+39.12
09+095.7  10+29.50  11+0.000  12+12.43
01+0109.  02+0307.  03+1830.  04+6.147  05+225.4  06+18.32  07+0.002  08+39.29
09+095.8  10+29.51  11+0.000  12+12.43
01+0109.  02+0307.  03+1845.  04+6.437  05+221.5  06+18.36  07+0.002  08+39.40
09+095.9  10+29.51  11+0.000  12+12.43
01+0109.  02+0307.  03+1900.  04+6.175  05+223.4  06+16.77  07+0.002  08+39.50
09+096.0  10+29.51  11+0.000  12+12.43
01+0121.  02+0307.  03+1900.  04+6.248  05+221.6  06+18.16  07+0.002  08+39.33
09+095.8  10+29.51  11+0.000  12+12.43
01+0109.  02+0307.  03+1915.  04+6.321  05+214.5  06+17.92  07+0.002  08+39.46
09+096.2  10+29.51  11+0.000  12+12.43
01+0109.  02+0307.  03+1930.  04+5.722  05+221.8  06+17.45  07+0.002  08+39.60
09+096.4  10+29.51  11+0.000  12+12.43
01+0109.  02+0307.  03+1945.  04+5.980  05+222.2  06+16.80  07+0.003  08+39.64
09+096.5  10+29.51  11+0.000  12+12.43
01+0109.  02+0307.  03+2000.  04+5.986  05+218.0  06+15.17  07+0.002  08+39.70
09+096.4  10+29.51  11+0.000  12+12.43
01+0121.  02+0307.  03+2000.  04+6.002  05+219.1  06+17.15  07+0.002  08+39.60
09+096.4  10+29.51  11+0.000  12+12.43
01+0109.  02+0307.  03+2015.  04+6.734  05+221.1  06+17.31  07+0.002  08+39.88
09+096.3  10+29.52  11+0.000  12+12.42
01+0109.  02+0307.  03+2030.  04+6.707  05+218.5  06+17.73  07+0.002  08+39.99
09+095.9  10+29.52  11+0.000  12+12.42
01+0109.  02+0307.  03+2045.  04+6.399  05+217.9  06+16.81  07+0.002  08+40.03
09+095.4  10+29.52  11+0.000  12+12.42
01+0109.  02+0307.  03+2100.  04+6.339  05+226.5  06+16.17  07+0.002  08+39.98
09+095.2  10+29.52  11+0.000  12+12.42
01+0121.  02+0307.  03+2100.  04+6.545  05+221.0  06+17.35  07+0.002  08+39.97
09+095.7  10+29.52  11+0.000  12+12.42
01+0109.  02+0307.  03+2115.  04+5.838  05+226.1  06+18.28  07+0.002  08+39.71
09+095.0  10+29.52  11+0.000  12+12.42
01+0109.  02+0307.  03+2130.  04+6.287  05+228.2  06+16.81  07+0.002  08+39.46
09+095.3  10+29.52  11+0.000  12+12.42
01+0109.  02+0307.  03+2145.  04+5.997  05+225.3  06+15.85  07+0.003  08+39.16
09+095.4  10+29.53  11+0.000  12+12.42
01+0109.  02+0307.  03+2200.  04+5.703  05+223.6  06+15.70  07+0.003  08+38.98
09+095.6  10+29.53  11+0.000  12+12.42
01+0121.  02+0307.  03+2200.  04+5.956  05+225.8  06+16.77  07+0.003  08+39.33
09+095.3  10+29.52  11+0.000  12+12.42
01+0109.  02+0307.  03+2215.  04+5.078  05+219.1  06+16.51  07+0.004  08+38.85
09+095.5  10+29.53  11+0.000  12+12.41
01+0109.  02+0307.  03+2230.  04+5.709  05+221.1  06+13.87  07+0.003  08+38.62
09+095.5  10+29.52  11+0.000  12+12.41
01+0109.  02+0307.  03+2245.  04+5.299  05+218.3  06+16.57  07+0.003  08+38.53
09+095.4  10+29.52  11+0.000  12+12.41
01+0109.  02+0307.  03+2300.  04+5.277  05+217.1  06+14.90  07+0.003  08+38.46
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09+095.3  10+29.52  11+0.000  12+12.41
01+0121.  02+0307.  03+2300.  04+5.341  05+218.9  06+15.57  07+0.003  08+38.62
09+095.4  10+29.52  11+0.000  12+12.41
01+0109.  02+0307.  03+2315.  04+5.745  05+210.0  06+16.69  07+0.003  08+38.22
09+095.1  10+29.52  11+0.000  12+12.41
01+0109.  02+0307.  03+2330.  04+5.148  05+213.8  06+14.48  07+0.003  08+38.02
09+095.0  10+29.52  11+0.000  12+12.40
01+0109.  02+0307.  03+2345.  04+5.567  05+220.0  06+15.60  07+0.004  08+38.03
09+095.3  10+29.53  11+0.000  12+12.40
01+0109.  02+0307.  03+2400.  04+6.178  05+218.9  06+14.98  07+0.004  08+38.07
09+095.4  10+29.54  11+0.000  12+12.40
01+0121.  02+0307.  03+2400.  04+5.660  05+215.7  06+15.97  07+0.004  08+38.08
09+095.2  10+29.53  11+0.000  12+12.40
01+0109.  02+0308.  03+0015.  04+5.803  05+220.3  06+15.62  07+0.003  08+38.04
09+095.4  10+29.54  11+0.000  12+12.40
01+0109.  02+0308.  03+0030.  04+5.596  05+223.6  06+15.39  07+0.004  08+37.98
09+095.4  10+29.54  11+0.000  12+12.40
01+0109.  02+0308.  03+0045.  04+5.240  05+216.5  06+14.63  07+0.003  08+38.04
09+095.3  10+29.55  11+0.000  12+12.40
01+0109.  02+0308.  03+0100.  04+5.965  05+218.0  06+16.39  07+0.003  08+38.23
09+095.0  10+29.55  11+0.000  12+12.39
01+0121.  02+0308.  03+0100.  04+5.651  05+219.6  06+15.74  07+0.004  08+38.07
09+095.3  10+29.55  11+0.000  12+12.40
01+0109.  02+0308.  03+0115.  04+5.777  05+225.6  06+14.11  07+0.003  08+38.49
09+094.4  10+29.55  11+0.000  12+12.39
01+0109.  02+0308.  03+0130.  04+5.537  05+226.1  06+14.58  07+0.002  08+38.62
09+094.1  10+29.55  11+0.000  12+12.39
01+0109.  02+0308.  03+0145.  04+4.590  05+227.9  06+16.05  07+0.003  08+38.58
09+093.9  10+29.56  11+0.000  12+12.39
01+0109.  02+0308.  03+0200.  04+4.477  05+220.3  06+16.30  07+0.003  08+38.47
09+093.9  10+29.55  11+0.000  12+12.39
01+0121.  02+0308.  03+0200.  04+5.095  05+225.0  06+15.54  07+0.003  08+38.54
09+094.1  10+29.55  11+0.000  12+12.39
01+0109.  02+0308.  03+0215.  04+4.319  05+216.9  06+14.53  07+0.004  08+38.38
09+093.6  10+29.55  11+0.000  12+12.39
01+0109.  02+0308.  03+0230.  04+4.403  05+212.9  06+16.49  07+0.003  08+38.57
09+093.2  10+29.55  11+0.000  12+12.39
01+0109.  02+0308.  03+0245.  04+5.077  05+217.1  06+15.10  07+0.003  08+38.70
09+092.5  10+29.56  11+0.000  12+12.39
01+0109.  02+0308.  03+0300.  04+5.186  05+221.2  06+17.23  07+0.003  08+39.06
09+092.0  10+29.56  11+0.000  12+12.39
01+0121.  02+0308.  03+0300.  04+4.746  05+217.0  06+16.14  07+0.003  08+38.68
09+092.8  10+29.56  11+0.000  12+12.39
01+0109.  02+0308.  03+0315.  04+5.532  05+217.7  06+17.00  07+0.003  08+39.07
09+091.2  10+29.56  11+0.000  12+12.39
01+0109.  02+0308.  03+0330.  04+5.277  05+213.4  06+16.15  07+0.003  08+38.60
09+090.7  10+29.55  11+0.000  12+12.39
01+0109.  02+0308.  03+0345.  04+5.104  05+213.8  06+15.45  07+0.004  08+38.19
09+090.7  10+29.55  11+0.000  12+12.39
01+0109.  02+0308.  03+0400.  04+4.592  05+210.3  06+20.39  07+0.005  08+38.01
09+090.9  10+29.54  11+0.000  12+12.38
01+0121.  02+0308.  03+0400.  04+5.126  05+213.8  06+17.54  07+0.004  08+38.47
09+090.9  10+29.55  11+0.000  12+12.39
01+0109.  02+0308.  03+0415.  04+5.434  05+215.5  06+16.75  07+0.004  08+37.75
09+091.3  10+29.54  11+0.000  12+12.38
01+0109.  02+0308.  03+0430.  04+5.531  05+213.1  06+16.33  07+0.003  08+37.79
09+091.4  10+29.54  11+0.000  12+12.38
01+0109.  02+0308.  03+0445.  04+5.492  05+210.8  06+15.75  07+0.003  08+37.89
09+090.9  10+29.54  11+0.000  12+12.38
01+0109.  02+0308.  03+0500.  04+5.617  05+215.5  06+17.11  07+0.003  08+38.08
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09+090.4  10+29.54  11+0.000  12+12.38
01+0121.  02+0308.  03+0500.  04+5.518  05+213.7  06+16.60  07+0.003  08+37.88
09+091.0  10+29.54  11+0.000  12+12.38
01+0109.  02+0308.  03+0515.  04+5.861  05+217.3  06+15.92  07+0.003  08+38.20
09+089.6  10+29.53  11+0.000  12+12.38
01+0109.  02+0308.  03+0530.  04+5.049  05+217.3  06+16.78  07+0.003  08+38.14
09+089.0  10+29.53  11+0.000  12+12.37
01+0109.  02+0308.  03+0545.  04+5.448  05+214.4  06+19.49  07+0.003  08+38.15
09+088.5  10+29.53  11+0.000  12+12.37
01+0109.  02+0308.  03+0600.  04+4.846  05+211.5  06+16.37  07+0.003  08+38.13
09+087.9  10+29.53  11+0.000  12+12.37
01+0121.  02+0308.  03+0600.  04+5.301  05+215.1  06+17.35  07+0.003  08+38.15
09+088.7  10+29.53  11+0.000  12+12.37
01+0109.  02+0308.  03+0615.  04+5.514  05+219.4  06+16.49  07+0.003  08+38.11
09+087.8  10+29.54  11+0.000  12+12.37
01+0109.  02+0308.  03+0630.  04+4.742  05+216.4  06+13.68  07+0.003  08+38.04
09+087.6  10+29.54  11+0.000  12+12.37
01+0109.  02+0308.  03+0645.  04+5.295  05+218.0  06+16.32  07+0.003  08+38.12
09+087.7  10+29.54  11+0.000  12+12.37
01+0109.  02+0308.  03+0700.  04+6.445  05+216.2  06+17.27  07+0.003  08+38.48
09+087.0  10+29.54  11+0.000  12+12.36
01+0121.  02+0308.  03+0700.  04+5.499  05+217.5  06+16.04  07+0.003  08+38.19
09+087.5  10+29.54  11+0.000  12+12.37
01+0109.  02+0308.  03+0715.  04+5.918  05+211.1  06+15.77  07+0.003  08+38.64
09+086.0  10+29.54  11+0.000  12+12.36
01+0109.  02+0308.  03+0730.  04+6.676  05+210.7  06+17.00  07+0.002  08+38.86
09+085.2  10+29.54  11+0.000  12+12.36
01+0109.  02+0308.  03+0745.  04+6.227  05+209.7  06+18.29  07+0.003  08+39.04
09+084.8  10+29.54  11+0.000  12+12.36
01+0109.  02+0308.  03+0800.  04+6.391  05+213.6  06+19.27  07+0.003  08+39.36
09+084.1  10+29.54  11+0.000  12+12.36
01+0121.  02+0308.  03+0800.  04+6.303  05+211.2  06+17.68  07+0.003  08+38.97
09+085.0  10+29.54  11+0.000  12+12.36
01+0109.  02+0308.  03+0815.  04+5.961  05+212.4  06+20.70  07+0.003  08+39.56
09+083.3  10+29.54  11+0.000  12+12.36
01+0109.  02+0308.  03+0830.  04+6.514  05+212.8  06+18.77  07+0.003  08+39.82
09+082.6  10+29.54  11+0.000  12+12.36
01+0109.  02+0308.  03+0845.  04+6.514  05+217.5  06+18.86  07+0.002  08+40.15
09+081.8  10+29.55  11+0.000  12+12.36
01+0109.  02+0308.  03+0900.  04+6.970  05+212.1  06+17.89  07+0.002  08+40.42
09+081.0  10+29.55  11+0.000  12+12.36
01+0121.  02+0308.  03+0900.  04+6.490  05+213.7  06+19.21  07+0.002  08+39.99
09+082.2  10+29.54  11+0.000  12+12.36
01+0109.  02+0308.  03+0915.  04+6.906  05+213.1  06+18.72  07+0.002  08+40.76
09+080.1  10+29.54  11+0.000  12+12.36
01+0109.  02+0308.  03+0930.  04+6.974  05+214.4  06+18.65  07+0.002  08+41.25
09+079.2  10+29.54  11+0.000  12+12.36
01+0109.  02+0308.  03+0945.  04+07.05  05+220.4  06+22.60  07+0.002  08+41.75
09+078.4  10+29.55  11+0.000  12+12.37
01+0109.  02+0308.  03+1000.  04+07.64  05+215.2  06+19.59  07+0.002  08+41.98
09+077.8  10+29.55  11+0.000  12+12.37
01+0121.  02+0308.  03+1000.  04+07.14  05+215.7  06+20.13  07+0.002  08+41.43
09+078.9  10+29.55  11+0.000  12+12.37
01+0109.  02+0308.  03+1015.  04+6.865  05+216.0  06+18.81  07+0.002  08+42.30
09+077.2  10+29.55  11+0.000  12+12.37
01+0109.  02+0308.  03+1030.  04+6.525  05+212.7  06+22.44  07+0.003  08+43.12
09+076.4  10+29.54  11+0.000  12+12.37
01+0109.  02+0308.  03+1045.  04+6.634  05+213.5  06+20.60  07+0.002  08+43.61
09+075.3  10+29.54  11+0.000  12+12.37
01+0109.  02+0308.  03+1100.  04+07.56  05+209.0  06+18.71  07+0.002  08+44.16
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09+074.4  10+29.54  11+0.000  12+12.37
01+0121.  02+0308.  03+1100.  04+6.895  05+212.8  06+20.35  07+0.002  08+43.30
09+075.8  10+29.54  11+0.000  12+12.37
01+0109.  02+0308.  03+1115.  04+07.92  05+215.8  06+18.32  07+0.002  08+44.52
09+073.7  10+29.54  11+0.000  12+12.38
01+0109.  02+0308.  03+1130.  04+07.17  05+214.2  06+20.21  07+0.002  08+44.82
09+073.1  10+29.53  11+0.000  12+12.38
01+0109.  02+0308.  03+1145.  04+6.575  05+209.0  06+18.70  07+0.002  08+45.55
09+072.4  10+29.53  11+0.000  12+12.38
01+0109.  02+0308.  03+1200.  04+07.01  05+215.2  06+20.78  07+0.002  08+46.36
09+071.2  10+29.53  11+0.000  12+12.39
01+0121.  02+0308.  03+1200.  04+07.17  05+213.6  06+19.71  07+0.002  08+45.31
09+072.6  10+29.54  11+0.000  12+12.38
01+0109.  02+0308.  03+1215.  04+6.499  05+223.6  06+50.73  07+0.002  08+43.14
09+58.25  10+29.53  11+0.000  12+12.39
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```
01+0109.  02+0308.  03+1230.  04+0.500  05+08.17  06+4.804  07+0.032  08-60.39
09-269.6  10+29.54  11+0.030  12+12.39
01+0109.  02+0308.  03+1245.  04+0.500  05+3.432  06+0.131  07+0.030  08-60.41
09-269.8  10+29.54  11+0.000  12+12.39
01+0109.  02+0308.  03+1300.  04+0.500  05+3.285  06+0.069  07+0.025  08-60.40
09-269.9  10+29.54  11+0.000  12+12.39
01+0121.  02+0308.  03+1300.  04+2.000  05+355.3  06+55.00  07+0.008  08-34.51
09-187.8  10+29.54  11+0.030  12+12.39
01+0109.  02+0308.  03+1315.  04+0.500  05+3.289  06+0.000  07+0.027  08-60.39
09-269.8  10+29.53  11+0.000  12+12.39
01+0109.  02+0308.  03+1330.  04+0.500  05+3.287  06+0.084  07+0.027  08-60.40
09-269.8  10+29.52  11+0.000  12+12.39
01+0109.  02+0308.  03+1345.  04+0.500  05+3.296  06+0.125  07+0.030  08-60.39
09-269.7  10+29.51  11+0.000  12+12.39
01+0109.  02+0308.  03+1400.  04+0.500  05+3.269  06+0.376  07+0.029  08-60.39
09-269.3  10+29.51  11+0.000  12+12.39
01+0121.  02+0308.  03+1400.  04+0.500  05+3.285  06+0.468  07+0.029  08-60.39
09-269.7  10+29.51  11+0.000  12+12.39
01+0109.  02+0308.  03+1415.  04+0.500  05+3.239  06+0.000  07+0.033  08-60.37
09-269.4  10+29.50  11+0.000  12+12.39
01+0109.  02+0308.  03+1430.  04+0.500  05+3.223  06+0.223  07+0.033  08-60.39
09-269.5  10+29.49  11+0.000  12+12.39
01+0109.  02+0308.  03+1445.  04+0.500  05+3.221  06+0.261  07+0.029  08-60.41
09-269.5  10+29.49  11+0.000  12+12.39
01+0109.  02+0308.  03+1500.  04+0.500  05+3.232  06+0.226  07+0.033  08-60.41
09-269.5  10+29.50  11+0.000  12+12.39
01+0121.  02+0308.  03+1500.  04+0.500  05+3.229  06+0.222  07+0.033  08-60.39
09-269.4  10+29.50  11+0.000  12+12.39
01+0109.  02+0308.  03+1515.  04+0.500  05+3.214  06+0.240  07+0.033  08-60.40
09-269.4  10+29.50  11+0.000  12+12.40
01+0109.  02+0308.  03+1530.  04+0.500  05+3.236  06+0.028  07+0.031  08-60.40
09-269.3  10+29.50  11+0.000  12+12.40
01+0109.  02+0308.  03+1545.  04+0.500  05+3.227  06+0.000  07+0.033  08-60.40
09-269.3  10+29.49  11+0.000  12+12.40
01+0109.  02+0308.  03+1600.  04+0.500  05+3.232  06+0.000  07+0.032  08-60.40
09-269.3  10+29.50  11+0.000  12+12.40
01+0121.  02+0308.  03+1600.  04+0.500  05+3.227  06+0.201  07+0.033  08-60.40
09-269.3  10+29.50  11+0.000  12+12.40
01+0109.  02+0308.  03+1615.  04+0.500  05+3.232  06+0.000  07+0.024  08-60.41
09-269.3  10+29.49  11+0.000  12+12.40
01+0109.  02+0308.  03+1630.  04+0.500  05+3.230  06+0.000  07+0.015  08-60.40
09-269.4  10+29.49  11+0.000  12+12.40
01+0109.  02+0308.  03+1645.  04+0.500  05+3.233  06+0.000  07+0.013  08-60.40
09-269.4  10+29.48  11+0.000  12+12.40
01+0109.  02+0308.  03+1700.  04+0.500  05+3.232  06+0.000  07+0.016  08-60.40
09-269.4  10+29.48  11+0.000  12+12.40
01+0121.  02+0308.  03+1700.  04+0.500  05+3.232  06+0.223  07+0.018  08-60.40
09-269.4  10+29.48  11+0.000  12+12.40
01+0109.  02+0308.  03+1715.  04+0.500  05+3.233  06+0.000  07+0.028  08-60.41
09-269.4  10+29.47  11+0.000  12+12.39
01+0109.  02+0308.  03+1730.  04+0.500  05+3.232  06+0.000  07+0.033  08-60.39
09-269.4  10+29.47  11+0.000  12+12.39
01+0109.  02+0308.  03+1745.  04+0.500  05+3.238  06+0.000  07+0.032  08-60.41
09-269.5  10+29.46  11+0.000  12+12.39
01+0109.  02+0308.  03+1800.  04+0.500  05+3.257  06+0.000  07+0.033  08-60.40
09-269.6  10+29.44  11+0.000  12+12.39
01+0121.  02+0308.  03+1800.  04+0.500  05+3.240  06+0.390  07+0.032  08-60.40
09-269.5  10+29.46  11+0.000  12+12.39
01+0109.  02+0308.  03+1815.  04+0.500  05+3.270  06+0.000  07+0.027  08-60.40
09-269.6  10+29.46  11+0.000  12+12.39
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01+0109. 02+0308. 03+1830. 04+0.500 05+3.258 06+0.000 07+0.030 08-60.40
09-269.7 10+29.47 11+0.000 12+12.39
01+0109. 02+0308. 03+1845. 04+0.500 05+3.257 06+0.023 07+0.032 08-60.41
09-269.7 10+29.47 11+0.000 12+12.39
01+0109. 02+0308. 03+1900. 04+0.500 05+3.263 06+0.089 07+0.033 08-60.41
09-269.7 10+29.46 11+0.000 12+12.38
01+0121. 02+0308. 03+1900. 04+0.500 05+3.262 06+0.419 07+0.033 08-60.40
09-269.7 10+29.46 11+0.000 12+12.39
01+0109. 02+0308. 03+1915. 04+0.500 05+3.262 06+0.000 07+0.032 08-60.43
09-269.7 10+29.46 11+0.000 12+12.38
01+0109. 02+0308. 03+1930. 04+0.500 05+3.237 06+0.050 07+0.031 08-60.41
09-269.7 10+29.46 11+0.000 12+12.38
01+0109. 02+0308. 03+1945. 04+0.500 05+3.224 06+0.211 07+0.028 08-60.40
09-269.6 10+29.47 11+0.000 12+12.37
01+0109. 02+0308. 03+2000. 04+0.500 05+3.235 06+0.104 07+0.033 08-60.38
09-269.6 10+29.47 11+0.000 12+12.37
01+0121. 02+0308. 03+2000. 04+0.500 05+3.240 06+0.192 07+0.031 08-60.40
09-269.6 10+29.46 11+0.000 12+12.38
01+0109. 02+0308. 03+2015. 04+0.500 05+3.242 06+0.165 07+0.032 08-60.37
09-269.6 10+29.47 11+0.000 12+12.37
01+0109. 02+0308. 03+2030. 04+0.500 05+3.244 06+0.146 07+0.032 08-60.38
09-269.6 10+29.46 11+0.000 12+12.37
01+0109. 02+0308. 03+2045. 04+0.500 05+3.247 06+0.023 07+0.028 08-60.39
09-269.6 10+29.45 11+0.000 12+12.37
01+0109. 02+0308. 03+2100. 04+0.500 05+3.257 06+0.028 07+0.027 08-60.40
09-269.6 10+29.45 11+0.000 12+12.36
01+0121. 02+0308. 03+2100. 04+0.500 05+3.248 06+0.495 07+0.032 08-60.38
09-269.6 10+29.46 11+0.000 12+12.37
01+0109. 02+0308. 03+2115. 04+0.500 05+3.246 06+0.140 07+0.029 08-60.39
09-269.7 10+29.45 11+0.000 12+12.36
01+0109. 02+0308. 03+2130. 04+0.500 05+3.242 06+0.000 07+0.029 08-60.39
09-269.7 10+29.47 11+0.000 12+12.36
01+0109. 02+0308. 03+2145. 04+0.500 05+3.244 06+0.036 07+0.026 08-60.40
09-269.7 10+29.47 11+0.000 12+12.36
01+0109. 02+0308. 03+2200. 04+0.500 05+3.243 06+0.000 07+0.027 08-60.40
09-269.7 10+29.45 11+0.000 12+12.36
01+0121. 02+0308. 03+2200. 04+0.500 05+3.244 06+0.464 07+0.028 08-60.39
09-269.7 10+29.46 11+0.000 12+12.36
01+0109. 02+0308. 03+2215. 04+0.500 05+3.242 06+0.000 07+0.043 08-60.40
09-269.7 10+29.45 11+0.000 12+12.36
01+0109. 02+0308. 03+2230. 04+0.500 05+3.244 06+0.000 07+0.032 08-60.39
09-269.7 10+29.45 11+0.000 12+12.36
01+0109. 02+0308. 03+2245. 04+0.500 05+3.247 06+0.000 07+0.047 08-60.39
09-269.7 10+29.44 11+0.000 12+12.36
01+0109. 02+0308. 03+2300. 04+0.500 05+3.253 06+0.068 07+0.045 08-60.39
09-269.7 10+29.43 11+0.000 12+12.36
01+0121. 02+0308. 03+2300. 04+0.500 05+3.247 06+0.431 07+0.044 08-60.39
09-269.7 10+29.44 11+0.000 12+12.36
01+0109. 02+0308. 03+2315. 04+0.500 05+3.262 06+0.000 07+0.028 08-60.39
09-269.8 10+29.42 11+0.000 12+12.36
01+0109. 02+0308. 03+2330. 04+0.500 05+3.267 06+0.000 07+0.027 08-60.39
09-269.8 10+29.42 11+0.000 12+12.35
01+0109. 02+0308. 03+2345. 04+0.500 05+3.271 06+0.000 07+0.028 08-60.39
09-269.8 10+29.42 11+0.000 12+12.35
01+0109. 02+0308. 03+2400. 04+0.500 05+3.287 06+0.000 07+0.025 08-60.40
09-269.8 10+29.42 11+0.000 12+12.35
01+0121. 02+0308. 03+2400. 04+0.500 05+3.272 06+0.465 07+0.027 08-60.39
09-269.8 10+29.42 11+0.000 12+12.35
01+0109. 02+0309. 03+0015. 04+0.500 05+3.278 06+0.000 07+0.024 08-60.40
09-269.8 10+29.41 11+0.000 12+12.35
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01+0109.  02+0309.  03+0030.  04+0.500  05+3.280  06+0.064  07+0.028  08-60.39
09-269.9  10+29.41  11+0.000  12+12.34
01+0109.  02+0309.  03+0045.  04+0.500  05+3.284  06+0.103  07+0.029  08-60.39
09-269.9  10+29.41  11+0.000  12+12.34
01+0109.  02+0309.  03+0100.  04+0.500  05+3.280  06+0.000  07+0.026  08-60.38
09-269.9  10+29.39  11+0.000  12+12.34
01+0121.  02+0309.  03+0100.  04+0.500  05+3.281  06+0.455  07+0.027  08-60.39
09-269.9  10+29.40  11+0.000  12+12.34
01+0109.  02+0309.  03+0115.  04+0.500  05+3.269  06+0.000  07+0.028  08-60.40
09-269.9  10+29.39  11+0.000  12+12.34
01+0109.  02+0309.  03+0130.  04+0.500  05+3.270  06+0.000  07+0.031  08-60.41
09-269.9  10+29.38  11+0.000  12+12.34
01+0109.  02+0309.  03+0145.  04+0.500  05+3.264  06+0.166  07+0.033  08-60.40
09-269.9  10+29.37  11+0.000  12+12.34
01+0109.  02+0309.  03+0200.  04+0.500  05+3.237  06+0.209  07+0.033  08-60.39
09-269.9  10+29.37  11+0.000  12+12.34
01+0121.  02+0309.  03+0200.  04+0.500  05+3.260  06+0.272  07+0.032  08-60.40
09-269.9  10+29.37  11+0.000  12+12.34
01+0109.  02+0309.  03+0215.  04+0.500  05+3.234  06+0.153  07+0.033  08-60.39
09-269.9  10+29.36  11+0.000  12+12.34
01+0109.  02+0309.  03+0230.  04+0.500  05+3.237  06+0.057  07+0.033  08-60.37
09-269.8  10+29.35  11+0.000  12+12.34
01+0109.  02+0309.  03+0245.  04+0.500  05+3.243  06+0.000  07+0.031  08-60.38
09-269.8  10+29.34  11+0.000  12+12.33
01+0109.  02+0309.  03+0300.  04+0.500  05+3.247  06+0.125  07+0.036  08-60.40
09-269.9  10+29.33  11+0.000  12+12.33
01+0121.  02+0309.  03+0300.  04+0.500  05+3.240  06+0.431  07+0.034  08-60.38
09-269.8  10+29.35  11+0.000  12+12.33
01+0109.  02+0309.  03+0315.  04+0.500  05+3.242  06+0.193  07+0.040  08-60.40
09-269.9  10+29.33  11+0.000  12+12.33
01+0109.  02+0309.  03+0330.  04+0.500  05+3.234  06+0.198  07+0.033  08-60.39
09-269.9  10+29.32  11+0.000  12+12.33
01+0109.  02+0309.  03+0345.  04+0.500  05+3.234  06+0.153  07+0.032  08-60.39
09-269.9  10+29.31  11+0.000  12+12.33
01+0109.  02+0309.  03+0400.  04+0.500  05+3.243  06+0.098  07+0.033  08-60.39
09-269.9  10+29.30  11+0.000  12+12.32
01+0121.  02+0309.  03+0400.  04+0.500  05+3.238  06+0.396  07+0.035  08-60.39
09-269.9  10+29.32  11+0.000  12+12.33
01+0109.  02+0309.  03+0415.  04+0.500  05+3.245  06+0.000  07+0.027  08-60.39
09-269.9  10+29.29  11+0.000  12+12.32
01+0109.  02+0309.  03+0430.  04+0.500  05+3.245  06+0.069  07+0.030  08-60.39
09-269.9  10+29.29  11+0.000  12+12.32
01+0109.  02+0309.  03+0445.  04+0.500  05+3.244  06+0.137  07+0.030  08-60.39
09-269.9  10+29.27  11+0.000  12+12.32
01+0109.  02+0309.  03+0500.  04+0.500  05+3.244  06+0.136  07+0.032  08-60.38
09-269.9  10+29.27  11+0.000  12+12.32
01+0121.  02+0309.  03+0500.  04+0.500  05+3.245  06+0.297  07+0.030  08-60.39
09-269.9  10+29.28  11+0.000  12+12.32
01+0109.  02+0309.  03+0515.  04+0.500  05+3.255  06+0.093  07+0.030  08-60.37
09-269.9  10+29.26  11+0.000  12+12.32
01+0109.  02+0309.  03+0530.  04+0.500  05+3.248  06+0.133  07+0.030  08-60.37
09-269.9  10+29.25  11+0.000  12+12.32
01+0109.  02+0309.  03+0545.  04+0.500  05+3.246  06+0.130  07+0.032  08-60.37
09-269.9  10+29.24  11+0.000  12+12.32
01+0109.  02+0309.  03+0600.  04+0.500  05+3.268  06+0.132  07+0.033  08-60.37
09-269.9  10+29.23  11+0.000  12+12.32
01+0121.  02+0309.  03+0600.  04+0.500  05+3.254  06+0.349  07+0.032  08-60.37
09-269.9  10+29.25  11+0.000  12+12.32
01+0109.  02+0309.  03+0615.  04+0.500  05+3.280  06+0.053  07+0.047  08-60.38
09-269.9  10+29.22  11+0.000  12+12.31
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01+0109.  02+0309.  03+0630.  04+0.500  05+3.276  06+0.000  07+0.049  08-60.38
09-269.9  10+29.21  11+0.000  12+12.31
01+0109.  02+0309.  03+0645.  04+0.500  05+3.278  06+0.000  07+0.044  08-60.38
09-269.9  10+29.21  11+0.000  12+12.31
01+0109.  02+0309.  03+0700.  04+0.500  05+3.278  06+0.036  07+0.032  08-60.38
09-269.9  10+29.21  11+0.000  12+12.31
01+0121.  02+0309.  03+0700.  04+0.500  05+3.278  06+0.468  07+0.046  08-60.38
09-269.9  10+29.21  11+0.000  12+12.31
01+0109.  02+0309.  03+0715.  04+0.500  05+3.277  06+0.064  07+0.032  08-60.39
09-269.9  10+29.21  11+0.000  12+12.31
01+0109.  02+0309.  03+0730.  04+0.500  05+3.274  06+0.000  07+0.033  08-60.38
09-269.9  10+29.19  11+0.000  12+12.31
01+0109.  02+0309.  03+0745.  04+0.500  05+3.270  06+0.000  07+0.033  08-60.38
09-269.9  10+29.17  11+0.000  12+12.31
01+0109.  02+0309.  03+0800.  04+0.500  05+3.268  06+0.000  07+0.033  08-60.38
09-269.9  10+29.18  11+0.000  12+12.31
01+0121.  02+0309.  03+0800.  04+0.500  05+3.272  06+0.478  07+0.033  08-60.38
09-269.9  10+29.19  11+0.000  12+12.31
01+0109.  02+0309.  03+0815.  04+0.500  05+3.271  06+0.000  07+0.033  08-60.38
09-269.9  10+29.19  11+0.000  12+12.31
01+0109.  02+0309.  03+0830.  04+0.500  05+3.274  06+0.023  07+0.035  08-60.38
09-269.9  10+29.19  11+0.000  12+12.30
01+0109.  02+0309.  03+0845.  04+0.500  05+3.326  06+0.243  07+0.038  08-60.38
09-269.9  10+29.18  11+0.000  12+12.30
01+0109.  02+0309.  03+0900.  04+0.500  05+3.351  06+0.150  07+0.032  08-60.38
09-269.9  10+29.18  11+0.000  12+12.30
01+0121.  02+0309.  03+0900.  04+0.500  05+3.306  06+0.190  07+0.048  08-60.38
09-269.9  10+29.19  11+0.000  12+12.30
01+0109.  02+0309.  03+0915.  04+0.500  05+3.284  06+0.000  07+0.032  08-60.38
09-269.9  10+29.17  11+0.000  12+12.30
01+0109.  02+0309.  03+0930.  04+0.500  05+3.281  06+0.000  07+0.030  08-60.39
09-269.9  10+29.16  11+0.000  12+12.30
01+0109.  02+0309.  03+0945.  04+0.500  05+3.283  06+0.000  07+0.032  08-60.39
09-269.9  10+29.16  11+0.000  12+12.30
01+0109.  02+0309.  03+1000.  04+0.500  05+3.275  06+0.000  07+0.033  08-60.40
09-270.0  10+29.16  11+0.000  12+12.30
01+0121.  02+0309.  03+1000.  04+0.500  05+3.281  06+0.496  07+0.032  08-60.39
09-269.9  10+29.16  11+0.000  12+12.30
01+0109.  02+0309.  03+1015.  04+0.500  05+3.284  06+0.000  07+0.045  08-60.40
09-269.9  10+29.16  11+0.000  12+12.30
01+0109.  02+0309.  03+1030.  04+0.500  05+3.279  06+0.000  07+0.028  08-60.39
09-269.9  10+29.15  11+0.000  12+12.30
01+0109.  02+0309.  03+1045.  04+0.500  05+3.276  06+0.000  07+0.026  08-60.39
09-270.0  10+29.15  11+0.000  12+12.30
01+0109.  02+0309.  03+1100.  04+0.500  05+3.290  06+0.000  07+0.035  08-60.40
09-270.0  10+29.15  11+0.000  12+12.30
01+0121.  02+0309.  03+1100.  04+0.500  05+3.282  06+0.460  07+0.038  08-60.39
09-270.0  10+29.15  11+0.000  12+12.30
01+0109.  02+0309.  03+1115.  04+0.500  05+3.283  06+0.000  07+0.041  08-60.39
09-270.0  10+29.15  11+0.000  12+12.30
01+0109.  02+0309.  03+1130.  04+0.500  05+3.292  06+0.102  07+0.031  08-60.40
09-269.9  10+29.14  11+0.000  12+12.30
01+0109.  02+0309.  03+1145.  04+0.500  05+3.305  06+0.138  07+0.028  08-60.39
09-269.9  10+29.14  11+0.000  12+12.30
01+0109.  02+0309.  03+1200.  04+0.500  05+3.299  06+0.062  07+0.029  08-60.38
09-269.9  10+29.13  11+0.000  12+12.30
01+0121.  02+0309.  03+1200.  04+0.500  05+3.295  06+0.444  07+0.037  08-60.39
09-269.9  10+29.14  11+0.000  12+12.30
01+0109.  02+0309.  03+1215.  04+0.500  05+3.292  06+0.091  07+0.030  08-60.40
09-269.9  10+29.13  11+0.000  12+12.30
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01+0109.  02+0309.  03+1230.  04+0.500  05+3.287  06+0.104  07+0.032  08-60.38
09-269.9  10+29.12  11+0.000  12+12.30
01+0109.  02+0309.  03+1245.  04+0.500  05+3.273  06+0.000  07+0.034  08-60.37
09-269.9  10+29.12  11+0.000  12+12.30
01+0109.  02+0309.  03+1300.  04+0.500  05+3.276  06+0.000  07+0.035  08-60.37
09-269.9  10+29.11  11+0.000  12+12.30
01+0121.  02+0309.  03+1300.  04+0.500  05+3.282  06+0.475  07+0.038  08-60.38
09-269.9  10+29.12  11+0.000  12+12.30
01+0109.  02+0309.  03+1315.  04+0.500  05+3.268  06+0.032  07+0.034  08-60.39
09-270.0  10+29.11  11+0.000  12+12.30
01+0109.  02+0309.  03+1330.  04+0.500  05+3.257  06+0.110  07+0.024  08-60.40
09-269.9  10+29.10  11+0.000  12+12.30
01+0109.  02+0309.  03+1345.  04+0.500  05+3.261  06+0.000  07+0.030  08-60.39
09-269.9  10+29.09  11+0.000  12+12.30
01+0109.  02+0309.  03+1400.  04+0.500  05+3.255  06+0.028  07+0.032  08-60.41
09-270.0  10+29.09  11+0.000  12+12.30
01+0121.  02+0309.  03+1400.  04+0.500  05+3.260  06+0.487  07+0.031  08-60.40
09-269.9  10+29.10  11+0.000  12+12.30
01+0109.  02+0309.  03+1415.  04+0.500  05+3.269  06+0.000  07+0.047  08-60.42
09-269.9  10+29.08  11+0.000  12+12.30
01+0109.  02+0309.  03+1430.  04+0.500  05+3.262  06+0.211  07+0.047  08-60.41
09-270.0  10+29.08  11+0.000  12+12.30
01+0109.  02+0309.  03+1445.  04+0.500  05+3.239  06+0.093  07+0.032  08-60.42
09-270.0  10+29.08  11+0.000  12+12.30
01+0109.  02+0309.  03+1500.  04+0.500  05+3.220  06+0.272  07+0.033  08-60.42
09-269.9  10+29.07  11+0.000  12+12.30
01+0121.  02+0309.  03+1500.  04+0.500  05+3.248  06+0.289  07+0.048  08-60.42
09-269.9  10+29.08  11+0.000  12+12.30
01+0109.  02+0309.  03+1515.  04+0.500  05+3.214  06+0.188  07+0.032  08-60.41
09-269.9  10+29.07  11+0.000  12+12.30
01+0109.  02+0309.  03+1530.  04+0.500  05+3.239  06+0.095  07+0.030  08-60.39
09-269.9  10+29.07  11+0.000  12+12.30
01+0109.  02+0309.  03+1545.  04+0.500  05+3.233  06+0.000  07+0.031  08-60.40
09-269.9  10+29.07  11+0.000  12+12.30
01+0109.  02+0309.  03+1600.  04+0.500  05+3.233  06+0.000  07+0.031  08-60.40
09-269.8  10+29.08  11+0.000  12+12.30
01+0121.  02+0309.  03+1600.  04+0.500  05+3.230  06+0.356  07+0.032  08-60.40
09-269.9  10+29.07  11+0.000  12+12.30
01+0109.  02+0309.  03+1615.  04+0.500  05+3.239  06+0.000  07+0.030  08-60.41
09-269.7  10+29.07  11+0.000  12+12.30
01+0109.  02+0309.  03+1630.  04+0.500  05+3.237  06+0.000  07+0.034  08-60.40
09-269.8  10+28.98  11+0.000  12+12.30
01+0109.  02+0309.  03+1645.  04+0.500  05+3.226  06+0.000  07+0.035  08-60.40
09-269.6  10+28.96  11+0.000  12+12.30
01+0109.  02+0309.  03+1700.  04+0.500  05+3.234  06+0.000  07+0.023  08-60.40
09-269.3  10+28.32  11+0.000  12+12.30
01+0121.  02+0309.  03+1700.  04+0.500  05+3.234  06+0.258  07+0.046  08-60.40
09-269.6  10+28.83  11+0.000  12+12.30
01+0109.  02+0309.  03+1715.  04+0.500  05+3.227  06+0.000  07+0.033  08-60.40
09-269.3  10+28.27  11+0.000  12+12.30
01+0109.  02+0309.  03+1730.  04+0.500  05+3.228  06+0.000  07+0.031  08-60.42
09-269.3  10+28.28  11+0.000  12+12.30
01+0109.  02+0309.  03+1745.  04+0.500  05+3.215  06+0.000  07+0.032  08-60.40
09-269.5  10+28.39  11+0.000  12+12.30
01+0109.  02+0309.  03+1800.  04+0.500  05+3.217  06+0.000  07+0.022  08-60.42
09-269.6  10+28.37  11+0.000  12+12.30
01+0121.  02+0309.  03+1800.  04+0.500  05+3.222  06+0.000  07+0.031  08-60.41
09-269.4  10+28.33  11+0.000  12+12.30
01+0109.  02+0309.  03+1815.  04+0.500  05+3.222  06+0.000  07+0.036  08-60.40
09-269.5  10+28.26  11+0.000  12+12.30
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01+0109.  02+0309.  03+1830.  04+0.500  05+3.226  06+0.000  07+0.026  08-60.40
09-269.5  10+28.44  11+0.000  12+12.30
01+0109.  02+0309.  03+1845.  04+0.500  05+3.222  06+0.000  07+0.019  08-60.41
09-269.4  10+28.47  11+0.000  12+12.30
01+0109.  02+0309.  03+1900.  04+0.500  05+3.215  06+0.000  07+0.022  08-60.41
09-269.4  10+28.26  11+0.000  12+12.30
01+0121.  02+0309.  03+1900.  04+0.500  05+3.221  06+0.000  07+0.032  08-60.41
09-269.4  10+28.36  11+0.000  12+12.30
01+0109.  02+0309.  03+1915.  04+0.500  05+3.224  06+0.000  07+0.020  08-60.42
09-269.7  10+27.91  11+0.000  12+12.30
01+0109.  02+0309.  03+1930.  04+0.500  05+3.218  06+0.000  07+0.037  08-60.41
09-269.5  10+28.12  11+0.000  12+12.30
01+0109.  02+0309.  03+1945.  04+0.500  05+3.221  06+0.000  07+0.040  08-60.41
09-269.4  10+28.67  11+0.000  12+12.30
01+0109.  02+0309.  03+2000.  04+0.500  05+3.220  06+0.000  07+0.030  08-60.41
09-269.4  10+29.04  11+0.000  12+12.30
01+0121.  02+0309.  03+2000.  04+0.500  05+3.221  06+0.000  07+0.039  08-60.41
09-269.5  10+28.43  11+0.000  12+12.30
01+0109.  02+0309.  03+2015.  04+0.500  05+3.216  06+0.000  07+0.026  08-60.41
09-269.4  10+28.98  11+0.000  12+12.29
01+0109.  02+0309.  03+2030.  04+0.500  05+3.239  06+0.000  07+0.031  08-60.41
09-269.8  10+29.11  11+0.000  12+12.29
01+0109.  02+0309.  03+2045.  04+0.500  05+3.243  06+0.000  07+0.033  08-60.42
09-269.7  10+29.37  11+0.000  12+12.29
01+0109.  02+0309.  03+2100.  04+0.500  05+3.237  06+0.000  07+0.033  08-60.41
09-269.7  10+29.43  11+0.000  12+12.29
01+0121.  02+0309.  03+2100.  04+0.500  05+3.234  06+0.270  07+0.032  08-60.41
09-269.7  10+29.22  11+0.000  12+12.29
01+0109.  02+0309.  03+2115.  04+0.500  05+3.255  06+0.000  07+0.032  08-60.41
09-269.8  10+29.47  11+0.000  12+12.29
01+0109.  02+0309.  03+2130.  04+0.500  05+3.245  06+0.000  07+0.034  08-60.40
09-269.7  10+29.48  11+0.000  12+12.29
01+0109.  02+0309.  03+2145.  04+0.500  05+3.222  06+0.000  07+0.033  08-60.40
09-269.4  10+29.39  11+0.000  12+12.29
01+0109.  02+0309.  03+2200.  04+0.500  05+3.217  06+0.000  07+0.041  08-60.40
09-269.4  10+29.44  11+0.000  12+12.29
01+0121.  02+0309.  03+2200.  04+0.500  05+3.235  06+0.000  07+0.037  08-60.40
09-269.6  10+29.45  11+0.000  12+12.29
01+0109.  02+0309.  03+2215.  04+0.500  05+3.238  06+0.000  07+0.030  08-60.39
09-269.8  10+29.44  11+0.000  12+12.29
01+0109.  02+0309.  03+2230.  04+0.500  05+3.253  06+0.000  07+0.027  08-60.40
09-269.6  10+29.44  11+0.000  12+12.81
01+0109.  02+0309.  03+2245.  04+0.500  05+3.243  06+0.000  07+0.027  08-60.41
09-269.4  10+29.43  11+0.000  12+12.95
01+0109.  02+0309.  03+2300.  04+0.500  05+3.243  06+0.000  07+0.032  08-60.43
09-269.3  10+29.43  11+0.000  12+12.99
01+0121.  02+0309.  03+2300.  04+0.500  05+3.245  06+0.293  07+0.029  08-60.40
09-269.5  10+29.44  11+0.000  12+12.76
01+0109.  02+0309.  03+2315.  04+0.500  05+3.240  06+0.000  07+0.032  08-60.42
09-269.2  10+29.43  11+0.000  12+13.02
01+0109.  02+0309.  03+2330.  04+0.500  05+3.249  06+0.000  07+0.030  08-60.41
09-269.2  10+29.43  11+0.000  12+13.04
01+0109.  02+0309.  03+2345.  04+0.500  05+3.246  06+0.000  07+0.027  08-60.41
09-269.3  10+29.43  11+0.000  12+13.06
01+0109.  02+0309.  03+2400.  04+0.500  05+3.254  06+0.000  07+0.029  08-60.41
09-269.5  10+29.42  11+0.000  12+13.08
01+0121.  02+0309.  03+2400.  04+0.500  05+3.247  06+0.370  07+0.032  08-60.41
09-269.3  10+29.43  11+0.000  12+13.05
01+0109.  02+0310.  03+0015.  04+0.500  05+3.254  06+0.000  07+0.033  08-60.43
09-269.4  10+29.42  11+0.000  12+13.10
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APPENDIX G
CALIBRATION SHEETS

Miller Brewing Company
Fulton, New York

EMISSION INVENTORY REPORT

JANUARY 1994

PUMP CALIBRATION SHEET

Project: SBEM
Date: 10/28/93
Time: 1230
Pump ID: R1
w/charcoal tubes

Barometric Pressure, (Pb): 29.72 (in-Hg)
Temperature, (T): 78 (F)
Operator: KJ.

SS.

1/8" below Black

Rotameter Reading (Bottom of the Ball)					
115	120	125		150	
Sampling Medium					
2- 8mm	Charcoal Tubes		← →	NA	
Actual Liters Per Minutes, ALPM					
.665	.699	.719		.914	.934
.665	.694	.712		.894	.935
.665	.701	.722		.900	.935
.663	.701	.727		.898	.932
.665	.702	.729		.898	.926
.666	.700	.727		.897	.923
.665	.700	.729		.897	.939
.664	.201	.730		.914	.937
.665	.705	.736		.905	.941
.664	.706	.735		.905	.936
Avg(ALPM)					
0.6647	0.7009	0.7266		0.9022	0.9337
Average Standard Liters Per Minute, Avg(SLPM)					

$$SLPM = ALPM \times \{[(Pb-Pv)/29.92] \times [293/(273+T)]\}$$

$$C = (5/9) \times (F-32)$$

Vapor Pressure (Pv) Table	
(C)	(in-Hg)
15	0.50
16	0.54
17	0.57
18	0.61
19	0.65
20	0.69
21	0.73
22	0.78
23	0.83
24	0.88
25	0.94
26	0.99
27	1.06
28	1.12
29	1.18
30	1.25
31	1.33
32	1.40

Remarks:

Remarks: @ 1/8" below; A SPACE IS MAINTAINED; THIS IS AN EQUIVALENT READING.
As the ball stops @ the black "NO VIBRATION" INSTANTANEOUSLY
L/M ≅ 0.98 LPM

* POST CAL

PUMP CALIBRATION SHEET

Project: SBEM

Date: 11/15/93

Time: 1230

Pump ID: R1

Barometric Pressure, (Pb): 2990 (in-Hg)

Temperature, (T): 78 °F (F)

Operator: KG

S.S.

Rotameter Reading (Bottom of the Ball)					
115	119	125	140	145	150
Sampling Medium					
2-8mm Charcoal Traps.			← NONE →		
Actual Liters Per Minutes, ALPM					
.669	.695	.738	.802	.850	.878
.672	.701	.737	.808	.851	.992
.671	.701	.736	.802	.849	.891
.667	.702	.737	.808	.844	.893
.669	.701	.739	.803	.847	.891
.672	.701	.740	.830	.852	.893
.669	.700	.739	.809	.849	.882
.671	.701	.741	.780	.852	.892
.670	.701	.738	.805	.853	.892
.669	.700	.736	.802	.852	.888
29003					
Avg(ALPM)					
0.6699	0.7003	0.7381	0.8049	0.8499	0.8992
Average Standard Liters Per Minute, Avg(SLPM)					

SLPM = ALPM x {[(Pb-Pv)/29.92] x [293/(273+T)]}

C = (5/9) x (F-32)

Vapor Pressure (Pv) Table		
(C)	(In-Hg)	155
15	0.50	
16	0.54	
17	0.57	
18	0.61	.875
19	0.65	.933
20	0.69	.929
21	0.73	.927
22	0.78	.929
23	0.83	.921
24	0.88	925
25	0.94	.859
26	0.99	.903
27	1.06	.932
28	1.12	
29	1.18	
30	1.25	
31	1.33	
32	1.40	

Remarks:

.9173

Remarks:

PUMP CALIBRATION SHEET

Project: SBEM
Date: 10/28/93
Time: 1105
Pump ID: R2

Barometric Pressure, (Pb): 29.71 (in-Hg)
Temperature, (T): 77 (F)
Operator: KG

w/charcoal traps

S.S.

Rotameter Reading (Bottom of the Ball)					
80	85	90	100	110	120
Sampling Medium					
2 - 8mm Charcoal →			← N/A →		
Actual Liters Per Minutes, ALPM					
.673	.711	.755	.853	.973	1.03
.665	.709	.757	.847	.930	1.03
.667	.708	.752	.876	.988	1.04
.672	.709	.754	.831	.927	1.08
.669	.713	.756	.856	.935	1.08
.666	.713	.757	.821	.973	1.06
.666	.712	.755	.874	.974	1.09
.666	.713	.755	.873	.980	1.09
.669	.713	.753	.862	.976	1.03
.669	.713	.756	.879	.994	1.09
Avg(ALPM)					
0.6682	0.7114	0.755	0.8572	0.965	1.062
Average Standard Liters Per Minute, Avg(SLPM)					

SLPM = ALPM x {[(Pb-Pv)/29.92] x [293/(273+T)]}
C = (5/9) x (F-32)

Vapor Pressure (Pv) Table		
(C)	(In-Hg)	130
15	0.50	//////
16	0.54	N/A
17	0.57	//////
18	0.61	1.15
19	0.65	1.14
20	0.69	1.13
21	0.73	1.14
22	0.78	1.14
23	0.83	1.14
24	0.88	1.16
25	0.94	1.15
25	0.99	1.14
27	1.06	1.14
28	1.12	
29	1.18	
30	1.25	
31	1.33	
32	1.40	

Remarks:

1.143

Remarks:

[POST CAL]

PUMP CALIBRATION SHEET

Project: SBEM

Date: 11/15/93

Time: 1315

Pump ID: R2

Barometric Pressure, (Pb): 29.89 (in-Hg)

Temperature, (T): 76° (F)

Operator: KJG

S.S

Rotameter Reading (Bottom of the Ball)					
80	85	90	100	110	120
Sampling Medium					
2-8mm	Charcoal	→	←	NONE	→
Actual Liters Per Minutes, ALPM					
.664	.716	.758	.851	.926	1.01
.663	.720	.759	.850	.978	.998
.665	.720	.755	.855	.961	1.06
.667	.722	.763	.858	.916	1.03
.666	.722	.761	.864	.917	1.01
.668	.721	.762	.816	.925	1.03
.668	.723	.759	.866	.987	1.07
.669	.721	.763	.838	.971	1.03
.666	.725	.760	.853	.925	1.01
.670	.722	.760	.858	.991	1.01
Avg(ALPM)					
0.6666	0.7212	0.76	0.8513	0.9497	1.0258
Average Standard Liters Per Minute, Avg(SLPM)					

SLPM = ALPM x {[(Pb-Pv)/29.92] x [293/(273+T)]}

C = (5/9) x (F-32)

Vapor Pressure (Pv) Table	
(C)	(in-Hg)
15	0.50
16	0.54
17	0.57
18	0.61
19	0.65
20	0.69
21	0.73
22	0.78
23	0.83
24	0.88
25	0.94
26	0.99
27	1.06
28	1.12
29	1.18
30	1.25
31	1.33
32	1.40

Remarks:

Remarks:

PUMP CALIBRATION SHEET

Project: SBEM
Date: 10/28/93
Time: 1055
Pump ID: <R3>

Barometric Pressure, (Pb): 29.70 (in-Hg)
Temperature, (T): 76 (F)
Operator: KJG

w/charcoal

5.5

Rotameter Reading (Bottom of the Ball)					
70	75	80	100	110	120
Sampling Medium					
2-8mm Carbon Traps ⟶			⟵ TYGON TUBING ⟶		
Actual Liters Per Minutes, ALPM					
.584	.649	.690	.877	.974	1.04
.592	.651	.689	.867	.925	1.04
.588	.643	.687	.867	.963	1.09
.589	.647	.689	.857	.973	1.05
.591	.646	.657	.871	.963	1.05
.594	.647	.691	.857	.962	1.04
.592	.650	.689	.872	.972	1.08
.589	.651	.686	.861	.975	1.05
.593	.645	.690	.847	.975	1.07
.590	.648	.691	.856	.976	1.06
Avg(ALPM)					
0.5902	0.6477	0.6889	0.864	0.9658	1056
Average Standard Liters Per Minute, Avg(SLPM)					

SLPM = ALPM x {[(Pb-Pv)/29.92] x [293/(273+T)]}
C = (5/9) x (F-32)

Vapor Pressure (Pv) Table		
(C)	(In-Hg)	130
15	0.50	1.13
16	0.54	1.16
17	0.57	1.13
18	0.61	1.13
19	0.65	1.15
20	0.69	1.14
21	0.73	1.17
22	0.78	1.15
23	0.83	1.13
24	0.88	1.15
25	0.94	1.18
26	0.99	
27	1.06	
28	1.12	
29	1.18	
30	1.25	
31	1.33	
32	1.40	

Remarks:

1.147

Remarks:

POST CALIB

PUMP CALIBRATION SHEET

Project: SBEM
Date: 11/15/93
Time: 1340
Pump ID: <R3>

Barometric Pressure, (Pb): 2989 (in-Hg)
Temperature, (T): 75 (F)
Operator: KJG

Rotameter Reading (Bottom of the Ball)					
70	75	80	100	110	120
Sampling Medium					
2-8mm Charcoal	Tube		← NONE →		
Actual Liters Per Minutes, ALPM					
.584	.642	.687	.873	.923	1.03
.586	.642	.688	.827	.985	1.03
589	.643	.685	.841	.938	1.03
.587	.644	.687	.896	.930	1.09
589	.644	.689	.825	.971	1.03
588	643	.692	.865	.929	1.03
.591	.644	.692	.865	.991	1.03
.590	.642	.696	.877	.989	1.03
.588	.640	.694	.830	.992	1.04
.590	.640	.692	.885	.978	1.03
Avg(ALPM)					
0.5882	0.6424	0.6902	0.8584	0.963	1.037
Average Standard Liters Per Minute, Avg(SLPM)					

$$SLPM = ALPM \times \{[(Pb-Pv)/29.92] \times [293/(273+T)]\}$$

$$C = (5/9) \times (F-32)$$

Vapor Pressure (Pv) Table	
(C)	(in-Hg)
15	0.50
16	0.54
17	0.57
18	0.61
19	0.65
20	0.69
21	0.73
22	0.78
23	0.83
24	0.88
25	0.94
26	0.99
27	1.06
28	1.12
29	1.18
30	1.25
31	1.33
32	1.40

Remarks:

Remarks:

PUMP CALIBRATION SHEET

Project: SBEM

Date: 11/1/93

Time: 1643 EDT

Pump ID: D

Barometric Pressure, (Pb): 29.60 (in-Hg)

Temperature, (T): 72° (F)

Operator: KJG

Pump.

black

Rotameter Reading (Bottom of the Ball)					
1LPM.					
Sampling Medium					
2 - 8mm Charcoal Tubes.					
Actual Liters Per Minutes, ALPM					
1.05					
1.03					
1.03					
1.03					
1.03					
1.04					
1.03					
1.03					
1.05					
.997					
1.03					
1.03					
1.03					
1.03					
1.03					
1.03					
1.03					
Avg(ALPM)					
Average Standard Liters Per Minute, Avg(SLPM)					

SLPM = ALPM x {[(Pb-Pv)/29.92] x [293/(273+T)]}

C = (5/9) x (F-32)

Vapor Pressure (Pv) Table	
(C)	(in-Hg)
15	0.50
16	0.54
17	0.57
18	0.61
19	0.65
20	0.69
21	0.73
22	0.78
23	0.83
24	0.88
25	0.94
26	0.99
27	1.06
28	1.12
29	1.18
30	1.25
31	1.33
32	1.40

Remarks:

Remarks: This is a calibration for the Nov. 1, 1993 ~~[illegible]~~ [illegible] next EF2; 3 samples were taken.

DRY GAS METER CALIBRATION SHEET (POST-TEST)

Client ______

Project No. 93-458-OH

Module 09-N

Orifice (2.95)

Run By C. Scott

Date 11-1-93

Barometric Pressure 29.33

Avg. Vacuum in Hg 8.5

Avg. ΔH "WC	Vw initial	Vw final	Vw ft.^{3}	Vdg initial	Vdg final	Vdg ft.^{3}	tw °F	tdgi °F	tdgo °F	Time θ min.
1.18	117.570	123.042	6.472	900.004	906.548	6.544	59	57	58	10 min
1.18	123.042	129.362	6.320	906.548	912.983	6.435	59	59	65	10 min
1.18	129.362	136.718	7.356	912.983	920.503	7.520	59	61	68	12 min

		Mc(Y)	ΔH@
ΔH	$\frac{\Delta H}{13.6}$	$\frac{Vw\ Pb\ (tdg + 460)}{Vdg(Pb + \Delta H/13.6)(tw + 460)}$	$\frac{0.0317\,\Delta H}{Pb\ (td + 460)}\left[\frac{(tw + 460)\theta}{Vw}\right]^2$
1.18	.087	.98	1.5833
1.18	.087	.99	1.6604
1.18	.087	.99	1.2256

ΔH = Orifice Setting

Vw = Volume of Gas of Wet Test Meter

Vdg = Volume of Gas of Dry Gas Meter

tw = Temperature of Fluid in Wet Test Meter

tdgi = Inlet Temperature of Dry Gas Meter

tdgo = Outlet Temperature of Dry Gas Meter

tdg = Average Temperature of Dry Gas Meter

θ = Time required to pull specified cubic feet

Mc = Dry Gas Meter Correction Factor

ΔH@ = Orifice setting that would pull .75 cfm of air at standard conditions

Dry Gas Meter Calibration Sheet

Client ______
Run By DANIELS, DAN
Project No. 93-458-OH
Date 9/30/93
Module 09/N
Barometric Press. 29.74
Orifice 2.95

ΔH in. H_2O	Vw initial	Vw final	Vw ft.^{3}	Vd initial	Vd final	Vd ft.^{3}	tw °F	tdi °F	tdo °F	td	Time θ min.
.5	837.060	841.510	4.450	571.199	575.680	4.481	65	73	67	70	11.0
1.0	841.610	847.570	5.960	575.780	581.907	6.127	65	75	70	73	10.0
1.5	847.690	854.470	6.780	582.029	589.0[illegible]	6.98[illegible]	65	76	72	74	10.0
2.0	819.410	827.150	7.740	553.180	561.050	7.870	65	73	67	70	10.0
3.0	827.230	836.970	9.740	561.220	571.140	9.920	65	73	67	70	10.0

ΔH	$\frac{\Delta H}{13.6}$	Mc(Y) $\frac{Vw\ Pb(td + 460)}{Vd(Pb + \Delta H/13.6)(tw + 460)}$	Yi	$\Delta H@$ (For Small Orifice Only) $\frac{0.0317\Delta H}{Pb\ (td + 460)}\left[\frac{(tw + 460)\ \theta}{Vw}\right]^2$	$\Delta H@i$
.5	.0368	1.00		1.3996	
1.0	.0737	.98		1.5605	
1.5	.110	.98		1.8088	
2.0	.147	.99		1.8506	
3.0	.221	.98		1.3996	
Average		.90		1.6038	

ΔH = Orifice Setting

Vw = Volume of Gas of Wet Test Meter

Vd = Volume of Gas of Dry Gas Meter

tw = Temperature of Fluid in Wet Test Meter

tdi = Inlet Temperature of Dry Gas Meter

tdo = Outlet Temperature of Dry Gas Meter

td = Average Temperature of Dry Gas Meter

θ = Time required to pull specified cubic feet

Mc = Dry Gas Meter Correction Factor

$\Delta H@$ = Orifice setting that would pull .75 cfm of air at standard conditions

Yi = Ratio of reading of wet test meter to dry test meter ±.02 from average

$\Delta H@i$ = Ha tolerance for individual values ±.20 from average.

TOTAL SOURCE ANALYSIS

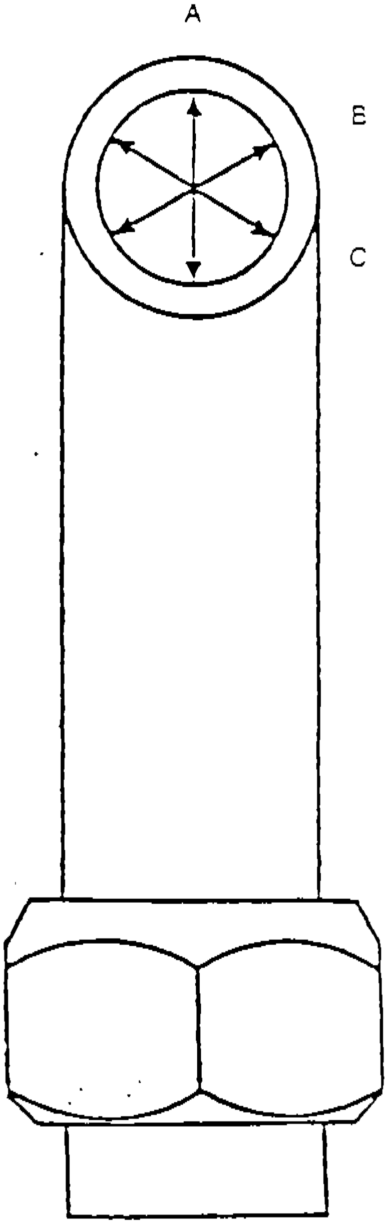
Nozzle Calibration

1 - Kerotherm
2 - Nutech
3 - ASME
4 - Glass

Sized By Wes Carr

Date	Nozzle	Dimension			Difference	Avg. Diameter
		A	B	C		
10-20-93	2-1	.188	.188	.189	.001	.188
	2-2	.181	.182	.182	.001	.182
	2-3	.182	.182	.183	.001	.182
	2-4	.177	.177	.177	.000	.177
	2-5					
	2-6	.186	.187	.187	.001	.187
	2-7	.189	.189	.190	.001	.189
	2-8					
	2-9					
	2-10	.244	.245	.246	.002	.245
	2-11	.264	.265	.263	.002	.264
	2-12	.310	.311	.311	.001	.311
	2-13	.253	.255	.255	.002	.254
	2-14	.310	.310	.309	.001	.310
	2-15	.373	.373	.375	.002	.374
	2-16	.311	.312	.313	.002	.312
	2-17					
	2-18					
	2-19	.374	.374	.373	.001	.374
	2-20	.376	.376	.376	.000	.376
	2-21	.368	.369	.369	.001	.369
	2-22	.373	.373	.373	.000	.373
	2-23	.489	.490	.491	.002	.490
	2-24	.494	.494	.494	000	.494
	2-25	.495	.495	.495	.000	.495
	2-26	.504	.504	.504	.000	.504
	2-27	.586	.586	.586	.000	.586
	2-28	.692	.692	.692	.000	.692
	2-29					
	2-30	.759	.760	.760	.001	.760
	2-31	.495	.495	.495	.000	.495
	2-32	.755	.755	.755	.000	.755
	2-33	1.007	1.007	1.007	.000	1.007
	2-34	1.030	1.030	1.030	.000	1.030
	2-35	1.150	1.150	1.150	.000	~~1.150~~ 1.150

All Dimensions are in inches.



Total Source Analysis, Inc.
Environmental Testing Consultants

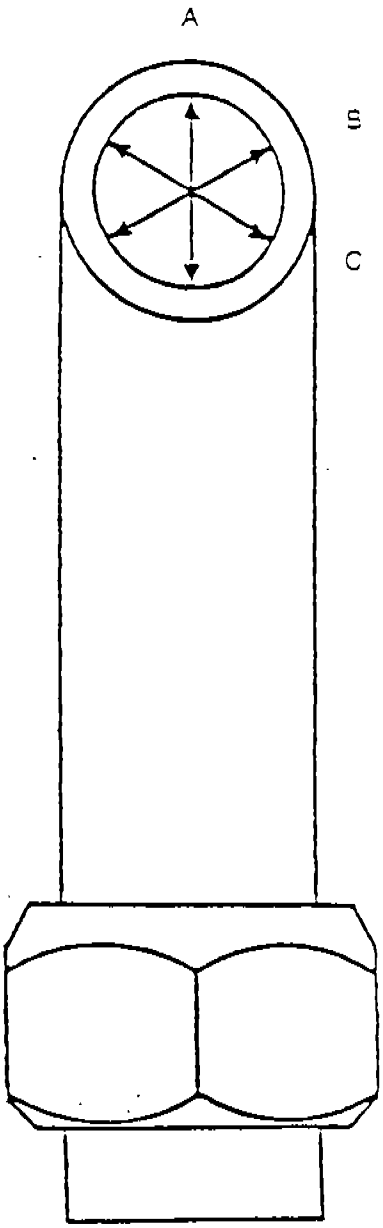
Nozzle Calibration

Sized By [illegible]

1 - AeroTherm
2 NuTech
3 ASME
4 Glass

All Dimensions are in inches.

Date	Nozzle	Dimension A	B	C	Difference	Avg. Diameter
10-20-93	2-36	.145	.146	.146	.001	.146
	2-37					
	2-38	.230	.230	.231	.001	.230
	2-39	.623	.624	.625	.002	.624
	2-40	.444	.446	.445	.002	.445
	2-41	.756	.756	.756	.000	.756
	2-42	.374	.375	.373	.002	.374
	2-43					
	2-44	.505	.505	.505	.000	.505
	2-45	.498	.499	.498	.001	.498
	2-46	.120	.120	.120	.000	.120
	2-47					
	2-48					
	2-49					
	2-50	.250	.252	.250	.002	.251
	2-51	.180	.180	.180	.000	.180
	2-52	.180	.179	.180	.001	.180
	2-53	.180	.178	.180	.002	.179
	2-54	.180	.180	.180	.000	.180
	2-55	.180	.180	.180	.000	.180
	2-56					
	2-57	.250	.251	.251	.001	.251
	2-58	.248	.248	.248	.000	.248
	2-59	.370	.370	.370	.000	.370
	2-60	.375	.375	.375	.000	.375
	2-61	.375	.375	.375	.000	.375
	2-62	.376	.375	.376	.001	.376
	2-63	.375	.375	.375	.000	.375
	2-64	.500	.500	.500	.000	.500
	2-65	.500	.500	.500	.000	.500
	2-66	.500	.500	.500	.000	.500
	2-67	.500	.500	.500	.000	.500
	2-68	.495	.495	.495	.000	.495
	2-69	.184	.184	.184	.000	.184
	2-70	.250	.250	.250	.000	.250



Total Source Analysis, Inc.
Environmental Testing Consultants

Nozzle Calibration

Sized By Wes Car.

1-Aerotherm

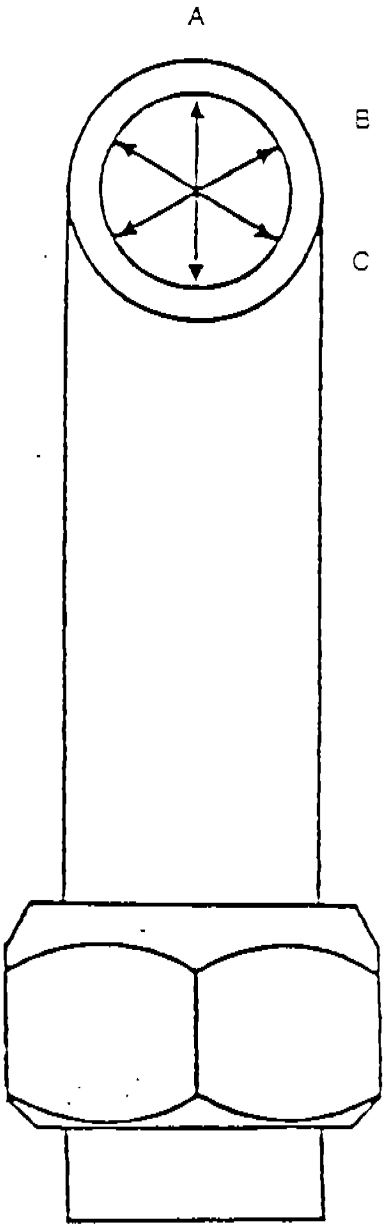
2-Nutech

3-ASME

4 Glass

Date	Nozzle	Dimension A	B	C	Difference	Avg. Diameter
10-20-93	2-71	.182	.183	.182	.001	.182
	2-72	.250	.252	.253	.003	.252
	2-73	.180	.181	.181	.001	.181
	2-74	.179	.180	.180	.001	.180
	2-75	.185	.185	.186	.001	.185
	2-76	.185	.185	.185	.000	.185
	2-77	.185	.186	.186	.001	.186
	2-78	.250	.250	.250	.000	.250
	2-79	.252	.251	.251	.001	.251
	2-80	.250	.250	.250	.000	.250
	2-81	.250	.252	.250	.002	.251
	2-82					
	2-83	.248	.248	.248	.000	.248
	2-84	.251	.252	.251	.001	.251
	2-85	.245	.245	.245	.000	.245
	2-86	.252	.251	.251	.001	.251
	2-87	.250	.250	.251	.001	.250
	2-88	.373	.373	.373	.000	.373
	2-89	.375	.375	.375	.000	.375
	2-90	.376	.376	.376	.000	.376
	2-91	.377	.377	.375	.002	.376
	2-92	.377	.375	.376	.002	.376
	2-93	.375	.375	.374	.001	.375
	2-94	.377	.376	.377	.001	.377
	2-95	.375	.375	.375	.000	.375
	2-96	.376	.375	.375	.001	.375
	2-97	.376	.376	.376	.000	.376
	2-98	.375	.375	.375	.000	.375
	2-99	.500	.500	.500	.060	.500
	2-100	.499	.499	.499	.060	.499
	2-101	.500	.500	.500	.000	.500
	2-102	.498	.500	.500	.002	.499
	2-103	.501	.502	.500	.002	.501
	2-104	.500	.500	.500	.000	.500
	2-105	.500	.500	.500	.000	.500

All Dimensions are in inches.



Total Source Analysis, Inc.
Environmental Testing Consultants

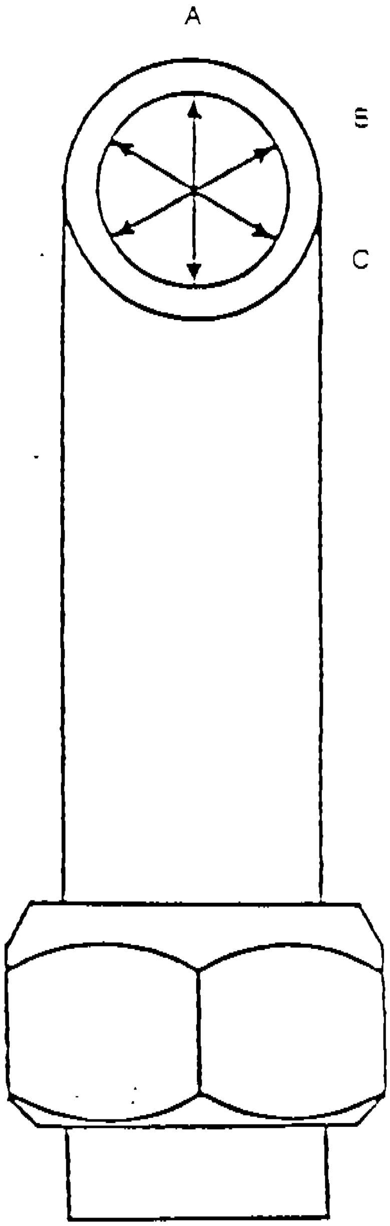
Nozzle Calibration

Sized By Wes [illegible]

1 AeroTherm
2 NuTech
3 ASME
4 Glass

Date	Nozzle	Dimension			Difference	Avg. Diameter
		A	B	C		
10-20-93	2-106	.499	.500	.500	.001	.500
	2-107	.501	.500	.500	.001	.500
	2-108	.501	.501	.501	.000	.501

All Dimensions are in inches.



Total Source Analysis, Inc.
Environmental Testing Consultants

Pitot Calibration Form

Client ______

Project No. 43-458-OH

Test Location Keg WASH Bottle WASH

Run By DAN J. DANIELS

Date 10-24-93

Pitot No. G-3-2-2

	● "A" Side Calibration			
Run No.	Δ P std cm H_2O (in. H_2O)	Δ P (s) cm H_2O (in. H_2O)	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(A)$
1	.86	1.20	.847	–
2	.86	1.20	.847	–
3	.86	1.20	.847	–
	Average	$\bar{C}_p$ (Side A)	.847	–

	●● "B" Side Calibration			
Run No.	Δ P std cm H_2O (in. H_2O)	Δ P (s) cm H_2O (in. H_2O)	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(B)$
1	.86	1.20	.847	–
2	.86	1.20	.847	–
3	.86	1.20	.847	–
	Average	$\bar{C}_p$ (Side B)	.847	–

Calculations:

$$C_p\ (s) = 0.99 \sqrt{\frac{\Delta P\ (\text{standard})}{\Delta P\ (s)}}$$

$$\text{Deviation} = C_{p(s)} - \bar{C}_p(A \text{ or } B)$$

$$\text{Average Deviation} = \sigma(A \text{ or } B) = \frac{\sum_{1}^{3} |C_p(s) - \bar{C}_p(A \text{ or } B)}{3}$$

$|\bar{C}_p(\text{Side A}) - \bar{C}_p(\text{Side B})|$ = .000

Nozzle size used for Calibrations (inches) .560

Intercomponent Spacings During Calibrations:

Pitot - Nozzle: 1/2 Z

* Pitot - Thermocouple: 1/2 Z

Pitot - Probe Sheath: 3

* or two inches from end of thermocouple to center line of pitot tube.

Dry Gas Meter Calibration Sheet

Client ______________________ Run By DANIELS, DAN

Project No. ______________________ Date 12-9-95

Module 09/N Barometric Press. 29.41

Orifice 2.95

ΔH in. H_2O	Vw initial	Vw final	Vw ft.^{3}	Vd initial	Vd final	Vd ft.^{3}	tw °F	tdi °F	tdo °F	td	Time θ min.
.5	641.590	645.670	4.080	543.735	547.897	4.162	62	73	67	70	10.0
1.0	645.840	651.530	5.690	548.074	553913	5.839	62	73	67	70	10.0
1.5	651.620	658.380	6.760	554.002	560938	6.936	62	75	69	72	10.0
2.0	623.330	631.270	7.940	525.071	533.168	8.097	62	71	64	67	10.0
3.0	631.520	641.470	9950	533.425	543599	10.174	62	75	69	72	100

ΔH	$\frac{\Delta H}{13.6}$	Mc(Y) $\frac{Vw\ Pb(td + 460)}{Vd(Pb + \Delta H/13.6)(tw + 460)}$	Yi	ΔH@ (For Small Orifice Only) $\frac{0.0317\Delta H}{Pb\ (td + 460)}\left[\frac{(tw + 460)\ \theta}{Vw}\right]^2$	ΔH@i
.5	.0368	.99		1.6645	
1.0	.0737	.99		1.7116	
1.5	.110	.99		1.8121	
2.0	.147	.99		1.7680	
3.0	.221	.99		16729	
Average		.99		1.7258	

ΔH = Orifice Setting

Vw = Volume of Gas of Wet Test Meter

Vd = Volume of Gas of Dry Gas Meter

tw = Temperature of Fluid in Wet Test Meter

tdi = Inlet Temperature of Dry Gas Meter

tdo = Outlet Temperature of Dry Gas Meter

td = Average Temperature of Dry Gas Meter

θ = Time required to pull specified cubic feet

Mc = Dry Gas Meter Correction Factor

ΔH@ = Orifice setting that would pull .75 cfm of air at standard conditions

Yi = Ratio of reading of wet test meter to dry test meter ±.02 from average

ΔH@i = Ha tolerance for individual values ±.20 from average.

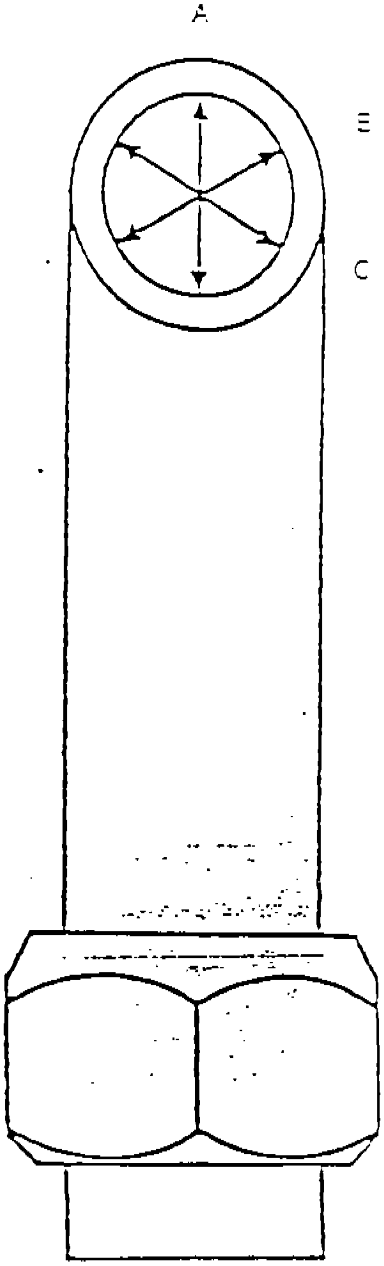
Nozzle Calibration

Sized By Wes Carr

1-Aerotherm
2-Nutech
3-ASME
4 Glass

All Dimensions are in inches.

Date	Nozzle	Dimension A	Dimension B	Dimension C	Difference	Avg. Diameter
11-1-93	2-71	.182	.183	.182	.001	.182
	2-72	.250	.252	.253	.003	.252
	2-73	.180	.181	.181	.001	.181
	2-74	.179	.180	.180	.001	.180
	2-75	.185	.185	.186	.001	.185
	2-76	.185	.185	.185	.000	.185
	2-77	.185	.186	.186	.001	.186
	2-78	.250	.250	.250	.000	.250
	2-79	.252	.251	.251	.001	.251
	2-80	.250	.250	.250	.000	.250
	2-81	.250	.252	.250	.002	.251
	2-82					
	2-83	.248	.248	.248	.000	.248
	2-84	.251	.252	.251	.001	.251
	2-85	.245	.245	.245	.000	.245
	2-86	.252	.251	.251	.001	.251
	2-87	.250	.250	.251	.001	.250
	2-88	.373	.373	.373	.000	.373
	2-89	.375	.375	.375	.000	.375
	2-90	.376	.376	.376	.000	.376
	2-91	.377	.377	.375	.002	.376
	2-92	.377	.375	.376	.002	.376
	2-93	.375	.375	.374	.001	.375
	2-94	.377	.376	.377	.001	.377
	2-95	.375	.375	.375	.000	.375
	2-96	.376	.375	.375	.001	.375
	2-97	.376	.376	.376	.000	.376
	2-98	.375	.375	.375	.000	.375
	2-99	.500	.500	.500	.000	.500
	2-100	.499	.499	.499	.000	.499
	2-101	.500	.500	.500	.000	.500
	2-102	.498	.500	.500	.002	.499
	2-103	.501	.501	.500	.002	.501
	2-104	.500	.500	.500	.000	.500
	2-105	.500	.500	.500	.000	.500



Thermocouple Calibrations

(~~Gas Meter; Impinger Outlet~~ [✓ Stack])

Client ______________________ Barometric Press 29.14

Project No. ______________________

Thermocouple Identification	Ice Bath		Boiling Water		Thermometer Number	Date
	Trendicator	Thermometer	Trendicator	Thermometer		
G-3-2A	32	32	208	208	ECA/PS 30755	11-30-93

Thermocouple Calibrations

([✓ Oven]/[✓ Probe])

Client ____________________ Barometric Press 29.14

Project No. ____________________

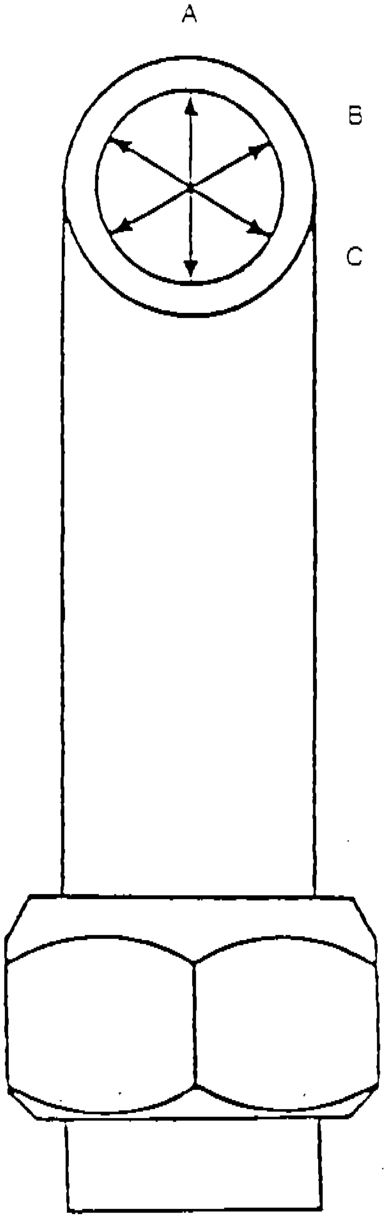
Thermocouple Identification	Trendicator	Thermometer	Thermometer Number	Date
G-3-2	258	258	GCA/DS 30755	1-30-93
#2 small oven	260	260	" "	" "
(Nutech)				

Nozzle Calibration

Sized By C. Scott (post calibration)
12-28-93

Date	Nozzle	Dimension			Difference	Avg. Diameter
		A	B	C		
12-28-93	N-72	.253	.252	.252	.001	.252
	N-96	.375	.375	.375	.000	.375

All Dimensions are in inches.



Total Source Analysis, Inc.
Environmental Testing Consultants

Pitot Calibration Form

Client ______

Project No. ______

Test Location ______

Run By C. Scott

Date 12-4-93

Pitot No. G-3-2-2

● "A" Side Calibration

Run No.	Δ P std cm H_2O (in. H_2O)	Δ P (s) cm H_2O (in. H_2O)	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(A)$
1	.86	1.20	.847	.00
2	.86	1.20	.847	.00
3	.86	1.20	.847	.00
Average		$\bar{C}_p$ (Side A)	.847	

●● "B" Side Calibration

Run No.	Δ P std cm H_2O (in. H_2O)	Δ P (s) cm H_2O (in. H_2O)	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(B)$
1	.86	1.20	.847	.00
2	.86	1.20	.847	.00
3	.86	1.20	.847	.00
Average		$\bar{C}_p$ (Side B)	.847	

Calculations:

$$C_p(s) = 0.99 \sqrt{\frac{\Delta P \text{ (standard)}}{\Delta P \text{ (s)}}}$$

$$\text{Deviation} = C_{p(s)} - \bar{C}_p(\text{A or B})$$

$$\text{Average Deviation} = \sigma(\text{A or B}) = \frac{\sum_{1}^{3} |C_p(s) - \bar{C}_p(\text{A or B})|}{3}$$

$|\bar{C}_p(\text{Side A}) - \bar{C}_p(\text{Side B})| =$ .000

Nozzle size used for Calibrations (inches) .560

Intercomponent Spacings During Calibrations:

Pitot - Nozzle: 1/2 ≥

* Pitot - Thermocouple: 1/2 ≥

Pitot - Probe Sheath: 3

* or two inches from end of thermocouple to center line of pitot tube.

Thermocouple Calibrations

([redacted], Probe)

Client

Barometric Press 29.11

Project No.

Glass Probes

Thermocouple Identification	Trendicator	Thermometer	Thermometer Number	Date
			GCA/PS 3075C	12-2-93
1 - 3ft	240	240		
2 - "	241	241		
3 - "	245	245		
4 - "	246	246		
1 - 5ft	242	242		
2 - "	244	244		
3 - "	243	243		
4 - "	244	244		
1 - 7ft	245	245		
2 - "	246	246		
1 - 10 ft	245	245		
2 - "	248	248		
3 - "	248	248		
4 - "	246	246		
1 - 12 ft	240	240		
2 - "	244	244		
3 - "	248	248		
1 - 15 ft	242	242		
2 - "	244	244		
3 - "	250	250		
4 - "	249	249		

Nutech

Thermocouple Calibrations

(Gas Meter [redacted])

Client ______________________ Barometric Press 29.11

Project No. ______________________

Thermocouple Identification	Ice Bath		Boiling Water		Thermometer Number	Date
	Trendicator	Thermometer	Trendicator	Thermometer		
					GCA1FS 20755	12-2-93
Meter #						
1 - inlet	35	35	206	206		
1 - outlet	35	35	206	206		
2 - inlet	33	33	210	209		
2 - outlet	33	33	210	209		
3 - inlet	34	34	211	211		
3 - outlet	35	34	211	210		
4 - inlet	35	35	210	210		
4 - outlet	35	35	210	210		
5 - inlet	34	34	207	207		
5 - outlet	34	34	207	207		
6 - inlet	33	33	210	210		
6 - outlet	33	33	210	210		
7 - inlet	35	35	211	211		
7 - outlet	35	35	211	211		
8 - inlet	34	34	209	209		
8 - outlet	34	34	209	209		
9 - inlet	35	35	207	207		
9 - outlet	35	35	207	207		
10 - inlet	33	33	209	209		
10 - outlet	34	33	209	210		
11 - inlet	34	33	205	205		
11 - outlet	33	33	205	205		
12 - inlet	34	34	210	210		
12 - outlet	35	34	210	210		
14 - inlet	33	33	209	209		
14 outlet	33	33	209	209		

Thermocouple Calibrations

(Oven, [redacted])

Client ______

Barometric Press 29.54

Project No. ______

Nutech Ovens

Thermocouple Identification	Trendicator	Thermometer	Thermometer Number	Date
Nutech			GCA/PS 30755	12-2-93
LARge OVEN#				
1	201	200		
2	200	200		
3.	205	206		
4	203	202		
5	204	203		
Nutech				
SMALL OVEN#				
1	205	204		
2	203	204		
3	201	202		

Nutech

Thermocouple Calibrations

(~~[illegible]~~, Impinger Outlet ~~Stack~~)

Client ______

Barometric Press 29.11

Project No. ______

Thermocouple Identification	Ice Bath		Boiling Water		Thermometer Number	Date
	Trendicator	Thermometer	Trendicator	Thermometer		
					GCA/PS 30755	12-2-93
IMPINGER #						
1	33	33	208	208		
2	34	34	210	210		
3	33	33	210	210		
4	33	33	207	207		
5	34	34	207	207		
6	33	33	207	207		
7	33	33	209	209		
8	34	34	211	211		
9	33	33	209	209		
10	33	33	210	210		
11	35	35	211	211		
12	36	35	208	208		

APPENDIX H
SAMPLE VOLUME FOR FACILITY TESTS

Miller Brewing Company
Fulton, New York

EMISSION INVENTORY REPORT

JANUARY 1994

SAMPLE VOLUME FOR FACILITY TESTS

WASTEWATER PLANT

Sample ID	Rota ID	Qrr (Lpm)	Pcal/Tcal (in. Hg/°R)	Tsrc (°R)	Psrc (in.Hg)	%H20 (%)	t (minutes)	SV (Liters)
EWWT 2.1	R2	0.983	0.054	501.25	29.54	0	30	26.94
EWWT 2.2	R2	0.988	0.054	502.3	29.55	0	30	27.12
EWWT 2.3	R2	1.0006	0.054	504.16	29.54	0	30	27.58

SV = Qrr (Tsrc / Tcal) (Pcal / Psrc) (1 / (1-%H20 / 100)) t
SV = corrected sample volume
Qrr = sample pump flow rate per avg. rotometer value
Tsrc= ° F + 460°R (source temp.)
Tcal = ° F + 460°R (calibration temp.)
Psrc= Pb.src - Pv.src
Pcal = (Pb.cal-Pv.cal)
t = sampling duration
%H20= moisture content at source

APPENDIX H

SAMPLE VOLUME FOR FACILITY TESTS

ROTAMETER CALIBRATION VALUES

ROTAMETER #1			ROTAMETER #2			ROTAMETER #3		
R1 (units)	Pre (Lpm)	Post (Lpm)	R2 (units)	Pre (Lpm)	Post (Lpm)	R3 (units)	Pre (Lpm)	Post (Lpm)
115	0.6647	0.6699	80	0.6682	0.6666	70	0.5902	0.5882
120	0.7009	0.7003	85	0.7114	0.7212	75	0.6477	0.6424
125	0.7266	0.7381	90	0.755	0.76	80	0.6889	0.6902
140		0.8049	100	0.8572	0.8513	100	0.864	0.8584
145		0.8499	110	0.965	0.9497	110	0.9658	0.963
150	0.9022	0.8992	120	1.062	1.0258	120	1.056	1.037
155		0.9173	130	1.143				
158	0.9337							
Pcal	29.72	29.9	Pcal	29.71	29.89	Pcal	29.7	29.89
Tcal	78	76	Tcal	77	76	Tcal	76	75
Avg. Pcal	28.87		Avg. Pcal	28.88		Avg. Pcal	28.8	
Avg. Tcal	537		Avg. Tcal	536.5		Avg. Tcal	535.5	
Avg, Pcal/Tcal	0.05376		Avg, Pcal/Tcal	0.0538		Avg. Pcal/Tcal	0.05378	

R1,2,3 = Rotameter #1, #2, #3
Pre = Pretest flow rate
Post = Post Test Flow Rate
Units = Rotameter Scale Reading
Pcal = Calibration atmospheric pressure
Tcal = Calibration Temperature
Avg. Pcal = Average atmospheric pressure during calibration
Avg. Tcal = Average atmospheric pressure during calibration

SAMPLE VOLUME FOR FACILITY TESTS

BREWHOUSE

Sample ID	Rota ID	Qrr (Lpm)	Pcal/Tcal (In.Hg/ R)	Tsrc (R)	Psrc (In.Hg)	%H20 (%)	t (minutes)	SV (Liters)
K1	R1	0.648	0.054	602	29.35	20.7	88	79.28
K2	R1	0.681	0.054	595	29.52	12.3	88	74.03
K3	R2	0.688	0.054	573	30.01	9.5	90	70.29
LT1	R3	0.965	0.054	613	29.35	27.2	90	134.08
LT2	R3	0.912	0.054	589	29.55	14.7	90	103.19
LT3	R3	0.957	0.054	604	30.00	21.8	90	119.20
MT1	R2	0.7575	0.054	520	29.34	1.7	60	44.13
MT2	R2	0.7575	0.054	506.5	29.56	1.1	58	40.96
MT3	R1	0.685	0.054	513.3	29.45	1.4	60	39.06
C1	R1	0.685	0.054	667.4	30.00	90.5	20	172.09
C2	R1	0.704	0.054	667.4	30.00	90.5	20	176.86
C3	R1	0.685	0.054	667.4	30.00	90.5	20	172.09
VOC-CS-WT1	P	1	0.056	590	29.92	15.1	6	7.84
Na-BH-K1	R2	0.983	0.054	503.5	29.67	0.9	30	27.20

SV = Qrr (Tsrc / Tcal) (Pcal / Psrc) (1 / (1-%H20 / 100)) t

SV = corrected sample volume
Qrr = sample pump flow rate per avg. rotameter value
Tsrc =°F + 460°R (source temp.)

Tcal =° F + 460°R (calibration temp.)
Psrc = Pb.src - Pv.src
Pcal = (Pb.cal-Pv.cal)
t = sampling duration
%H20= moisture content at source

SAMPLE VOLUME FOR FACILITY TESTS

COLD SERVICES

Sample ID	Rota ID	Qrr (Lpm)	Pcal/Tcal (InHg/°R)	Tsrc (°R)	Psrc (in.Hg)	%H20 (%)	t (minutes)	SV (Liters)
Na-CS-FB1.1	R2	1.04	0.054	530	29.15	2.5	15	15.65
Na-CS-FB1.2	R2	1.04	0.054	530	29.15	2.5	15	15.65
Na-CS-FB1.3	R2	1.04	0.054	530	29.15	2.5	15	15.65
Cl-CS-B3.1	R2	1.04	0.054	530	29.15	2.5	15	15.65
E-CS-HW.1	R3	0.585	0.054	500.5	29.8	0.8	30	15.99
E-CS-HW.2	R3	0.6	0.054	500.5	29.76	0.8	30	16.42
E-CS-HW.3	R3	0.6	0.054	500.5	29.73	0.8	30	16.44
E-CS-HW.4	R3	0.6	0.054	500.5	29.64	0.8	30	16.49
E-CS-HW.5	R3	0.589	0.054	500.5	29.45	0.8	30	16.29
E-CS-IV.1	R3	0.572	0.054	500.5	29.8	0.8	30	15.63
E-CS-IV.2	R3	0.598	0.054	500.5	29.76	0.8	30	16.36
E-CS-IV.3	R3	0.598	0.054	500.5	29.73	0.8	30	16.37
E-CS-IV.5	R3	0.589	0.054	500.5	29.45	0.8	30	16.29
E-CS-IV.7	R3	0.589	0.054	500.5	29.4	0.8	30	16.32
E-CS-PFII	P	1	0.055	490	29.08	0.6	2.08	1.95
E-CS-FC.1	P	1	0.055	520	29.1	1.7	2	2.01
E-CS-CFT 25.1	P	2	0.056	488	29.2	0.0	2	3.71
E-CS-SYT 34.1	P	2	0.056	505	29.2	1.0	2	3.88
E-CS-FC8.1	P	1	0.056	500	29.2	0.8	4	3.83
E-CS-FC8.2	P	1	0.056	512	29.2	1.3	4	3.94
E-CS-FERM B3.2	P	2	0.056	512	29.2	1.3	2	3.94
E-CS-FERM B3.3	P	2	0.056	512	29.2	1.3	2	3.94
E-CS-FERM B3.4	P	2	0.056	512.5	29.2	1.3	2	3.95
E-CS-FERM B3.5	P	2	0.056	514.3	29.2	1.4	2	3.97
E-CS-FERM B3.6	P	2	0.056	514.8	29.2	1.5	2	3.97
E-CS-FERM B3.7	P	2	0.056	516	29.2	1.5	1.95	3.88
E-CS-FERM B3.8	P	2	0.056	516.5	29.2	1.5	1.5	2.99
E-CS-FERM B3.9	P	2	0.056	518.5	29.2	1.7	1.5	3.01
E-CS-FERMB3.10	P	1	0.056	520	29.2	1.7	0.5	0.50
E-CS-FERM C2.1	P	1	0.056	512	29.2	1.3	0.5	0.49
E-CS-2x2.1	R3	1.047	0.054	511	28.79	1.3	30	30.36
VOC-CS-2x2.1	R3	1.047	0.054	511	28.79	1.3	30	30.36

SV = Qrr (Tsrc/Tcal) (Pcal/Psrc) (1/(1-%H20/100))t
SV = corrected sample volume
Qrr = sample pump flow rate per avg. rotameter value
Tsrc = °F + 460°R (source temp.)
Tcal = °F + 460°R (calibration temp.)
Psrc = Pb. src - Pv. src
Pcal = (Pb. cal - Pv. cal)
t = sampling duration
%H20= moisture content at source

SAMPLE VOLUME FOR FACILITY TESTS

UTILITIES

Sample ID	Roto ID	Qrr (Lpm)	Pcal/Tcal (in.Hg/°R)	Tsrc (°R)	Psrc (in.Hg)	%H20 (%)	t (minutes)	SV (Liters)
EU-CREGN.1	P	2	0.056	545	29.20	0	2	4.14
EU-CREGN.2	P	2	0.056	569	29.20	0	2	4.33
EU-CREGN.3	P	2	0.056	597	29.20	0	3	6.81
EU-CREGN.4	P	2	0.056	628	29.20	0	3	7.16
EU-CREGN.5	P	2	0.056	645	29.20	0	3	7.36
EU-CREGN.6	P	2	0.056	659	29.20	0	3	7.52
EU-CREGN.7	P	2	0.056	669	29.20	0	3	7.63
EU-EXH-C2.1	R2	0.6215	0.054	532	28.80	2.64	30	19.04
EU-EXH-C9.1	R2	0.625	0.054	532	28.80	2.64	30	19.15
NH3-U.1	R3	0.2	0.054	508	29.13	0	30	5.63
NH3-U.2	R3	0.2	0.054	507.5	29.13	0	30	5.62
NH3-U.3	R3	0.2	0.054	507	29.15	0	30	5.61
NH3-U.4	R3	0.2	0.054	506.5	29.14	0	30	5.61
CL-U.1	R1	0.911	0.054	508	29.13	0	30	25.62
CL-U.2	R1	0.866	0.054	507.5	29.13	0	30	24.33
CL-U.3	R1	0.85	0.054	507	29.15	0	30	23.85
EU-CO2-S.1	P	1	0.061	480	29.20	0	4	4.00
EU-CO2-S2.1	P	1	0.061	480	29.20	0	4	4.00
EU-CO2-STT.1	P	1	0.061	480	29.20	0	4	4.00
EU-CO2-S3.1	P	1	0.061	480	29.20	0	4	4.00
EU-CO2-S1.1	P	1	0.061	480	29.20	0	4	4.00

SV = Qrr (Tsrc/Tcal) (Pcal/Psrc) (1/(1-%H20/100))t
SV = corrected sample volume
Qrr = sample pump flow rate per avg. rotameter value
Tsrc = ° F + 460°R(source temp.)
Tcal = ° F + 460°R(calibration temp.)
Psrc = Pb. src - Pv. src
Pcal = (Pb. cal - Pv cal)
T = sampling duration
%H20 = moisture content at source

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SAMPLE VOLUME FOR FACILITY TESTS

ANNEX

Sample ID	Rota ID	Qrr (Lpm)	Pcal/Tcal (in Hg/°R)	Tsrc (°R)	Psrc (in.Hg)	%H20 (%)	t (minutes)	SV (Liters)
EA-CW.1	R2	0.663	0.054	539	28.44	3.34	30	20.99
EA-CW.2	R2	0.684	0.054	540	28.44	3.45	30	21.72
EA-CW.3	R2	0.684	0.054	540	28.43	3.45	30	21.73
EA-IB9.1	R2	0.642	0.054	531	28.75	2.56	30	19.65
EA-IB9.2	R2	0.667	0.054	532	28.68	2.64	30	20.53
EA-IB9.3	R2	0.667	0.054	531	28.75	2.56	30	20.43

SV = corrected sample volume
Qrr = sample pump flow rate per avg. rotameter value
Tsrc = ° F + 460° R (source temp.)
Tcal = ° F + 460° R (calibration temp.)
Psrc = Pb.src - Pv.src
Pcal = (Pb.cal-Pv.cal)
t = sampling duration
%H20= moisture content at source

SAMPLE VOLUME FOR FACILITY TESTS

PACKAGING

Sample ID	Rota ID	Qrr (Lpm)	Pcal/Tcal (inHg/°R)	Tsrc (R)	Psrc (in.Hg)	%H20 (%)	t (minutes)	SV (Liters)
EE-P-EF2.1	P	1	0.057	530	29.92	2.5	30	30.99
EE-P-EF2.2	P	1	0.057	530	29.92	2.5	30	30.99
EE-P-EF2.3	P	1	0.057	530	29.92	2.5	30	30.99
EP-B13-A.1	R2	0.625	0.054	538	28.59	3.2	30	19.63
EP-B13-A.2	R2	0.625	0.054	539	28.56	3.3	30	19.71
EP-B13-B.1	R2	0.625	0.054	538	28.59	3.2	30	19.63
EP-B13-B.2	R2	0.625	0.054	539	28.56	3.3	30	19.71
EP-C9-A.1	R2	0.68	0.054	538	28.58	3.2	30	21.36
EP-C9-A.2	R2	0.625	0.054	538	28.54	3.2	30	19.66
EP-C9-A.3	R2	0.626	0.054	537	28.56	3.1	30	19.62
EP-C9-B.1	R2	0.647	0.054	538	28.54	3.2	30	20.35
EP-C9-B.2	R2	0.651	0.054	539	28.49	3.3	30	20.58
EP-B4-A.1	R1	0.733	0.054	530	28.80	2.5	30	22.31
EP-B4-A.2	R1	0.738	0.054	528	28.84	2.3	30	22.31
EP-B4-A.3	R1	0.757	0.054	532	28.75	2.6	30	23.21
EP-B4-B.1	R1	0.711	0.054	533	28.73	2.7	30	21.87
EP-B4-B.2	R1	0.664	0.054	535	28.63	2.9	30	20.61
EP-B4-B.3	R1	0.653	0.054	534	28.65	2.8	30	20.21
EP-B5.1	R1	0.726	0.054	515	29.06	1.5	32	22.47
EP-B5.2	R1	0.65	0.054	515	29.11	1.5	34	21.33
EP-BD-13.1	R2	0.676	0.054	516	28.71	1.5	30	19.92
EP-BD-13.2	R2	0.676	0.054	519	28.65	1.7	30	20.12
EP-BD-13.3	R2	0.684	0.054	516	28.69	1.5	22	14.79
EP-RC.1	R2	0.67	0.054	511	28.79	1.3	30	19.45
EP-RC.2	R2	0.684	0.054	511	28.78	1.3	30	19.87
EPR TANK HEAD	P	2	0.054	500	29.20	0.8	1	1.92
F-P.1	R2	0.6	0.054	532	28.68	2.6	20	12.31
F-P.2	R2	0.6	0.054	532	28.68	2.6	20	12.31
F-P.3	R2	0.6	0.054	532	28.65	2.6	20	12.32
EP-EF29.1	R3	0.621	0.054	531	28.40	2.6	30	19.23
EP-EF29.2	R3	0.606	0.054	531	28.39	2.6	30	18.77
EP-EF29.3	R3	0.606	0.054	531	28.39	2.6	30	18.77
CL-P-B5.1	R1	0.918	0.054	515	29.10	1.5	30	26.60
CL-P-B5.2	R1	0.898	0.054	515	29.11	1.5	30	26.01
CL-P-B5.3	R1	0.916	0.054	515	29.06	1.5	30	26.57
CL-P-B13.1	R1	0.901	0.054	537	28.23	3.1	30	28.53
CL-P-B13.2	R1	0.850	0.054	538	28.18	3.2	30	27.05

SV = Qrr (Tsrc / Tcal) (Pcal / Psrc) (1 / (1-%H20 / 100)) t
SV = corrected sample volume
Qrr = sample pump flow rate per avg. rotometer value
Tsrc = °F + 460 R (source temp.)
Tcal = °F + 460 R (calibration temp.)
Psrc = Pb.src - Pv.src
Pcal = (Pb.cal-Pv.cal)
t = sampling duration
%H20= moisture content at source

APPENDIX I
SOURCE FLOW RATES DURING STACK TEST

Miller Brewing Company
Fulton, New York

EMISSION INVENTORY REPORT

JANUARY 1994

APPENDIX I

SOURCE FLOW RATES DURING STACK TEST

EPA Method 2 Flow Traverse, Source Volume Displacement & Estimated Values

BREWHOUSE

Sample ID	Stack Diameter (inches)	Stack Area (ft^2)	Pb (in. Hg)	Pg (in. H20)	Stack Gas Mol. Wt.	Pitot Coefficient
K1	42.00	9.62	29.33	0.24	26.60	0.84
K2	42.00	9.62	29.33	0.19	27.50	0.84
K3	42.00	9.62	30.00	0.12	27.80	0.84
LT1	24.00	3.14	29.33	0.03	25.90	0.84
LT2	24.00	3.14	29.33	0.04	27.20	0.84
LT3	24.00	3.14	30.00	0.05	26.50	0.84
MT1	16.00	1.40	29.33	0.12	28.70	0.84
MT2	16.00	1.40	29.33	0.12	28.70	0.84
MT3	16.00	1.40	30.00	0.12	28.70	0.84
C1	16.00	1.40	30.00	0.05	19.00	0.84
C2	16.00	1.40	30.00	0.05	19.00	0.84
C3	16.00	1.40	30.00	0.05	19.00	0.84
VOC-CS-WT1						
Na-BH-K1						

Sample ID	Average Sqrt. delta-P (in. H2O)	Average Ts (°F)	Average Tst (°R)	Ps (in. Hg)	Exit Velocity (ft/s)	Q Actual Gas Flow Rate (acfm)
K1	0.47	142.00	602.00	29.35	29.42	16982
K2	0.47	134.50	594.50	29.34	28.75	16599
K3	0.39	112.70	572.70	30.01	23.38	13498
LT1	0.10	153.00	613.00	29.33	6.45	1216
LT2	0.07	129.00	589.00	29.33	4.38	826
LT3	0.10	144.00	604.00	30.00	6.26	1180
MT1	0.03	60.00	520.00	29.34	1.78	149
MT2	0.07	46.50	506.50	29.34	3.95	331
MT3	0.05	53.25	513.25	29.34	2.87	240
C1	0.23	207.35	667.35	30.00	17.99	1507
C2	0.23	207.35	667.35	30.00	17.99	1507
C3	0.23	207.35	667.35	30.00	17.99	1507
VOC-CS-WT1						228
Na-BH-K1						577

SOURCE FLOW RATES DURING STACK TEST
EPA Method 2 Flow Traverse, Source Volume Displacement & Estimated Values

COLD SERVICES

Sample ID	Stack Diameter (inches)	Stack Area (ft^2)	Exit Velocity (ft/min)	Q Actual Gas Flow Rate (acfm)
Na-CS-FB1.1	33	6	30	180
Na-CS-FB1.2	33	6	30	180
Na-CS-FB1.3	33	6	30	180
Cl-CS-B1.1	33	6	30	180
E-CS-HW.1		29	1070	30500
E-CS-HW.2		29	1070	30500
E-CS-HW.3	729	29	1070	30500
E-CS-HW.5		29	1070	30500
E-CS-IV.1	80.1	35	1075	37600
E-CS-IV.2	80.1	35	1075	37600
E-CS-IV.3		35	1075	37600
E-CS-IV.5		35	1075	37600
E-CS-PFII				2
E-CS-FC.1				1
E-CS-CFT25.1	1.5	0.0123	325	4
E-CS-SYT34.1	4	0.087	300	26
E-CS-FERM B3.1	6	0.2	5	1
E-CS-FERM B3.2	6	0.2	5	1
E-CS-FERM B3.3	6	0.2	10	2
E-CS-FERM B3.4	6	0.2	10	2
E-CS-FERM B3.5	6	0.2	10	2
E-CS-FERM B3.6	6	0.2	10	2
E-CS-FERM B3.7	6	0.2	135.6	27.1
E-CS-FERM B3.8	6	0.2	191.18	38.2
E-CS-FERM B3.9	6	0.2	295	47.9
E-CS-FERM B3.10	6	0.2	282.8	56.6
E-CS-2x2.1	21.3	3.25	1150	3738

SOURCE FLOW RATES DURING STACK TEST
EPA Method 2 Flow Traverse, Source Volume Displacement & Estimated Values

UTILITIES

Sample ID	Stack Diameter (inches)	Stack Area (ft^2)	Exit Velocity (ft/sec)	Actual Gas Flowrate (acfm)
EU-CREGN.1	6	0.2	1550	310
EU-CREGN.2	6	0.2	1400	280
EU-CREGN.3	6	0.2	1500	300
EU-CREGN.4	6	0.2	1800	353
EU-CREGN.5	6	0.2	1500	300
EU-CREGN.6	6	0.2	1350	265
EU-CREGN.7	6	0.2	2350	461
EU-EXH-C2.1	62.4	27	600	16200
EU-EXH-C9.1	62.4	27	600	16200
NH3-U.1				AMB
NH3-U.2				AMB
NH3-U.3				AMB
NH3-U.4				AMB
CL-U.1				AMB
CL-U.2				AMB
CL-U.3				AMB
EU-CO2-S.1				TANK
EU-CO2-S2.1				TANK
EU-CO2-STT.1				TANK
EU-CO2-S3.1				TANK
EU-CO2-S1.1				TANK

SOURCE FLOW RATES DURING STACK TEST
EPA Method 2 Flow Traverse, Source Volume Displacement & Estimated Values

PACKAGING

Sample ID	Stack Diameter (inches)	Stack Area (ft^2)	Exit Velocity (ft/sec)	Q Actual Gas Flow Rate (ACFM)
EE-P-EF2.1	48	12.6	1071	13500
EE-P-EF2.2	48	12.6	1071	13500
EE-P-EF2.3	48	12.6	1071	13500
EP-B13-A.1	48	12.6	1596	20106
EP-B13-A.2	48	12.6	1596	20106
EP-B13-B.1	48	12.6	1071	13500
EP-B13-B.2	48	12.6	1071	13500
EP-C9-A.1	48	12.6	1071	13500
EP-C9-A.2	48	12.6	1071	13500
EP-C9-A.3	48	12.6	1071	13500
EP-C9-B.1	48	12.6	1071	13500
EP-C9-B.2	48	12.6	1071	13500
EP-B4-A.1	48	12.6	1071	13500
EP-B4-A.2	48	12.6	1071	13500
EP-B4-A.3	48	12.6	1071	13500
EP-B4-B.1	48	12.6	1071	13500
EP-B4-B.2	48	12.6	1071	13500
EP-B4-B.3	48	12.6	1071	13500
EP-B5.1	21	2.41	1850	6013
EP-B5.2	21	2.41	1850	6013
EP-B5.3	21	2.41	1850	6013
EP-BD-13.1	48	12.6	198	2500
EP-BD-13.2	48	12.6	198	2500
EP-BD-13.3	48	12.6	198	2500
F-P.1	48	13	1080	13500
F-P.2	48	13	1080	13500
F-P.3	48	13	1080	13500
EP-EF29.1	48	13	1080	13500
EP-EF29.2	48	13	1080	13500
EP-EF29.3	48	13	1080	13500
CL-P-B5.1	24	3	1850	6013
CL-P-B5.2	24	3	1850	6013
CL-P-B5.3	24	3	1850	6013
CL-P-B13.1	48	13	1608	20106
CL-P-B13.2	48	13	1608	20106

SOURCE FLOW RATES DURING STACK TEST
EPA Method 2 Flow Traverse, Source Volume Displacement & Estimated Values

ANNEX

Sample ID	Stack Diameter (inches)	Stack Area (ft^2)	Exit Velocity (ft/sec)	Actual Gas Flowrate (acfm)
EA-CW.1	Indoor Sample			
EA-CW.2	Indoor Sample			
EA-CW.3	Indoor Sample			
EA-IB9.1	Indoor Sample			
EA-IB9.2	Indoor Sample			
EA-IB9.3	Indoor Sample			

BREWHOUSE- HEATING-VENTILATING-AIR CONDITIONING-AND AIR HANDLING UNITS - BREWHOUSE

EQUIP NO.	LOCATION	AREA SERVING	MAKE	TYPE	SERIAL NO.	MOTOR	HP	FRAME	MOTOR RPM	FAN RPM	CFM	BELT SIZE	QTY	PM ISS'D	REMARKS
646P1	3RD FLR HVAC ROOM	OFFICE AREA	BELL/GOSSET	CHILLED WATER	172555	AC	1.5	145TZ	1725						ID M98544
647P1	3RD FLR HVAC ROOM	OFFICE AREA	BELL/GOSSET	HOT WATER CONVERTER	172546	AC	.75	—	1750				1		ID·MAGCOG7606-B
659A1	3RD FLR HVAC ROOM	3RD FLR LOCKER AND RESTROOM	TRANE	HV/AC	KSF291575	CENTURY	1	143T	1740			A37	2	X	1EA 24X24X2
661C1	1ST FLR CEILING BY ELEVATOR	MEZZANIE AND CORRIDOR VENT	GREEN HECK	SUPPLY FAN	328417	RELIANCE	1/2	ED56	1725			4L 520	1	X	
662C1	4TH FLR ROOF	MEZZANIE AND CORRIDOR EXHAUST		EXHAUST	309P421	AC	1/4	D48	1725		1620	3L 280	1	X	
1619A1	2ND FLR HVAC ROOM	1ST FLOOR EAST	YORK	HV		MARATON	25	284T	1760			B124	3	X	CS528-FOAFY 1-4FT+1-2FT ROLL 76731039-H-2
1620A1	3RD FLR HVAC ROOM	3RD FLOOR EAST	YORK	HV		MARATON	30	286T	1760			B124	4	X	CS528-FA-AFY 1-4FT+1-2FT ROLL 76 731039-H-5
1621A1	3RD FLR HVAC ROOM	2ND FLOOR EAST	YORK	HV		MARATON	30	286T	1760			B128	4	X	CS-528-FU AFY 1-4FT 1-2FT ROLL 76 731039-H-11
1622A1	4TH FLOOR EAST	4TH FLOOR EAST	YORK	HV		MARATON	3	182T	1725			A48	1	X	OS 32 FOLPY 76-731039-H-5
1622C1	4TH FLOOR EAST	4TH FLOOR EAST		EXHAUST		G.E	.25		850					X	MOTOR 5K45MG2922
1623A1	5TH FLOOR EAST	5TH FLOOR EAST	YORK	HV		MARATON	2	145T	1740			A48	1	X	OS32-FC-FOWY SER-24x34-2 76-731039-H-5
1629A1	6TH FLOOR EAST	6TH FLOOR EAST	YORK	HV		MARATON	3	182T	1725			A74	2	X	CS-113-FO-FCLP SER-24x24 76-731039-H-6
1626C1	4TH FLOOR ROOF	LOCKER ROOM 3RD FLOOR		EXHAUST	311P130A	AC	1/4	056	1725			2L10	1	X	
1691A1	D.E MIXING RM 1ST FLR	D.E MIXING RM 1ST FLR	TRANE	HV	K79M70703	MARATHON	2	145T	1725			A60	1	X	1-4FT-1-2FT ROLL
1691C1	DE MIXING RM 1ST FLR	D.E. MIXING RM 1ST FLR		EXHAUST	327P103	WESTINGHOUSE	1	D56	1725			4L 300	1	X	
695X1	4TH FLR ROOF	OFFICE AREA	TRANE	CONDENSER FANS	SE12921	CENTURY	1	L56Z	1140				1		
?	2ND FLR EAST MODICON RM	2ND FLR EAST MODICON ROOM	WESTINGHOUSE	AC	MGF02										
?	2ND FLR WEST MODICON ROOM	2ND FLR WEST MODICON ROOM		AC											
1692C1	ROOF OF DE. WHSE	D.E WHSE		EXHAUST											
1692C2	ROOF OF DE WHSE	D.E WHSE		EXHAUST											
1692C3	ROOF OF D.E. WHSE	D.E WHSE		EXHAUST											
565C1	ROOF GRAINS DRYING	GRAINS DRYING TOILET ROOM	PVC	EXHAUST											

REVISED 11-5-81

⑦ WAS SH76

BREWHOUSE- HEATING-VENTILATING-AIR CONDITIONING-AND AIR HANDLING UNITS - BREWHOUSE

EQUIP NO.	LOCATION	AREA SERVING	MAKE	TYPE	SERIAL NO.	MOTOR	HP	FRAME	MOTOR RPM	FAN RPM	CFM	BELT SIZE	QTY	PM ISS'D	REMARKS
528C1	2ND FLR COLD SERVICE ELEC RM	2ND FLR COLD SERVICE ELEC RM	BUFFALO FORGE	INTAKE		WESTING HOUSE	2		1160			NONE	NONE		
619A1	3RD FLR HVAC ROOM	3RD FLOOR WEST LAUTER TUN AREA	TRANE	HV	K5F292849	CENTURY	10	215T	1750		16,000	B80	2	X	4FT FILTER ROLL
620A1	1ST FLR ELEC EQUIP ROOM	SUPPLY TO 1ST FLR ELEC EQUIP RM	TRANE	HV	K5F291584	CENTURY	5	184T	1745		10,100	B60	2	X	4EA - 16X20X2 5EA - 20X20X2
621A1	3RD FLR HVAC ROOM	1ST FLOOR EAST	TRANE	HV	K5F292440	AJAX	15	254T	1755		28,750	B118	3	X	6FT FILTER ROLL
622A1	3RD FLR HVAC ROOM	1ST FLR WEST BREWKETTLE AREA	TRANE	HV	K5F292411	AJAX	15	254T	1755		28,750	B116	2	X	6FT FILTER ROLL
623A1	2ND RR PLATFORM SOUTH BREWHOUSE	SOUTH BREWHOUSE AREA	TRANE	HV	K5F292439		15	254T	1755		25,000	B105	2	X	6FT FILTER ROLL
624A1	3RD FLR HVAC ROOM	OFFICE AREA AND LOBBY	TRANE	HV/AC	K5F291609	CENTURY	5	184T	1745			B56	2	X	21FT FILTER ROLL
625A1	3RD FLR HVAC ROOM	2ND AND 3RD FLR WEST	TRANE	HV	K5F292848	AJAX	15	254T	1755		19,800	B100	2	X	56" FILTER ROLL
626A1	3RD FLR HVAC ROOM	MAKE UP SYSTEM BREWKETTLE AREA	TRANE	HV	K5F292847	MARATON	20 5	286T	1770 880		35000 17500	B118	3	X	6FT FILTER ROLL
627A1	1ST FLR NORTH CEILING	LOCKER & BREAK RM FLR 2R	TRANE	HV/AC	K5F291573	CENTURY	1.5	145T	1740		2550	A48	1	X	
628A1	2ND FLR WEST MODICON RM	WEST MODICON ROOM	TRANE	HV/AC		CENTURY	1	143T	1740		1200	A31	1	/	UNIT SHUTDOWN REPLACED W/WALL UNIT
629A1	3RD FLR ELEC EQUIP ROOM	3RD FLOOR ELEC EQUIP ROOM	TRANE	HV/AC	K5F291585	CENTURY	1/2	143T	1725		1350	TAUREX 3930	1	X	1EA - 24X24X2
630C1	1ST FLR ELEC EQUIP ROOM	1ST FLR ELEC EQUIP ROOM	WESTERN AXIAL	EXHAUST		LINCOLN	3	182T	1755			A60	2	X	VXO-3011256-H 424-1.
631C1	3RD FLR HVAC ROOM	1ST FLOOR WEST SIDE WEST B/H	WESTERN AXIAL	RETURN RELIEF		LINCOLN	15	254T	1750		26,090	B79	4	X	XVO-421120-H 424-2
632C1	3RD FLR HVAC ROOM	1ST FLOOR EAST SIDE WEST B/H	WESTERN AXIAL	EXHAUST		LINCOLN	20	254T	1750		28,750	B80	3	X	XVO-18535-K 424-3
634C1	3RD FLR HVAC ROOM	BREWHOUSE OFFICES	WESTERN AXIAL	EXHAUST		WESTINGHOUSE	2	145T	1725					X	VXO-18535K 424-4
635C1	3RD FLR HVAC ROOM	2ND AND 3RD FLOORS WEST	WESTERN AXIAL	EXHAUST		LINCOLN	5	184T	1745		16,970	B61	2	X	VXO36420-M 424-5
636C1	4TH FLOOR ROOF	?		EXHAUST	309P421	AC	1/4	D48	1725		1250	3L 280	1	X	
637C1	4TH FLOOR ROOF	?		EXHAUST	309P421	AC	1/4	D48	1725			3L 260	1	X	
638C1	6TH FLOOR ROOF	ELEVATOR ROOM OVER 6TH FLR	PVC	VENT	309P421	WESTING HOUSE	1/4	D48	1750			3L 250	1	X	
639C1	3RD FLR HVAC ROOM	LAUTER TUN AREA WEST	WESTERN AXIAL	EXHAUST		LINCOLN	10	254T	1745		14,755	B65	2	X	XVO3010-25-B 424-6
641A1	4TH FLOOR WEST	4TH FLOOR WEST	TRANE	H/V	K5F291586	CENTURY	3	182T	1745		6150	A51	2	X	24X24X2 5EA.
642A1	5TH FLOOR WEST	5TH FLOOR WEST	TRANE	H/V	K5F291587	CENTURY	3	182T	1745		6675	A48	2	X	24X24X2 5EA
643A1	6TH FLOOR WEST	6TH FLOOR WEST	TRANE	H/V	K5F291588	CENTURY	5	184T	1745		6800	A58	2	X	24X24X2 5EA
645C1	3RD FLR HVAC ROOM	OFFICE AREA	TRANE	CHILLER COMPRESSOR	LA5J20A30105										

REVISED 11/23/81

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29 UNITS
130 PM'S COMPLET

OFFICE AREA - HEATING-VENTILATING-AIR CONDITIONING-AND AIR HANDLING UNITS - OFFICE AREA

EQUIP NO.	LOCATION	AREA SERVING	MAKE	TYPE	SERIAL NO.	MOTOR	HP	FRAME	MOTOR RPM	FAN RPM	CFM	BELT SIZE	QTY	PM 1150	REMARKS
700AH1	2ND FLR BY LARGE LOCKER RM	PLANT MANAGERS AREA	TRANE	HV/AC	K5L300179	DELCO	10	215T	1725	1250	7300	B70	2	X	5-24X24X2 FILTERS
701AH1	ACROSS FROM NURSE	SAFETY - NURSE AND LOBBY	TRANE	HV/AC	K5L300180	DELCO	3	182T	1740	1730	2061	A43	2	X	2-24X24X2 FILTERS
702AH1	2ND FLR ACROSS FROM QC LAB	2ND FLR QC AND TRAFFIC OFFICE	TRANE	HV/AC	K5L300181	DELCO	5	184T	715	990	4700	A70	2	X	4-24X24X2 FILTERS
703AH1	ACROSS FROM NURSE	MILLER INN	TRANE	HV/AC	K5L300183	DELCO	7.5	213T	1750	1030	5579	B75	2	X	3-24X24X2 FILTERS
705AH1	2ND FLR BY LARGE LOCKER RM	2ND FLR HOURLY LOCKER ROOM	TRANE	HV/AC	K5L300182	DELCO	7.5	254T	1760			A70	2	X	5-24X24X2 FILTERS
706AH1	IN PKG MAINT SHOP	PKG MAINT. SHOP	TRANE	H+V	K6A300178	DELCO	$\frac{15}{3.15}$	284T	$\frac{1770}{885}$	1840	2229	B11	2	X	10-24X24X2 FILTERS 10-24X24X18 FILTERS
707C1	2ND FLR BY LARGE LOCKER RM	RETURN AIR FAN FOR 700AH1	TRANE	RETURN	LSL716925	MARATHON	2	145T	1715	1040		875	1	X	
708C1	ACROSS FROM NURSE	RETURN AIR FAN FOR 701AH1	TRANE	RETURN	LSL712926	MARATHON	.5	56-4	1725			4L 520	1	X	
709C1	2ND FLR ACROSS FROM QC LAB	RETURN AIR FAN FOR 702AH1	TRANE	RETURN	LSL716927	MARATHON	1.5	145T	1725			A62	1	X	
710C1	ACROSS FROM NURSE	RETURN AIR FAN FOR 703AH1	TRANE	RETURN	LSL716928	MARATHON	1.5	145T	1725	1085		A66	1	X	
727C1	SUPPLY AIR WEST MCC ROOM	OFFICE ROOF OVER ELECT ROOM	PVC	SUPPLY AIR											
728C1	ON ROOF OVER 2ND FLR N.E BY QC	SUPPLY AIR · ELECT RM WEST OF PKG MAINT		SUPPLY AIR		AC	1.5		1725			AP58	1		
733C1	2ND FLR BY LARGE LOCKER RM	MAIN LOCKER RM FOR 705 & 1752 EXHAUST FAN		EXHAUST		WESTINGHOUSE	$\frac{3}{1.33}$		$\frac{1715}{1150}$			B55	1		
746AH1	PKG MAINT SHOP	1ST FLOOR QC LAB	TRANE	HV/AC	K5L300185	DELCO	3	182T	1740	1840	2229	A51	2	X	2-24X24X2 FILTERS
747C1	PKG MAINT SHOP	AIR RETURN FOR 746AH1	TRANE	RETURN	LSL716930	MARATHON	.5	56-4	1740			4L-530	1	X	
1700A1	COMPUTER ROOM	COMPUTER ROOM	EDPAC	A/C											MCC ACROSS FROM NURSE
1700X1	ON ROOF	COMPUTER ROOM	HALLSTEAD MITCHELL	CONDENSER FANS	28806	BALDOR	1/3	48 420M	1140						MCC ACROSS FROM NURSE
1701A1	EQUIP RM EAST OF P.E OFFICE	STOCKROOM 1ST FLR	YORK	HV/AC	CS-50-FO-FCLP-Y	MARATHON	$\frac{3}{1.33}$	184-T	$\frac{1760}{1175}$	1130	4262	B55	1	X	2-24X24X2
1702A1	EQUIP RM EAST OF P.E OFFICE	2ND FLR STOCKROOM AND SALARY L'ROOM	YORK	H/V	CS-113-SV-FCLP-V	MARATHON	$\frac{5}{2.2}$	215-T	$\frac{1760}{1125}$	880	7295	B77	2	X	6-24X20X2
1703A1	EQUIP RM EAST OF P.E. OFFICE	1ST FLR MAIN PKG BREAK ROOM	YORK	HV/AC	CS-50-SV-FCMP-Y	MARATHON	3	182T	1725	1330	2484	A55	2	X	2-24X24X2 FILTERS
1703C1	EQUIP RM EAST OF P.E OFFICE	RETURN AIR FOR 1703A1	BUFFALO FORGE	RETURN	76J4729	LINCOLN	1	143T	1740	1775		A38	1	X	
1704A1	EQUIP RM EAST OF P.E OFFICE	2ND FLR ENGR OFFICES	YORK	HV/AC	CS-113-SV-FCMP-Y	SIEMANS ALLIS	7.5	213T	1750	1110	4581	B73	2	X	6-20X24X2 FILTERS
1704C1	EQUIP RM EAST OF P.E OFFICE	RETURN AIR FOR 1704A1	BUFFALO FORGE	RETURN	76J4730		1.5	145T	1735	1430		A42	1	X	
1706C1	CEILING OF STORE ROOM JANITORS CLOSET	TOILET ROOM EAST PACKAGING	PVC	EXHAUST	REX 14B	WESTING HOUSE	1/4	56	1725	890		A44	1		
1706C2	ABOVE CLG ACCESS PANEL SALARY GIRLS ROOM	MEN & LADIES TOILETS BY PE OFFICES	PVC	EXHAUST	REX 14B	WESTING HOUSE	1/4	56	1725	460		A44	1		

REVISED 11/25/81

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OFFICE AREA – HEATING-VENTILATING-AIR CONDITIONING-AND AIR HANDLING UNITS-OFFICE AREA

EQUIP NO.	LOCATION	AREA SERVING	MAKE	TYPE	SERIAL NO.	MOTOR	HP	FRAME	MOTOR RPM	FAN RPM	CFM	BELT SIZE	QTY	PM 1550	REMARKS
1712C1	EQUIP. RM EAST OF P.E OFFICE	EXHAUST FAN FOR MECH EQUIP ROOM	WESTINGHOUSE	EXHAUST		AC.	.25	56	1725			2440	1	X	
1714A1	EQUIP RM OVER CAFETERIA	CAFETERIA	TRANE	HV/AC	K79057032		25	284T	1755			BX90	3	X	10-24X24X2 FILTERS 10-24X24X18 FILTERS
1716C1	EQUIP RM OVER CAFETERIA	RETURN AIR FAN FOR 1714A1	TRANE	RETURN	K79E59823	BALDOR	10	215T	1725			A85	1	X	
1718C1	EQUIP RM OVER CAFETERIA	EQUIP ROOM EXHAUST FAN		EXHAUST		WESTINGHOUSE	.5		850						
1719A1	EQUIP RM 2ND FLR BY ELEVATOR	WEST 2ND FLR CONF RM & BREAKROOM	TRANE	HV/AC	K79D56553	BALDOR	1.5	145T	1725			A38	1	X	2-24X16X2 FILTERS
1720C1	CEILING 2ND FLR BY ELEVATOR	RETURN AIR FAN FOR 1719 A1	TRANE	RETURN	L79002437	GOULD	.33	HA-56	1725/1425			4L490	1	X	
1722A1	CEILING MAIN LOCKER ROOM.	MAKEUP AIR FOR KITCHEN HOODS	TRANE	MAKE UP AIR	K79C55519	BALDOR	3	182-T	1725			B51	1		24X24X2 - 2 EA.
1724C1	ON ROOF OVER CAFE	RESTROOM EXHAUST BY CAFE		EXHAUST		WESTING HOUSE	1/6	T-56	1725			4L 220	1		
1725C1	ON ROOF OVER CAFE	DISHWASHER EXHAUST FAN		EXHAUST		WESTING HOUSE	.5	T-56	1725			4L 220	1		
1726C1	ON ROOF OVER CAFE	KITCHEN HOOD EXHAUST FAN		EXHAUST		WESTING HOUSE	3		1725			A41	2		
* 1730A1	ACROSS FROM NURSE	IRD AND TNG	TRANE	HV/AC	K79E56351	BALDOR	1.5	145-T	1725	2055	1412	A43	2	X	2-24X24X2 FILTERS
** 1731C1	ACROSS FROM NURSE	RETURN AIR FOR 1730A1	TRANE	RETURN	L79002438	GOULD	.33	HA-56	1725/1425	1775		4L480	1	X	
1741A1	SMALL EQUIP RM BY P.E. OFFICE	EAST SALARY BREAK ROOM	TRANE	HV/AC	K79E56352	BALDOR	1.5	45-T	1725			A43	2	X	2-24X24X2 FILTERS
1741C1	CAFE LADIES & MENS TOILET	ON ROOF BY CAFE	PVC	EXHAUST											
1749C1	ON ROOF OVER CAFE	RESTROOM EXHAUST		EXHAUST											
1752C1	CEILING OVER MAIN LOCKER RM	RETURN EXHAUST TO SAHI FOR MAIN LOCKER RM	TRANE	RETURN	L79002439	GOULD	5	215T	1760/880			A66	2	X	
1740C1	ON ROOF	SALARY LOCKER MEN'S TOILET	PVC	EXHAUST		GE	1/10		1725						
1748C1	ON ROOF OVER SALARY LK ROOM	SALARY LOCKER ROOM	PVC	EXHAUST	311PO64A	WESTING HOUSE	1/3		1725			4L 250	1		
768C1	CEILING MEN'S TOILET 2ND FLR WEST	MENS TOILET EXHAUST FAN		EXHAUST											
729C1	LINE 3 PKG REST ROOMS	ON OFFICE ROOF OVER RESTROOMS	PVC	EXHAUST											
722C1	CEILING OF MEN'S ROOM	MEN'S ROOM BY MILLER INN		EXHAUST											
723C1	CEILING OF PERSONEL OFFICE	PERSONEL OR EMPLOYMENT OFFICE		EXHAUST											
725C1	ELEVATOR (WEST) CONTROL ROOM	*In Key Room*		EXHAUST											
726C1	CEILING OF TIME CLOCK HALLWAY			EXHAUST											

* NOTE UNIT 1730 WAS 744AHI – MCC IS STILL MARKED 744

** NOTE UNIT 1731 WAS 745 AHI – MCC IS STILL MARKED 745

REVISED 11/25/81

PACKAGING - HEATING-VENTILATING-AIR CONDITIONING-AND AIR HANDLING UNITS - PACKAGING

EQUIP NO.	LOCATION	AREA SERVING	MAKE	TYPE	SERIAL NO.	MOTOR	HP	FRAME	MOTOR RPM	FAN RPM	CFM	BELT SIZE	QTY	PM ISSD	REMARKS
531A1	PACKAGING	RAIL DOCK	TRANE	H+V	K5F292850	AJAX	15	254T	1755	780	23,500	B112	2	X	
532A1	PACKAGING	RAIL DOCK	TRANE	VENT	K5G293136	AJAX	15	254T	1755	738	23,500	B112	2	X	
534A1	PACKAGING	RAIL DOCK	TRANE	VENT	K5G293130	AJAX	15	254T	1755	738	23,500	B112	2	X	
535A1	PACKAGING	RAIL DOCK	TRANE	VENT	K5G293139	AJAX	15	254T	1755	738	23,500	B112	2	X	
537A1	PACKAGING	OVER PALLATIZER	TRANE	H+V	K5G293127	AJAX	15	254T	1755	780	23,500	B112	2	X	
538A1	PACKAGING	BY BATTERY CHARGING	TRANE	H+V	K5G293133	AJAX	15	254T	1755	780	23,500	B112	2	X	
539A1	PACKAGING	OVER STORAGE	TRANE	H+V	K5G293128	AJAX	15	254T	1755	780	23,500	B112	2	X	
540A1	PACKAGING	OVER LID PALLATIZERS	TRANE	H+V	K5G293129	AJAX	15	254T	1755	738	23,500	B112	2	X	
541A1	PACKAGING	BY BATTERY/ CHARGING AREA	TRANE	H+V	K5G293126	AJAX	15	254T	1755	780	23,500	B112	2	X	
542A1	PACKAGING	OVER LID STORAGE	TRANE	H+V	K5G293134	AJAX	15	254T	1755	780	23,500	B112	2	X	
543A1	PACKAGING	OVER DEPAL'S	TRANE	VENT	K5G293140	AJAX	15	254T	1755	738	23,500	B112	2	X	
544A1	PACKAGING	OVER DEPAL'S	TRANE	VENT	K5G293138	AJAX	15	254T	1755	738	23,500	B112	2	X	
545A1	PACKAGING	OVER RACK STORAGE	TRANE	VENT	K5G293132	AJAX	15	254T	1755	738	23,500	B112	2	X	
546A1	PACKAGING	OVER DEPAL'S	TRANE	H+V	K5G293131	AJAX	15	254T	1755	780	23500	B112	2	X	
547A1	PACKAGING	OVER DEPAL'S	TRANE	VENT	K5G293137	AJAX	15	254T	1755	780	23,500	B112	2	X	1 7/16 MPN 058949 MPD 47-SEALMASTER
548A1	PACKAGING	OVER CAN RECEIVING	TRANE	VENT	K5G293135	AJAX	15	254T	1755	738	23,500	B112	2	X	
549A1	PACKAGING	OVER BACK OF LINE 8	TRANE	H+V	K5F292417	AJAX	15	254T	1755	663	24,000	B97	3	X	
550A1	PACKAGING	OVER CENTER OF LINE 8	TRANE	VENT	K5F292418	AJAX	15	254T	1755	631	26,000	B97	3	X	
551A1	PACKAGING	OVER FILLER OF LINE 8	TRANE	H+V	K5F292413	AJAX	15	254T	1755	663	26,000	B97	3	X	
552A1	PACKAGING	OVER BACK OF LINE 7	TRANE	VENT	K5F292426	AJAX	15	254T	1755	631	24,000	B97	3	X	
553A1	PACKAGING	OVER CENTER OF LINE 7	TRANE	VENT	K5F292424	RELIANCE	15	254T	1755	631	26,000	B112	2	X	
554A1	PACKAGING	OVER FILLER OF LINE 7	TRANE	VENT	K5F292422	AJAX	15	254T	1755	631	26,000	B97	3	X	
555A1	PACKAGING	OVER BACK LINE 5	TRANE	H+V	K5F292414	AJAX	15	254T	1755	663	26,000	B97	3	X	
556A1	PACKAGING	OVER CENTER LINE 5	TRANE	VENT	K5F292425	AJAX	15	254T	1755	631	26,000	B97	3	X	
557A1	PACKAGING	OVER FILLER LINE 5	TRANE	H+V,	K5F292421	AJAX	15	254T	1755	663	26,000	B97	3	X	

REVISED 11/25-81

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PACKAGING - HEATING - VENTILATING - AIR CONDITIONING - AND AIR HANDLING UNITS - PACKAGING

EQUIP NO.	LOCATION	AREA SERVING	MAKE	TYPE	SERIAL NO.	MOTOR	HP	FRAME	MOTOR RPM	FAN RPM	CFM	BELT SIZE	QTY	PM 1550	REMARKS
558A1	PACKAGING	OVER BACK OF LINE 4	TRANE	VENT	K5F292426	AJAX	15	254T	1755	631	26,000	B97	3	☒	
559A1	PACKAGING	OVER CENTER OF LINE 4	TRANE	VENT	K5F292415	AJAX	15	254T	1755	631	26,000	B97	3	☒	
560A1	PACKAGING	OVER FILLER OF LINE 4	TRANE	VENT	K5F292412	AJAX	15	254T	1755	631	26,000	B97	3	☒	
561A1	PACKAGING	OVER BACK OF LINE 2	TRANE	H+V	K5F292419	AJAX	15	254T	1755	663	26,000	B97	3	☒	
562A1	PACKAGING	OVER CENTER OF LINE 2	TRANE	VENT	K5F292423	AJAX	15	254T	1755	631	26,000	B97	3	☒	
563A1	PACKAGING	OVER FILLER OF LINE 2	TRANE	H+V	K5F292436	AJAX	15	254T	1755	663	26,000	B97	3	☒	
573A1	BEER DUMP	BEER DUMP	TRANE	H+V	K5F293141	CENTURY	10	215T	1750	706	29,850	B100	2	☒	
1531A1	PACKAGING	OVER CENTER OF LINE 13	BUFFALO FORGE	VENT	76J5408	LINCOLN	20	256T	1750	732	30,500	B78	3		
1532A1	PACKAGING	OVER BOTTLE WASH	BUFFALO FORGE	H+V	76J5410	LINCOLN	15	254T	1750	775	10,500	B90	2		
1533A1	PACKAGING	OVER BACK OF LINE 12	BUFFALO FORGE	H+V	76J4329	LINCOLN	15	254T	1750	732	30,500	B90	2		
1534A1	PACKAGING	OVER CENTER OF LINE 12	BUFFALO FORGE	VENT	76J5428	LINCOLN	15	254T	1750	732	30,500	B97	2		
1535A1	PACKAGING	OVER LINE 12 FILLER	BUFFALO FORGE	H+V	76J4329	LINCOLN	15	254T	1750	775	30,500	B90	2		
1536A1	PACKAGING	OVER BACK OF LINE 11	BUFFALO FORGE	H+V	76J5410	LINCOLN	20	256T	1750	775	30,500	B78	3		
1537A1	PACKAGING	OVER MIDDLE OF LINE 11	BUFFALO FORGE	VENT	76J4326	LINCOLN	15	254T	1750	732	30,500	B97	2		
1538A1	PACKAGING	OVER FILLER OF LINE 11	BUFFALO FORGE	H+V	76J5411	LINCOLN	20	256T	1750	775	30,500	BX78	3		
1539A1	PACKAGING	OVER BOTTLEWASH	BUFFALO FORGE	VENT	76J5410	LINCOLN	15	254T	1750	732	30,500	B97	2		
1540A1	PACKAGING	OVER MIDDLE OF LINE 10	BUFFALO FORGE	VENT	76J5410	LINCOLN	20	256T	1750	732	30,500	B78	3		
1541A1	PACKAGING	OVER PALLETIZERS	YORK	H+V		MARATHON	25	284T	1760	1720	30,500	B103	4		MODEL CS402FOAFY ORDER 73103911-1541
1542A1	PACKAGING	OVER PALLETIZERS	YORK	H+V		MARATHON	25	284T	1760	1720	30,500	B105	4		MODEL CS402FOAFY ORDER 73103911-1542
1543A1	WAREHOUSE	SHIPPING	YORK	H+V		MARATHON	25	284T	1760	1720	30,500	B103	4		MODEL CS402FOAFY ORDER 73103911-1543
1544A1	WAREHOUSE	SHIPPING	YORK	H+V		MARATHON	25	284T	1760	1720	30,500	B103	4		MODEL CS402FOAFY ORDER 73103911-1544
1541A2	WAREHOUSE	SHIPPING	BUFFALO FORGE	H+V		LINCOLN	15	245T	1750	790	30,500	B90	2		
1542A2	WAREHOUSE	SHIPPING	BUFFALO FORGE	H+V		LINCOLN	15	245T	1750	790	30,500	B90	2		
1543A2	WAREHOUSE	SHIPPING	BUFFALO FORGE	H+V		LINCOLN	15	245T	1750	790	30,500	B90	2		
1544A2	WAREHOUSE	SHIPPING	BUFFALO FORGE	H+V		LINCOLN	15	245T	1750	790	30,500	B90	2		

REVISED 11-25-81

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PACKAGING - "HEATING-VENTILATING-AIR CONDITIONING-AND AIR HANDLING UNITS -PACKAGING"

EQUIP NO.	LOCATION	AREA SERVING	MAKE	TYPE	SERIAL NO.	MOTOR	HP	FRAME	MOTOR RPM	FAN RPM	CFM	BELT SIZE	QTY	PM ISSD	REMARKS
1599 EF18	PACKAGING CEILING/ROOF	PACKAGING LINES	GREEN HECK	EXHAUST FAN	520046 ✓	MARATHON	1.5	145T	1725		13,500	A46	1	☒	MODEL PBU-42-20-15
1599 EF19	↓	↓	↓	↓	520050 ✓	MPN 056080	1.5	145T	1725		13,500	A46	1	☒	↓
1599 EF20					520029 ✓	MPN 056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF21					520051 ✓	MPN 056080	1.5	145T	1726		13,500	A46	1	☒	
1599 EF22					520041 ✓	MPN 056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF23					520048 ✓	MPN 056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF24					520045 ✓	MAN 056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF25					520049 ✓	MPN 056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF26					520040 ✓	MPN 056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF27		BOTTLEWASH #1			520030 ✓	MPN 056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF28		BOTTLEWASH #2			520026 ✓	MPN 056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF29		BATTERY CHARGING			520042 ✓	MPN 056080	1.5	145T	1725		13,500	A46	1	☒	
	PACKAGING ROOF	BOTTLEWASH #1	HARTZEIL	EXHAUST	23735	U.S	3	182T	1740			A60	1		
	PACKAGING ROOF	BOTTLEWASH #2	HARTZEIL	EXHAUST	H22430	U.S	3	182T	1740			A60	1		
611C1	WAREHOUSE ROOF	BATTERY CHARGE ELECT VAULT	LOREN COOK	EXHAUST		MARATHON	1/6	FR48	1725			4L230	1		MODEL 154C1B
614C1	WAREHOUSE ROOF	MENS TOILET SANKEY AREA	LOREN COOK	EXHAUST		MARATHON	.75	FR56-5	1725			4L 260	1		MODEL 244C6B
610C1	WAREHOUSE ROOF	WHSE OFFICE TOILETS	PVC	EXHAUST		WESTING HOUSE	1/6	FR48	1725			3L 260	1		
609C1	WAREHOUSE ROOF	WHSE LUNCHROOM TOILETS	PVC	EXHAUST		WESTING HOUSE	1/3	FRB48	1725			3L 260	1		
1792C1	TRUCKER LOUNGE ROOF	TRUCKER LOUNGE TOILETS	PVC	EXHAUST		WESTING HOUSE	1/6	FR48	1725			4L 200	1		
	ROOF NEW GLASS WHSE	GLASS WHSE	PVC	EXHAUST								TRUFLEX 2691	1		
	ROOF NEW GLASS WHSE	GLASS WHSE	PVC	EXHAUST								TRUFLEX 2691	1		
	ROOF NEW GLASS WHSE	GLASS WHSE	PVC	EXHAUST								TRUFLEX 2691	1		

REVISED 11-25-91

OFFICE -MISC-EQUIP. HEATING-VENTILATING-AIR CONDITIONING-AND AIR HANDLING UNITS

EQUIP NO.	LOCATION	AREA SERVING	MAKE	TYPE	SERIAL NO.	MOTOR	HP	FRAME	MOTOR RPM	FAN RPM	CFM	BELT SIZE	QTY	PM ISSD	REMARKS
711WC1	ACROSS FROM NURSE	OFFICE AREA CHILLER	TRANE	CHILLER	15L716394										MODEL CCUA18004-EA
716P1	ACROSS FROM NURSE	OFFICE SECONDARY WEST HOT WATER RADITION	B+G	PUMP		DELCO	1/2	56C	1745						
717P1	ACROSS FROM NURSE	SOUTHEAST RADITION WATER PUMP	B+G	PUMP		DELCO	1/2	56C	1750						
718P1	ACROSS FROM NURSE	CONDENSATE RETURN PUMP		PUMP		G E	1.5		3450						
762P1	ACROSS FROM NURSE	PRIMARY HOT WATER (CONVERTER)	B+G	PUMP		LINCOLN	5	184T	1745						
1709P1	EQUIP ROOM EAST OF P.E. OFFICE	CONDENSATE RETURN PUMP	AURORA	PUMP		AURORA	1.5		3450						
1710P1	EQUIP ROOM EAST OF P.E. OFFICE	HOT WATER CONVERTER PUMP	B+G	PUMP		MARATHON	2		1735						
1711P1		CHILLED WATER PUMP		PUMP											
1715P1	ACROSS FROM NURSE	CHILLED WATER PUMP	B+G	PUMP	925787	MARATHON	15	254T	1750						
1715P2	ACROSS FROM NURSE	CHILLED WATER PUMP	B+G	PUMP	925788	MARATHON	15	254T	1750						
1737P1	OVER CAFETERIA	CHILLED WATER PUMP	B+G	PUMP		B+G	1	143T	1740						
1744P1	IN PKG MAINT SHOP	OFFICE AREA CHILLER	TRANE	CHILLER											MODEL CAUA1009-EA
1745X1	OUTSIDE PKG MAINT	CONDENSER FANS	TRANE	CONDENSER	J79B-0004D	HOWELL	7.5	T213T	1725			B96	2		
1746P1	IN PKG MAINT SHOP	OFFICE CHILLED WATER PUMP	B+G	PUMP		GOULD	5	184T	1745						
734C1	2ND FLR WEST CONF ROOM	PLANT M&R TOILET		EXHAUST											
732C1	WOMENS TOILET BY OLD CAFE	WOMEN TOILET BY OLD CAFE		EXHAUST											
736C1	QC LAB 2ND FLR SM. EXH. HOOD	QC LAB 2ND FLR SM EXH HOOD		EXHAUST											
721C1	WOMEN TOILET BY MILLER INN	WOMENS TOILET BY MILLER INN		EXHAUST											
713AC1	OUTSIDE BY CAFE	WEST HALF OFFICE AREA	TRANE	CONDENSOR											
714AC1	OUTSIDE BY CAFE	WEST HALF OFFICE AREA	TRANE	CONDENSOR											

③ REVISED 11/25/91

UTILITIES - HEATING-VENTILATING-AIR CONDITIONING-AND AIR HANDLING UNITS- UTILITIES

EQUIP NO.	LOCATION	AREA SERVING	MAKE	TYPE	SERIAL NO.	MOTOR	HP	FRAME	MOTOR RPM	FAN RPM	CFM	BELT SIZE	QTY	PM ISSD	REMARKS
685A9	UTILITIES MEZZANINE	NORTH SIDE UTILITIES	GALE	VENT		RELIANCE	20	256T	1755			BX 112	3	☒	3-5' ROLLS
685B9	UTILITIES MEZZANINE	SOUTH SIDE UTILITIES	GALE	VENT		RELIANCE	20	256T	1755			BX 112	3	☒	3-6' ROLLS
685A7A	UTILITIES MEZZANINE	1ST FLOOR ELECT ROOM	GALE	VENT		ALLIS CHALMER	10	215T	1750			BX 85	2	☒	2-5' ROLLS
685A7B	UTILITIES MEZZANINE	2ND FLOOR ELECT MEZZANINE	GALE	VENT		ALLIS CHALMER	10	215T	1750			BX 85	2	☒	1-5' ROLLS
1566A1	5FLR NEW BOILERHOUSE	5TH FLR CONTROL ROOM	EDPAC	A/C							776				
689C2	UTILITIES ROOF	UTILITIES		EXHAUST		BALDOR	2	145T	1725			A43	1	☒	
689C3	UTILITIES ROOF	UTILITIES		EXHAUST		BALDOR	2	145T	1725			A43	1	☒	
689C4	UTILITIES ROOF	UTILITIES		EXHAUST		BALDOR	2	145T	1725			A43	1	☒	
689C5	UTILITIES ROOF	UTILITIES		EXHAUST		BALDOR	2	145T	1725			A43	1	☒	
689C6	UTILITIES ROOF	UTILITIES		EXHAUST		BALDOR	2	145T	1725			A43	1	☒	
689C7	UTILITIES ROOF	UTILITIES		EXHAUST		BALDOR	2	145T	1725			A43	1	☒	
689C8	UTILITIES ROOF	UTILITIES		EXHAUST		BALDOR	2	145T	1725			A43	1	☒	
689C9	UTILITIES ROOF	UTILITIES		EXHAUST		BALDOR	2	145T	1725			A43	1	☒	
689C10	UTILITIES ROOF	UTILITIES		EXHAUST		BALDOR	2	145T	1725			A43	1	☒	
689C11	UTILITIES ROOF	UTILITIES		EXHAUST		BALDOR	2	145T	1725			A43	1	☒	
1685C1	UTILITIES, CLG, LOCKERROOM	UTILITIES LOCKERROOM	PVC	RETURN AIR							590				
685A13	UTILITIES MEZZANINE	SUPU'S OFFICE	CARRIER	A/C	A-534-130		1/6								MODEL #50 030490
1568X1	BOILERHOUSE ROOF	BOILER HOUSE CONTROL ROOM	TRANE	CONDENSER	C79M-1473A										
1685A1	GENERATOR ROOM MEZZ.	LOCKER ROOM	TRANE	H/V	K79M72913	BALDOR	.75	56	1725		1060	4L 410	1		2EA 16X25-2
1686A1	GENERATOR ROOM MEZZ	BREAK ROOM	TRANE	HVAC	K80A72852	BALDOR	.75	56	1725		992	4L 410	1		2EA 16X25X2
1686X1	GENERATOR ROOM ROOF	BREAK ROOM	TRANE	CONDENSER	C79K-107G1										
1568A1	BOILER CONTROL ROOM	BOILER CONTROL ROOM	TRANE	A/C	C79M14064	FRANKLIN	1.5	145T	3450		3417	A58	1		
1567A1	BOILER CONTROL ROOM	2ND FLR MCC ROOM	TRANE	VENT	K80B72675	MARATHON	1.5	56	1725		4966	A58	1		6EA WASHABLE 20X25X2
1684A1	GENERATOR ROOM	GENERATOR ROOM	TRANE	H+V	K80B72916	BALDOR	3		1725		14,700	B90	1		16EA 20X25X2
1689C1	~~BOILERHOUSE ROOF~~	UTILITIES LOCKERROOM	PVC	VENT			1/12				700				

REVISED 11-25-81

④

PACKAGING HEATING-VENTILATING-AIR CONDITIONING-AND AIR HANDLING UNITS - PACKAGING

EQUIP NO.	LOCATION	AREA SERVING	MAKE	TYPE	SERIAL NO.	MOTOR		HP	FRAME	MOTOR RPM	FAN RPM	CFM	BELT SIZE	QTY	PM ISS'D	REMARKS
578A1	WHSE ELECT EQUIP. RM.	WHSE OFFICES	TRANE	HV/AC	K77C15133	BALDOR		1.5	145T	1725			AP43	1		
578X1	WHSE ROOF	WHSE OFFICES	TRANE	CONDENSER FANS	76M-12989											RAUC-1004-C 169-904-1-C
1584A1	WHSE LUNCH RM MEZZ	WHSE LUNCH ROOM	TRANE	HV/AC	K79E56350	BALDOR		3	182T	1725			A43	2		
1584X1	WHSE ROOF	WHSE LUNCH ROOM	TRANE	CONDENSER FANS	C790-240-74											RAUC-1004-C 263-922-1-B
1789A1	WHSE OUTSIDE TRUCKERS LOUNGE	TRUCKERS LOUNGE	YORK	A/C		GE		3/4	FR48	3450			A48	1		
1791X1	WHSE ROOF	TRUCKERS LOUNGE	YORK	CONDENSER FANS	FM-119938			.5								MODEL C091-45E
612C1	ROOF	BEER DUMP	PVC	EXHAUST	JB-48	WESTING HOUSE		.75	056	1725			A86	2		
613C1	ROOF	BEER DUMP	PVC	EXHAUST	JB-48	GE		.75	FR56	1725 850			A85	2		
1599 EF1	PACKAGING CEILING/ROOF	PACKAGING LINES	GREENHECK	EXHAUST	520028	MARATHON		1.5	145T	1725		13,500	A46	1	☒	MODEL PEW-12-20-15
1599 EF2	PACKAGING CEILING/ROOF	PACKAGING LINES	GREEN HECK	EXHAUST	520034	MARATHON		1.5	145T	1725		13,500	A46	1	☒	TYP 29 UNITS ↓
1599 EF3	↓	↓	↓	↓	554950	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF4					520035	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF5					520031	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF6					520039	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF7					520032	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF8					520038	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF9					520036	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF10					520033	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF11					520043	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF12					520044	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF13					520037	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF14					520027	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF15					520052	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF16					520047	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	
1599 EF17	↓	↓	↓	↓	520053	MPN	056080	1.5	145T	1725		13,500	A46	1	☒	

REVISED 11-25-81

UTILITIES-WWTP-MISC HEATING-VENTILATING-AIR CONDITIONING-AND AIR HANDLING UNITS UTILITIES-WWTP-MISC

EQUIP NO.	LOCATION	AREA SERVING	MAKE	TYPE	SERIAL NO.	MOTOR	HP	FRAME	MOTOR RPM	FAN RPM	CFM	BELT SIZE	QTY	PM ISS'D	REMARKS
1564C1	BOILER HOUSE ROOF	BOILER HOUSE ELEVATOR ?	LAU INDUSTRIES	EXHAUST	SB-C060-6E04-P		15		860		51,600				
1564C2	BOILER HOUSE ROOF	BOILER HOUSE ELEVATOR ?	LAU INDUSTRIES	EXHAUST	SB-C060-6E09-P		15		860		51,600				
680C1	WATER PUMP HOUSE ROOF	WATER PUMP HOUSE	PVC	EXHAUST		WESTING HOUSE	1/6	FR48	1725				1		
679C1	WATER PUMP HOUSE ROOF	WATER PUMP HOUSE	PVC	EXHAUST			1.5	FR56	1725			A52	1		
570A1	WWTP	UPPER LEVEL	TRANE	HV	K6B301478		15	254T	1755			B85			44" FILTER ROLL
571A1	WWTP	UPPER LEVEL	TRANE	HV	K6B301479		15	254T	1755			B103			56" FILTER ROLL
526C1	WWTP		BUFFALO FORGE		7407H		5	215T	1170			B63	2		
574A1A	WWTP	BOILER ROOM	TRANE		K6B301477		2	145T	1730						26" FILTER ROLL
	OUTSIDE MAIN BLDG WWTP	OFFICE AREA	TRANE	CONDENSOR											
1781A1	OUTSIDE MAIN SECURITY OFFICE	MAIN SECURITY GATE OFFICE		A/C											
1782A1	OUTSIDE BEER SALES	EMPLOYEE SALES STORE	TRANE	HEAT PUMP A/C											

APPENDIX K
WASTEWATER TREATMENT PLANT
CAL3QHC MODELING

Miller Brewing Company
Fulton, New York

EMISSION INVENTORY REPORT

JANUARY 1994

MILLER BREWING COMPANY
FULTON, NEW YORK

WASTEWATER TREATMENT PLANT EQUALIZATION TANK AREA (9/15/93 Data)
CAL3QHC Modeling

```
SBEM WWTP INFLWW TO END EQ.TANK  9/15/93 60. 50.    0.    0: 6         1.    1    1

R1  1' above gate          19.0       56.7      0.914
R2  Bar screen chan.       4.57       56.7      0.914
R3  At weir                26.2       57.7      0.914
R4  Side edge tank         28.7       64.6      0.914
R5  Midway edge tank       32.6       64.6      0.914
R6  Downwind edge          38.7       64.6      0.914
ETHANOL INFL TO END EQUAL. TANK            6  1   0                                  Weighting
                                                                             Area     By Area
1
A:INFL.WW TO GATE 2 AG    0.     56.7    18.9    56.7   900.   72.   1. 1.83  34.6     0.13
1
B:GATE 2 TO WEIR    AG   18.9    56.7    26.2    56.7   900.   72.   1. 1.83  13.4     0.04
1
C:EQUAL.TANK CASCADEAG   26.5    53.0    26.5    59.0   900.   90.   1. 2.59  15.5     0.05
1
D:W TO E 1ST 1/3TANKAG   28.9    49.4    28.9    64.6   900.   27.   1. 5.18  78.7     0.26
1
E:W TO E 2ND 1/3TANKAG   34.1    49.4    34.1    64.6   900.    9.   1. 5.18  78.7     0.26
1
F:W TO E 3RD 1/3TANKAG   39.3    49.4    39.3    64.6   900.    9.   1. 5.18  78.7     0.26
.2 180.5 1000. 0.                                                           299.6     1.00
```

```
                  the maximum concentration, only the first
                  angle, of the angles with same maximum
                  concentrations, is indicated as maximum.

 WIND ANGLE RANGE: 168.-192.

 WIND   * CONCENTRATION
 ANGLE  *      (PPM)
 (DEGR)* REC1  REC2  REC3  REC4  REC5  REC6
 ------*-----------------------------------
 168.  *   9.8   8.3  30.0   7.4   2.6   2.1
 171.  *  10.0   8.3  30.2   8.2   2.7   2.2
 174.  *   9.6   8.3  30.6   9.1   2.9   2.3
 177.  *   8.3   8.3  30.8  10.3   3.0   2.4
 180.  *   8.3   8.3  30.5  11.3   3.4   2.4
 183.  *   8.3   8.3  30.5  12.5   3.8   2.5
 186.  *   9.7   8.3  30.3  13.6   4.3   2.5
 189.  *  10.0   8.3  29.8  14.5   4.9   2.5
 192.  *   9.8   8.3  29.0  15.1   5.6   2.6
```

MILLER BREWING COMPANY
FULTON, NEW YORK

WASTEWATER TREATMENT PLANT CLARIFIERS (11/4/93 Data)
CAL3QHC Modeling

```
SBEM WWTP CLARIFIER   11/4/93  RUN1     60.  50.   0.   0. 1         1.    1    1

R1 AVG. ETH CONC=.3     205.      100.      0.5
CLARIFIER TANK ETHANOL EMISSIONS          4  1   0
1                                                                     Area    %
C1:SQ CLARIFIER     AG   155.  83.8     155.  96.    3000.  6.  0. 12.  215    15
1
C2:SQ CLARIFIER     AG   178.  83.2     178.  95.7   3000.  6.  0. 12.  215    15
1
C3:SQ CLARIFIER     AG   178.  62.2     178.  76.2   3000.  6.  0. 12.  215    15
1
D1:AERATION TANK    AG   205.  101.     205.  70.0   3000.  3.  0. 19.8 735    55
1.3215.5 1000. 0.                                                  1380   100
```

```
                   the maximum concentration, only the first
                   angle, of the angles with same maximum
                   concentrations, is indicated as maximum.

 WIND ANGLE RANGE: 203.-227.

 WIND  * CONCENTRATION
 ANGLE *      (PPM)
 (DEGR)* REC1
 ------*------
 203.  *    .3
 206.  *    .4
 209.  *    .3
 212.  *    .3
 215.  *    .3
 218.  *    .3
 221.  *    .3
 224.  *    .3
 227.  *    .2
 ------*------
 MAX   *    .4
```

MILLER BREWING COMPANY
FULTON, NEW YORK

WASTEWATER TREATMENT PLANT AERATION TANKS (9/15/93 Data)
CAL3QHC Modeling

```
SBEM WWTP AERATION TANKS 9/15/93, RUN1   60. 50.   0.   0. 1         1.    1    1

R1 AVG. ETH CONC=.3      205.       100.       0.5
AERATION TANK ETHANOL EMISSIONS                4  1   0
1
C1:SQ CLARIFIER      AG   155.  83.8    155.  96.   3000.   1.  0. 12.
1
C2:SQ CLARIFIER      AG   178.  83.2    178.  95.7  3000.   2.  0. 12.
1
C3:SQ CLARIFIER      AG   178.  62.2    178.  76.2  3000.   2.  0. 12.
1
D1:AERATION TANK     AG   205.  101.    205.  70.0  3000.   1.  0. 19.8
0.2180.5 1000. 0.


                   the maximum concentration, only the first
                   angle, of the angles with same maximum
                   concentrations, is indicated as maximum.

 WIND ANGLE RANGE: 168.-192.

 WIND  * CONCENTRATION
 ANGLE *      (PPM)
 (DEGR)* REC1
 ------*------
 168.  *    .3
 171.  *    .3
 174.  *    .3
 177.  *    .3
 180.  *    .3
 183.  *    .3
 186.  *    .3
 189.  *    .3
 192.  *    .3
 ------*------
 MAX   *    .3
 DEGR. *  168


                   the maximum concentration, only the first
                   angle, of the angles with same maximum
                   concentrations, is indicated as maximum.

 WIND ANGLE RANGE: 168.-192.
```

AP-42 Section 9.12.
Reference 19-VOL II
Report Sect. 4
Reference 25

sbe

AIR EMISSIONS INVESTIGATION REPORT

Submitted to: **Miller Brewing Company**

February 24, 1994

SBE Environmental Company

Miller Brewing Company
Fulton, New York

Air Emissions Investigation Report

TABLE OF CONTENTS

Miller Brewing Company
Fulton, New York

Air Emissions Investigation Report

TABLE OF CONTENTS
(continued)

Miller Brewing Company
Fulton, New York

Air Emissions Investigation Report

LIST OF TABLES

Miller Brewing Company
Fulton, New York

Air Emissions Investigation Report

LIST OF FIGURES

AIR EMISSIONS INVESTIGATION REPORT

1.0 INTRODUCTION

This report quantifies the results of an air emissions investigation for volatile organic compounds and ethanol at the Miller Brewing Company Fulton, New York facility. The emissions have been quantified utilizing state of the art testing and analysis methodologies. Testing occurred in areas which were representative of each of the various processes which are in operation at the facility that have the potential to emit the compounds being investigated. The intimate process knowledge provided by Miller Brewing personnel was very helpful and was utilized in establishing the testing program. The SBE team consisted of the following firms:

- SBE Environmental Company - Program Management and Analysis
- RTP Environmental Associates, Inc. - Emissions Monitoring
- Environmental Health Laboratories - Laboratory Analysis

The scope of work was developed to provide the data necessary to complete the emission survey. SBE team members visited the site on two occasions prior to preparing and conducting the full emission test plan. This first task included facility familiarization by the SBE team, and collection of initial samples for ethanol at numerous locations throughout the facility. As a result of this task, an initial sampling plan was provided to Miller staff for their input and approval. The second task included full facility emission tests for VOCs and ethanol, and collection of concurrent data on process operations that would eventually be utilized as part of the emission quantification effort.

For the purposes of the emissions investigation the facility was divided into six major areas:

- Brewhouse,
- Cold Services,
- Utilities,

- Packaging,
- Annex, and
- Wastewater Treatment.

The final task was the analysis and compilation of the data taken during the facility tests into an emissions investigation report for the facility.

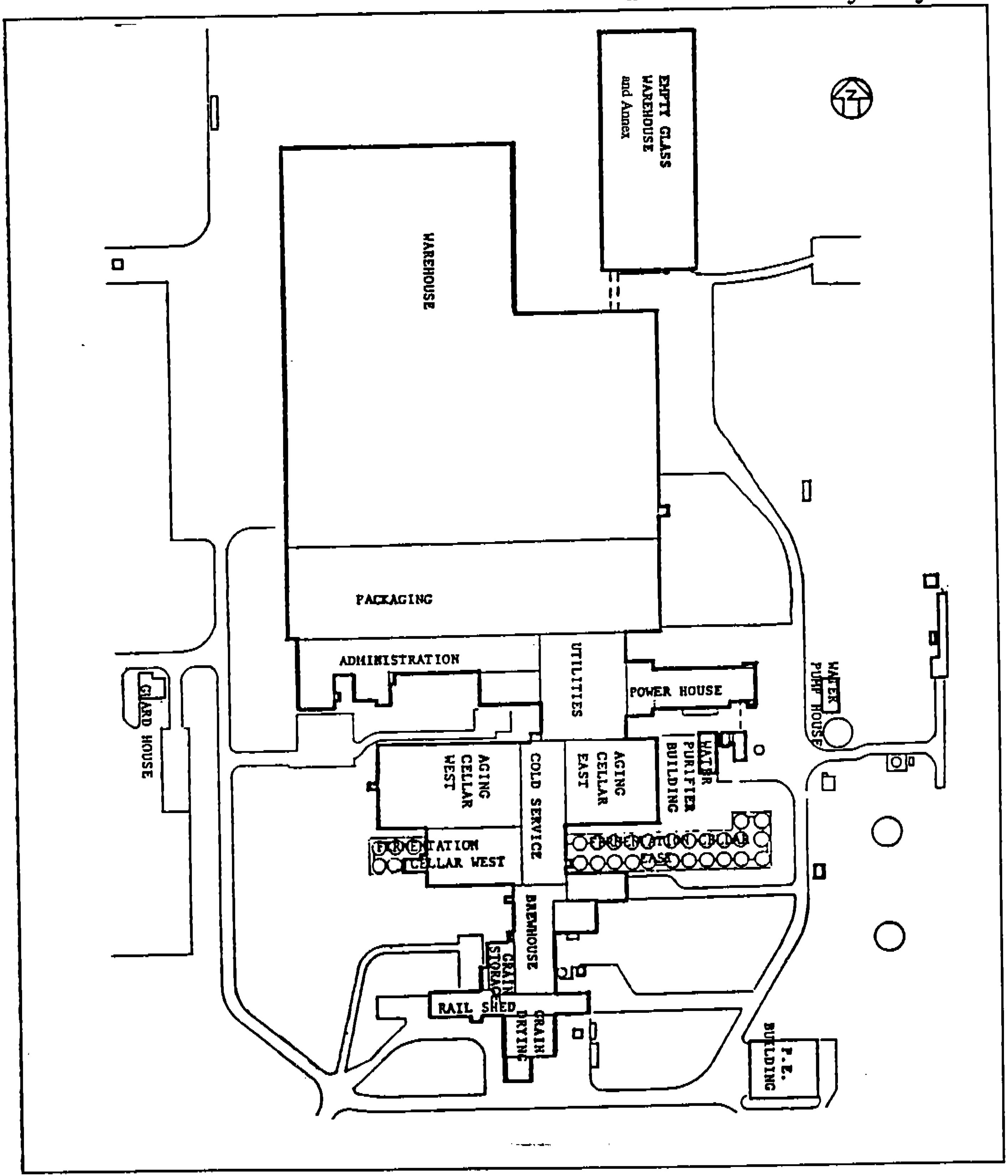
The following sections of this report will discuss the sampling and analytical methods utilized to obtain results, the methods of emissions quantification and a discussion of results and conclusions.

1.1 Facility Description and Layout

The Miller Brewing Company, Fulton, New York facility is a large brewery with a design capacity of eight million barrels of beer production per year. Recent operations, however, have been at approximately five million barrels per year. The data collected during the sampling program was combined with process data on plant operations to provide expected actual and potential annual emission rates for VOCs and ethanol. Subsequent to the completion of the testing program, and as a result of overall business conditions, steps were taken to put the brewery in a standby mode. However, the emissions reported herein characterize the facility when it is operating, and they can be adjusted, as appropriate, based upon barrels of beer actually produced.

As shown in Figure 1.1, the facility layout is oriented in a south to north direction. Raw materials (grains, etc.) generally enter at the southern end of the facility. The raw materials are dried and stored as necessary for use in the brewhouse where the they are combined according to specific recipes and the various types of hot wort are produced. Hot wort is delivered to the one of three fermentation cellars located to either the west or east of the cold services area. The aging cellars are also located to the east and west of the cold services area and just north of the fermentation cellars. The Utilities facility occupies the space north of the aging cellars. Packaging, where the beer is packaged for

Fulton Brewery Layout



Miller Brewing Company
Air Emissions Investigation

Figure 1.1

warehousing and shipment to distributors, is located north of the Utilities area. Empty glass is returned to the facility via the annex/empty glass warehouse. The wastewater treatment plant is located approximately 1/4 mile south of the brewhouse.

2.0 SAMPLING AND ANALYTICAL METHODS

2.1 Sampling Methods

This section briefly discusses some of the specific sampling and analytical methods applied in developing the emission investigation.

As discussed above, the sampling plan divided the facility into six sections. The sampling program was designed based on the intimate process knowledge of the Miller Brewing Company and on the broad sampling and testing experience of the SBE team.

In general, exhaust flows were measured using EPA Methods 1 and 2. In some cases, for example the hot wort tank, flows were calculated by using displaced volumes in the tank. Where moisture levels in the exhausts were significant, EPA Method 4 and/or a wet/dry bulb determination was applied. All EPA Methods are provided in 40 CFR Part 60, Appendix A. NIOSH Methods 1400 and P & CAM 127 provided in Appendix A of this report, were used for field sampling and analysis of ethanol and organic solvents.

Source sampling activities involved a series of tasks from mobilization, equipment calibration, process review, selection of sampling locations, individual test runs and concurrent source information, sample management, quality assurance and control, laboratory analyses and intermediate analyses, laboratory data reporting and review and finally, data analysis. A variety of techniques were used to collect or extract source samples during the test program.

In addition to source specific test methods, other analyzers were used to determine ethanol concentrations for on-site analysis. The primary tool was a MIRAN 1B2 analyzer which was used to quantify ethanol concentrations during the preliminary site visit and during the full field test. The general description and standard specification of MIRAN 1B2 analyzer is provided in Appendix A.

2.2 Analytical Methods

<u>Analytical Laboratory</u>

Extensive discussions were held with the analytical laboratory staff to assure that collection and analysis methods were appropriate for the compounds and concentrations encountered. The samples after collection onto various media were forwarded to Environmental Health Laboratories (EHL) of Farmingdale, New York for analysis. The sample labeling sequence allowed for convenient designation of where specific samples were taken and which compound was being tested.

Quality Assurance and Control Measures

A complete QA/QC program was established to assure accurate results. Every effort was made to assure the integrity of the test results. For example, the sample chain of custody records were developed for each sample including the sample handling procedures from preweighing and test sampling media through final sample analysis. Standard quality assurance and control procedures were followed in all aspects of the test effort for the emissions survey. The primary objectives of quality assurance and control were met by developing a detailed work plan, assuring personnel were well trained and utilization of equipment and methods that provided reliable data.

Instrumentation calibration and periodic accuracy checks were completed before and after each sampling period. The types and condition of the sampling media and glassware used during the test effort are also critical to assuring accurate data is obtained during the field program. The primary focus of sampling media was to pretest the tubes used in the field program. The glassware used in various sampling trains, where appropriate, was cleaned and triple rinsed prior to use. All chemical reagents or fixing agents used were certified to specified purity standards.

Field sampling included the collection of trip and field blanks as well as triplicate samples for precision checks at most sources. The analytical laboratory, EHL, used exclusively for evaluating samples has their own internal and external quality assurance and control procedures which were applied in this case.

High quality assurance and control goals were set for all field efforts and the pre/post sampling activities. Data points were checked and rechecked against known standards and previously collected data to, where possible, verify the data presented herein.

3.0 EMISSION QUANTIFICATION METHODS

3.1 Brewhouse

The brewhouse at the Fulton facility was evaluated for total volatile organic compounds. The approach used is presented below.

Total Volatile Organic Compounds (VOCs)

The measurement of total VOC emissions from the brewhouse facility was performed on November 1 and 2, 1993. Sampling was performed at four locations including the kettle, lauter tun, mash tun and cereal cooker exhausts. Further testing for the hot wort tank was performed on November 3, 1993 from the tank head space. Source flow rates were calculated from flow traverses, and a displacement volume rate for the hot wort tank.

Separate analyses of each charcoal trap from each sample pair revealed no significant breakthrough. All brewhouse samples contained detectable levels of VOCs. Two of eight sample pairs had detectable condensate values that were added to their respective sample mass. The emissions from the kettle, lauter tun, mash tun, cooker and hot wort tank were estimated by calculating a test release rate in milligrams per minute from the following equation:

$$TRR = C \times Q \times 28.32 \qquad \text{Equation 1}$$

where:

TRR = test release rate, mg/min
C = measured concentration, mg/liter
Q = source flow, acfm
28.32 = conversion of liters to ft^3

However, an additional requirement of the survey was to calculate emission rates based upon pounds per one thousand barrels (lbs/1,000 barrels) of finished product. Therefore, the test release rate, process time (PRT) and process volume (Vp) were utilized in calculating a test emission factor (TEF) in lbs/1,000 barrels. This is calculated by the following:

$$TEF = 2.205 \times 10^{-3} (TRR \times PRT \div Vp) \qquad \text{Equation 2}$$

where:

TEF = test condition emission factor, lbs/1,000 barrels
TRR = test release rate, mg/min
PRT = process time, min
Vp = process volume, barrels
2.205×10^{-3} =conversion of milligrams per bbl to pounds per 1,000 barrels

Process times and volumes were determined by reviewing the daily brewhouse schedules during the sampling. Throughout the remainder of the results presented in Section 3.0, it is to be noted that a process time and process volume have been accounted for in calculations, but are not presented due to their confidential nature. The VOC emission calculations per sample are summarized and shown below in Table 3.1.

It should be noted that some ethanol emissions from the brewhouse may occur during the summer months when spent yeast is added to the spent grains tank. However, due to the time of season of this particular sampling program the activity was not sampled.

To further evaluate the emissions of the brewhouse facility on an annual basis, an average test emission factor (TEF_{av}) is calculated for each brewhouse location and applied in Section 4.2 to an annual volume of beer brewed. The TEF_{av} factors are as follows for VOCs at the brewhouse: kettle 0.212 lbs/1,000 barrels, lauter tun 0.005 lbs/1,000 barrels, mash tun 0.053 lbs/1,000 barrels, cereal cooker 0.007 lbs/1,000 barrels and the hot wort tank 0.017 lbs/1,000 barrels.

3.2 Cold Services

The cold services area at Fulton facility contains several processes including fermentation, filtration, aging and package release. Ethanol is the compound of interest in these areas. The quantification method is discussed below.

As discussed more fully below, the measurements of ethanol emissions from cold services were made at the inlet and exhaust (heat wheel); fermenters; cold filter trap; primary filter trap; spent yeast tank; and miscellaneous locations from November 2 to November 5, 1993.

3.2.1 Heat Wheel

The heat wheel ethanol emissions were measured at approximately 3-hour intervals over a 24-hour period from November 2, 1993 to November 3, 1993. The flows for the heat wheel exhaust and inlet were determined from fan curve data supplied by Miller Brewing Company. A total of seven sample pairs were to be collected at this source directly onto carbon traps. During the sampling, one test had been aborted due to carbon tube breakage. Of the six remaining sample pairs, two were discarded because of unresolved differences and data compatibility. For each test sample, a test release rate was calculated using Equation 1 as provided in Table 3.2.

The heat wheel inlet and outlet operates 24 hours per day. The process volume of beer in the cold services area during the test was assumed to be equal to the volume of beer leaving the package release for that day and included an average of 2.5 percent beer loss. Using Equation 2, a test emission factor was calculated for the release of ethanol from the heat wheel inlet and outlet.

Since there were several samples for which release rates and inlet rates were calculated, it is necessary to compute an average test emission factor for the exhaust from cold services via the heat wheel. This average test emissions factor (TEF_{av}) is calculated by the following:

$$TEF_{AV} = [\Sigma(HW_o - HW_i)] \div n \qquad \text{Equation 3}$$

where:

TEF_{AV} = net average test emission factor, lbs/1,000 barrels
HW_o = test emission factor from the heat wheel exhaust, lbs/1,000 barrels
HW_i = test emission factor from the heat wheel inlet, lbs/1,000 barrels
n = number of samples considered, unitless

The TEF_{AV} for the heat wheel from Equation 3 is calculated to be 1.33 lbs/1,000 barrels. The samples used in calculating emission values for the heat wheel are listed in Table 4.2.

Brewhouse Emission Factor Calculations - VOCs

Sample ID	M (mg)	Sample Vol. (Liters)	Conc. (mg/l)	Actual Gas Flow Rate (acfm)	Test Release (mg/min)	Process Time (min)	Process Volume (bbl)	Test Emission Factor (lb/1000bbl)
VOC-BRH-K1	0.190(1)	79.3	0.0024	16982	1152	193	1100	0.446
VOC-BRH-K2	0.064	74.0	0.0009	16599	406.37	193	1100	0.157
VOC-BRH-K3	0.015	70.3	0.0002	13498	81.58	193	1100	0.032
Kettle Average								0.212
VOC-BRH-LT1	0.110	134.1	0.0008	1216	28.25	103	1100	0.006
VOC-BRH-LT2	0.059	103.2	0.0006	826	13.37	108	1100	0.003
VOC-BRH-LT3	0.120	119.2	0.0010	1180	33.64	110	1100	0.007
Lauter Tun Average								0.005
VOC-BRH-MT1	2.100	44.1	0.0476	149	201.3	94	1100	0.038
VOC-BRH-MT2	1.900	41.0	0.0464	331	435.2	94	1100	0.082
VOC-BRH-MT3	1.200	39.1	0.0307	240	209.1	94	1100	0.039
Mash Tun Average								0.053
VOC-BRH-C1	0.434(2)	172.1	0.0025	1507	107.6	45	1100	0.010
VOC-BRH-C2	0.180	176.9	0.0010	1507	43.43	45	1100	0.004
VOC-BRH-C3	0.350	172.1	0.0020	1507	86.80	44	1100	0.008
Cereal Cooker Average								0.007
VOC-CS-WT1	0.520	7.8	0.0663	228	428.3	20	1100	0.017

Notes:
M - mass of ethanol
Sample Volume (SV)

(1) 30 milliliter condensate sample VOC-BRH-K1C included.
(2) 30 milliliter condensate sample VOC-BRH-C1C included.

Table 3.1

Ethanol Cold Services Emission Factor Calculations

Sample ID	M (mg)	Sample Vol. (Liters)	Conc. (mg/l)	Actual Gas Flow Rate (acfm)	Test Release (mg/min)	Test Emission Factor (lb/1000bbl)
Heat Wheel						
E-CS-HW.1	0.3200	16.0	0.0200	30500	17288.6	3.0384
E-CS-HW.2	0.1000	16.4	0.0061	30500	5260.6	0.9245
E-CS-HW.3	0.0850	16.4	0.0052	30500	446.7	0.7850
E-CS-HW.5	0.0800	16.3	0.0049	30500	4240.9	0.7453
E-CS-IV.1	0.0061	15.6	0.0004	37600	415.5	0.0730
E-CS-IV.2	0.0020	16.4	0.0001	37600	126.9	0.0223
E-CS-IV.3	0.0054	16.4	0.0003	37600	351.2	0.0617
E-CS-IV.5	0.0020	16.3	0.0001	37600	127.4	0.0224
Average					TEF Avg.	1.33
Fermentation*						
E-CS-FERM B3.1	0.6200	3.9	0.1572	1	4.45	
E-CS-FERM B3.2	0.6200	3.9	0.1572	1	4.45	0.0004
E-CS-FERM B3.3	0.4400	3.9	0.1115	2	6.32	0.0005
E-CS-FERM B3.4*	0.4950	3.9	0.1253	2	7.10	0.0006
E-CS-FERM B3.5	0.5500	4.0	0.1387	2	7.85	0.0007
E-CS-FERM B3.6	0.7000	4.0	0.1762	2	9.98	0.0008
E-CS-FERM B3.7	0.8100	3.9	0.2085	27	160.2	0.0155
E-CS-FERM B3.8	0.8100	3.0	0.2707	38	293.2	0.0201
E-CS-FERM B3.9	0.9400	3.0	0.3126	48	424.5	0.0450
					Sub-Total	0.0835
E-CS-FERM, displ.			0.0786		0.02	0.0203
E-CS-FC.1	0.0063	2.0	0.0031	1060	94.01	0.0056
					Total	0.1095
Other Sources						
E-CS-CFT 25.1	0.5300	3.7	0.1428			0.0003
E-CS-PFII.1	0.1900	2.0	0.0973			0.0016
E-CS-SYT 34.1	0.6100	3.9	0.1573	26	115.79	0.041
E-CS-2x2.1	0.0170	30.4	0.0006	3738	59.28	0.0205
EPR TANK HEAD	1.1000	1.9	0.5738			

Table 3.2

3.2.2 Fermentation

Emissions from one of the fermenters was measured for ethanol approximately every three hours from November 2 to November 3, 1993 for a 24 hour period while it was venting. The exhaust flow was measured using a hand held velometer during each sampling period. Samples were taken in Tedlar bags and screened with the MIRAN 1B2 analyzer to determine ethanol concentrations and appropriate loading volumes onto carbon sampling tubes. This method assured proper loading and avoidance of breakthrough. Ethanol was detected in all samples. For each sample taken, a test release rate was calculated using Equation 1. The results are provided in Table 3.2.

By plotting each release rate over the fermenter sampling duration and calculating the area under the curve (the sum of each incremented average release rate multiplied by the associated time between those samples), an overall test emission factor was calculated for the fermenter during ventilation. The fermenter test emission factor associated with each sample listed in Table 3.2 was calculated using Equation 2.

In addition to the samples taken during the venting period, there were two additional values incorporated into an overall emission factor for the fermenter. The first was a displacement emission during the filling of the fermenter which was assumed to have a concentration equivalent to half of the first measured sample concentration. The second emission value considered was measured during the two hour venting period prior to a fermenter cleaning in place (CIP). These two emission events have been added into the emission factor and represent the ethanol emission of a fermenter throughout a full fermenting cycle per one thousand barrels of beer. The fermenter emission factors and associated values are listed in Table 3.2. The overall average value is 0.112 lbs/1,000 barrels for a fermenter cycle including the above processes.

3.2.3 Primary Filter and Polishing Filter

The primary filter exhaust was measured on November 2, 1993 during a carbon dioxide purge. A flow was not measurable from this vent because of the wet process conditions, therefore, a displacement volume was used in the calculation of a test release rate. The measured concentration was assumed to be the concentration of the exhaust gas during the entire filter purge cycle. The volume of the filter is 85 barrels (9,973 liters) and the filter is also under approximately three atmospheres of pressure. Thus, the actual exhaust volume was approximated to be 29,920 liters. However, both primary filters purge a total of six times per day. Therefore, the total exhaust volume for one day is 179,523 liters. The following equation was used to calculate the emission factor for this process.

$$TEF = (C \times V) \div Vp) \times 2.205 \times 10^{-3} \qquad \text{Equation 4}$$

where:

TEF = test emissions factor, lbs/1,000 barrels
C = ethanol conc., mg/l
V = filter volume, liters
Vp = process volume, barrels
2.205×10^{-3} = conversion of milligrams to lbs per 1,000 barrels

By using Equation 4, a test emission factor is calculated as 1.61E-03 lbs/1,000 barrels. The results are listed in Table 3.2 under "Other Sources" as Sample ID E-CS-PFII.

There are a total of three polishing filters; two of which filter pasteurized beer. The third polishing filter (polish draft filter) is only for nonpasteurized beer, and purges once per day. By applying the sample concentration of E-CS-PFII in Equation 4, the test emission factor was calculated as 8.56E-04 lbs/1,000 barrels.

3.2.4 Ceramic Filtration System

The ceramic filtration system or cold filter trap, was measured on November 3, 1993. The flow rate was measured using a hand held velometer. This system filters the nonpasteurized beer at a cold temperature prior to packaging.

The sample was first collected in a Tedlar bag, screened with the MIRAN 1B2 analyzer and then metered onto a carbon trap. The sampling occurred between purges prior to the filter trap cleaning. The emissions from the ceramic filter trap were estimated by calculating the test release rate using Equation 4. The test emission factor for the ceramic filter is listed in Table 3.2 under Other Sources as Sample E-CS-CFT 25.1.

3.2.5 Spent Yeast Tank

The spent yeast tank was measured for ethanol emissions on November 3, 1993. A flow rate was measured from the exhaust of the tank and is reported in Table 3.3. The sampling was performed by collecting a whole air sample. Screening was performed with a MIRAN 1B2 unit and by knowing the sample concentration, an appropriate sample volume was loaded onto a carbon trap. The analysis of the charcoal trap reported a detectable level of ethanol. The test release rate from the spent yeast tank was calculated by using Equation 1. The results are presented in Table 3.2 under other sources as Sample ID E-CS-SYT 34.1.

The release rate, the process time and volume of the spent yeast tank were considered in calculating the test emissions factor. The test emission factor was calculated using Equation 2 and was equal to 0.041 lbs/1,000 barrels.

3.2.6 Cold Services Exhausts

The cold services also has an independent exhaust that is separate from the heat wheel system. It operates continuously and was measured on November 5, 1993. A flow rate was taken during sampling using a hand held velometer. The sample taken was loaded directly onto a carbon trap and a detectable ethanol concentration was reported. For the test sample, the test release rate was determined by using Equation 1. A test emission factor was calculated using Equation 2 based on one day of exhaust and the process volume was assumed to be equivalent to the volume of beer leaving packaging release on the day of the test. The calculated values for this cold services exhaust for both the test release rate and the test emission factor are listed in Table 3.2. The emission factor for this source was 0.0205 lbs/1,000 barrels.

3.2.7 Spent Diatomaceous Earth

This source contains ethanol at levels similar to those occurring initially in the spent yeast tank. The test release rate is provided in Table 3.2 under other sources as Sample ID E-CS-SYT 34.1.

3.2.8 Surge Tanks

Twelve surge tanks were accounted for in the emissions survey. The surge tanks only exhaust after a CIP and under excess pressure conditions. They were not sampled directly, however, ethanol concentrations leaving the surge tanks during the tank fill after CIP were considered equivalent to that of the aging tank head space since the surge tanks contain brewed beer. Therefore, the emissions from this source are dependent upon the frequency of CIP and the displacement volume of the tanks. The surge tanks are cleaned once every three weeks and the surge tanks have a volume of 800 barrels each (93,868 liters).

By using the concentration of the aging tank headspace (0.574 mg/l) and multiplying through by an assumed displacement volume, a mass of 53,505 milligrams (0.118 lbs) is calculated by Equation 4. Multiplying this mass by twelve surge tanks and assuming 17.3 individual tank releases per year, based upon a tri-weekly CIP, an estimated annual ethanol emission rate is calculated to be 24.5 lbs/yr. Furthermore, by dividing through by the 1993 beer production in brewed barrels, a test emission factor of 0.00613 lbs/1,000 barrels is estimated. This value can be applied directly to an annual value for barrels of beer brewed per year.

3.3 Utilities

Ethanol sampling was performed in the Utilities facility. The Utilities facility filters fermentation off-gas through various traps, carbon beds and dryers. The purified gas is primarily used in aging to maintain a blanket of carbon dioxide over brewed beer that is being aged for packaging.

There are four carbon beds or purifiers at the Fulton facility. At any given time, one of these beds will be on a regeneration cycle. During this cycle, the carbon bed is flushed with clean air and thermally regenerated to clean the carbon bed of any organics. The measurement of ethanol emissions from carbon bed regeneration was taken during a 36 hour period from November 2, 1993 to November 3, 1993. During the sampling period, flow rates were determined for the carbon bed. Samples were first taken into a whole air Tedlar sample bag, screened on the MIRAN 1B2 analyzer and then metered onto a carbon trap for subsequent analysis via a certified laboratory. A total of seven samples was taken and all contained a detectable level of ethanol as shown in Table 3.3.

A test release rate for the carbon regeneration was calculated by using Equation 1. The process time and volume of brewed beer were used to calculate a test emission factor. The process value is based on the average volume of beer produced while the carbon bed was on filtration. These values were used to obtain a test emission factor by following Equation 2. The TEF_{AV} for the carbon regeneration process is 0.035 lbs/1,000 barrels.

Ethanol Utilities Emission Factor Calculations

Sample ID	M (mg)	Sample Vol. (Liters)	Conc. (mg/l)	Actual Gas Flow Rate (acfm)	Test Release (mg/min)	Test Emission Factor (lb/1000bbl)
EU-CREGN.1	0.0690	4.1	0.0166	360	169.7	0.045
EU-CREGN.2	0.0810	4.3	0.0187	360	190.9	0.050
EU-CREGN.3	0.0520	6.8	0.0076	360	77.85	0.021
EU-CREGN.4	0.0810	7.2	0.0113	353	113.0	0.030
EU-CREGN.5	0.0900	7.4	0.0122	360	124.7	0.033
EU-CREGN.6	0.0940	7.5	0.0125	265	93.85	0.025
EU-CREGN.7	0.0920	7.6	0.0121	461	157.4	0.041
Carbon Regeneration					TEF Avg.	0.035
EU-EXH-C2.1	0.1300	19.0	0.0068	16200	3132	0.550
EU-EXH-C9.1	0.1800	19.1	0.0094	16200	4312	0.758
Utilities Ventilation					TEF Avg.	0.655

TEF = Test mission Factor

Table 3.3

In addition to the carbon regeneration process emissions, Utilities has nine other exhaust locations. Two of the Utilities exhaust locations were measured for ethanol emissions by direct loading onto a carbon trap on November 3, 1993. Four of the nine exhaust locations were operating in the utilities building during the test. Both samples contained detectable ethanol concentrations. Exhaust flow rates were measured with a hand held velometer and were also approximated from fan curves supplied by Miller personnel.

The test release rate as calculated by using Equation 1, is presented in Table 3.3. The test emission factor was calculated by factoring in the amount of brewed beer that was released to packaging. The calculated value is 2.62 lbs/1,000 barrels of brewed beer with four fans operating. One would expect emissions to decrease as more fans go on line. The test emission factor is again used in calculating the annual and maximum annual emission rates in Section 4.0.

3.4 Packaging and Annex

3.4.1 Packaging

Measurement of ethanol emissions from the packaging facility was performed on November 4 and 5, 1993. Sampling was performed at various locations above the pasteurized and nonpasteurized bottling and canning lines, beer dump and the nonpasteurized bottling line on November 4, 1993. The roof locations servicing the keg filling station area and indoor building air near the railroad car staging area were sampled on November 5, 1994.

Exhaust rates, which were supplied by Miller via fan specifications, were used in calculating all emission rates with the exception of a high velocity fan located above the line 13 filling station and the exhaust servicing the non-pasteurized line. Both exhausts were measured using a velometer and/or hot wire anemometer.

All packaging samples contained detectable levels of ethanol with the exception of all three beer dump test charcoal sample traps. All charcoal trap mass loadings were within the designed range. Therefore, sample breakthrough, if any, was insignificant.

Emissions from each exhaust sampled above the bottling and canning areas of the packaging facility were first calculated as a test release rate in milligrams per minute by applying Equation 1. These values are presented in Table 3.4. These values were further converted to lbs/hr values.

Emissions for the pasteurized and nonpasteurized bottling and canning lines were estimated by averaging the observed ethanol emissions from six exhaust locations for five 1-hour November 4, 1993 production periods as provided in Table 3.4. Production values in barrels for seven packaging lines were provided for each 1-hour production period and averaged for all five 1-hour periods per line. A total hourly average of barrels packaged was calculated for five of the lines. The nonpasteurized line average hourly production was not added to this value since this line is serviced by a separate process exhaust system. However, fugitives from other conveyors and equipment on the nonpasteurized line are believed to contribute to exhaust ethanol emissions. Eliminating nonpasteurized average hourly production from the total hourly average production will likely yield a slightly more conservative pasteurized and nonpasteurized bottling and canning line ethanol emission factor.

Next, an ethanol emission and beer production profile of the roof area exhaust and production floor was developed in order to estimate an average ethanol emission for the roof areas (A and B) over the filling and pasteurization sections of the packaging lines. Average production and A and B exhausted ethanol values from Table 3.5 were plotted in Figure 3.1. The A exhausts are identified as those directly above the filling stations and the B exhausts are above the pasteurizing section of each line. The results indicate that the emission rates above the filling stations is much greater than the emissions above the pasteurizing section. An average emission rate for all A exhausts and all B exhausts was estimated by calculating the average concentration for each emission rate curve in Figure 3.1. The average A and B exhaust emission rates were calculated to be 1.39 and 0.498 pounds per hour (lbs/hr), respectively.

The pasteurized bottling and canning line emission factor was calculated by multiplying the sum of the average A and B vent emission rates by the number of A/B vent pairs (13) and correcting this value to a per 1,000 barrel production value using the 799.1 barrel total hourly average from Table 3.5. Using the following equation with applicable data, the calculated pasteurized bottling and canning line test emission factor TEF is 30.7 lbs/1,000 barrels.

Packaging and Annex Emission Factor Calculations

Packaging: Ethanol

Sample ID	M (1) (mg)	Sample Vol. (2) (Liters)	Conc. (mg/l)	Actual Gas (3) Flow Rate (acfm)	Test Release (mg/min)
A/B Roof Area					
EP-B13-A.1	0.540	19.6	0.0275	20106	15670
EP-B13-A.2	0.570	19.7	0.0289	20106	16470
EP-B13-B.1	0.320	19.6	0.0163	13500	6233
EP-B13-B.2	0.410	19.7	0.0208	13500	7954
EP-C9-A.2	0.810	19.7	0.0412	13500	15750
EP-C9-A.3	1.000	19.6	0.0510	13500	19490
EP-C9-B.1	0.270	20.4	0.0133	13500	5072
EP-C9-B.2	0.280	20.6	0.0136	13500	5202
EP-B4-A.1	0.110	22.3	0.0049	13500	1885
EP-B4-A.2	0.110	22.3	0.0049	13500	1885
EP-B4-A.3	0.110	23.2	0.0047	13500	1812
EP-B4-B.1	0.072	21.9	0.0033	13500	1258
EP-B4-B.2	0.081	20.6	0.0039	13500	1502
EP-B4-B.3	0.057	20.2	0.0028	13500	1079
EP-B5.1	1.100	22.5	0.0490	6013	8338
EP-B5.2	0.660	21.3	0.0309	6013	5268
EP-B5.3	0.600	18.2	0.0330	6013	5614
Keg Wash Area					
EP-EF29.1	0.030	19.2	0.0016	13500	596.6
EP-EF29.2	0.026	18.8	0.0014	13500	529.6
EP-EF29.3	0.020	18.8	0.0011	13500	407.4
Beer Dump Area					
EP-BD-13.1	<.0039	19.9			
EP-BD-13.2	<.0039	20.1			
EP-BD-13.3	<.0039	14.8			
Indoor Samples					
EP-RC.1	0.1000	19.5	0.0051		
EP-RC.2	0.0690	19.9	0.0050		

Annex: Ethanol

Sample ID	M (1) (mg)	Sample Vol. (2) (Liters)	Conc. (mg/l)	Actual Gas (3) Flow Rate (acfm)	Test Release (mg/min)
EA-CW.1	0.0720	21.0	0.0034	13500	1311.25
EA-CW.2	0.0760	21.7	0.0035	13500	1337.59
EA-CW.3	0.0700	21.7	0.0032	13500	1231.56
EA-1B9.1	0.1100	19.7	0.0056	13500	2140.01
EA-1B9.2	0.0990	20.5	0.0048	13500	1843.21
EA-1B9.3	0.1100	20.4	0.0054	13500	2058.57

(1) M - sample catch as reported by the contract laboratory (EHL).
(2) Sample volume corrected to source conditions.
(3) Actual gas flow rate as provided by Miller or measured by the SBE team.

Packaging Emission Rates Estimate

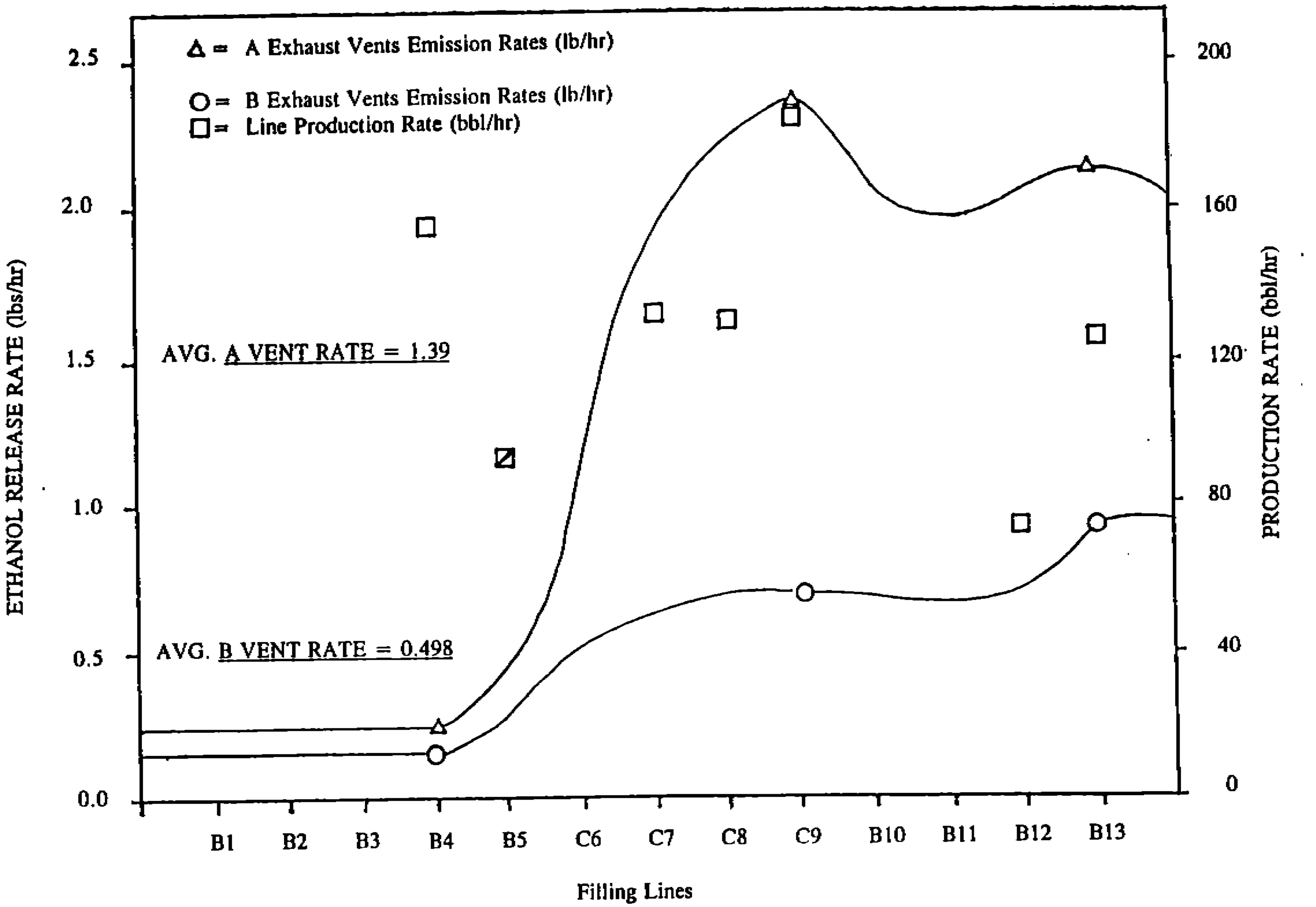


Figure 3.1

Packaging Bottle and Can Filling Ethanol Emissions

Test Time	0830-0930		0930-1030		1030-1130		1330-1430		1430-1530		Test Average	
Line ID	Production (bbl)(1)	Exhausted Ethanol (A/B vent)(3) (lbs)(2)	Production (bbl)(1)	Exhausted Ethanol (A/B vent)(3) (lbs)(2)	Production (bbl)(1)	Exhausted Ethanol (A/B vent)(3) (lbs)(2)	Production (bbl)(1)	Exhausted Ethanol (A/B vent)(3) (lbs)(2)	Production (bbl)(1)	Exhausted Ethanol (A/B vent)(3) (lbs)(2)	Production (bbl)(1)	Exhausted Ethanol (A/B vent)(3) (lbs)(2)
B1												
B2												
B3												
B4	181.4	0.249/	169.3	0.249/0.166	145.1	0.240/	157.2	/0.199	122.4	/0.143	155.1	0.246/0.169
B5(3)	87.1		87.1		108.9	1.103(4)	87.1	0.697	101.4	0.743	94.4	0.848
C6(3)												
C7	72.6		130.6		167.5		188.7		101.1		132.1	
C8	195.9						195.9		253.6		129.1	
C9	98.4		170.1		217.7		225.0	2.083/0.671	204.9	2.578/0.688	183.2	2.331/0.680
B10												
B11												
B12	8.9		87.1		79.8		101.6		95.6		74.6	
B13	116.1	2.072/0.825	137.9	2.179/1.052	123.4		108.9		138.6		125.0	2.126/0.939
										Total(5)	799.1	

1. Production provided by Miller per line per 1 hour test time. Blank values denote zero production for that line.
2. Observed ethanol emissions assumed for the 1 hour test time. Blank values denote no test data.
3. A exhaust - located over the filling station of the associated line.
   B exhaust - located over the pasteurization section of the associated line.
4. Non-pasteurized lines B5 and C6 data are presented but not used for profiling the average exhaust rate. Each non-pasteurized line has only one process exhaust vent.
5. Non-pasteurized production (B5) was not averaged into the total average production value by assuming that all ethanol emissions are serviced by the single exhaust therefore influencing a more conservative pasteurized bottling and canning emission factor (see Figure 4.1).

Table 3.5

$$TEF = (ER_A + ER_B) \times (A/B \text{ vent pairs}) \times 1{,}000 \div PRH \qquad \text{Equation 5}$$

or, $TEF = ((1.39 \text{ lbs/hr} + 0.498 \text{ lbs/hr}) \times (13) \times (1{,}000 \text{ barrels})) \div 799.1$ barrels/hr

where:

TEF = test emission factor, lbs/1,000 barrels
PRH = total hourly average production, barrels/hr
1,000 = emission factor conversion to lbs/1,000 barrels/hour
A/B vent pairs = number of A/B vent pairs (13)
ER_A = average A vent emission rate, lbs/hr
ER_B = average B vent emission rate, lbs/hr

A test emission factor for the nonpasteurized line clean room was based on the measured exhaust concentration and the exhaust flow rate as shown in Table 3.5.

The nonpasteurized bottling line emission factor, 8.98 lbs/1,000 barrels, based only on the clean room vent is less than the pasteurized bottling and canning line emission factor (30.7 lbs/1,000 barrels). However, the nonpasteurized bottling line fugitives cannot be determined. Thus, the final nonpasteurized bottling and canning lines emission factor will assumed to be equal to the pasteurized bottling and canning operation emission factor.

As mentioned above, the beer dump ethanol samples were reported by the analytical laboratory as not detected (Table 3.4 Sample EP-13). In estimating a beer dump emission factor, the A vent emission value (bottling and canning lines) corrected to 1,000 barrels of production will be used since MIRAN measurements indicated exhaust concentrations were similar. This beer dump test emission factor (1.74 lbs/1,000 barrels) is calculated according to the following equation and input parameters:

$$TEF = [(ER_A) \times (1{,}000)] \div PRH \qquad \text{Equation 6}$$

or, $TEF = [(1.39 \text{ lbs/hr}) \times 1{,}000 \text{ barrels}] \div (799.1 \text{ barrels/hr})$

where

ER_A = average A vent emission rate, lbs/hr
PRH = total hourly average production, barrels/hr
1,000 = conversion factor to lbs/1,000 barrels/hr

The roof area located above the two bottle wash lines was not sampled for ethanol emissions, however, fugitive releases primarily associated with the adjacent filling and packaging activities have been estimated using the average B vent emission value (bottling and canning lines) corrected to 1,000 barrels of production. Based on the test results, the bottle wash emission factor, 0.623 lbs/1,000 barrels, was calculated according to Equation 6.

Sampling on November 5, 1993 included the area servicing the keg filling station (keg-o-matic). The emission factor for the keg-o-matic line is calculated by dividing the average observed hourly ethanol emission rate by the recorded concurrent keg-o-matic production rate. The keg-o-matic test emission factor is 0.338 lbs/1,000 barrels based on the following equation and input parameters:

$$TEF = [(((TRR \div 3) \times 60) \div 453{,}592) \times 1{,}000 \text{ barrels}] \div (200 \text{ barrels}) \qquad \text{Equation 7}$$

where:

TRR = sum of three emission tests
3 = three emission tests
60 = minute to hour conversion
453,592 = milligrams per pound
1,000 = normalized rate production, barrels
200 = test rate production, barrels

Lastly, an emission factor must be determined for all ethanol fugitives not accounted for in the above mentioned exhaust points. An estimated packaging building fugitive emission rate was calculated by assuming that the majority of the fugitive releases occur in the northern third of the packaging building where the building air is likely to escape through doors and cracks due to lack of exhaust vents in the area and distance from active building exhaust vents. The fugitive volumetric flow rate is estimated by multiplying the building's exchange rate by one third the building volume. The ventilation exchange rate of the building, 1.22 room exchanges per hour, was calculated by using the following equation:

$$VER = (Q_T \times 60) \div V_B \qquad \text{Equation 8}$$

or,

$$VER = (436{,}882 \text{ cfm} \times 60) \div (21{,}500{,}000 \text{ ft}^3)$$

where:

VER = ventilation exchange rate, room exchanges per hour
Q_T = total building exhaust flow rate, cfm
60 = minutes to hours conversion
V_B = packaging building volume

Therefore, the fugitive volumetric flow rate, 8,740,000 cfh is calculated using the following equation:

$$Q_F = VER \times V_B \div 3 \qquad \text{Equation 9}$$

or, $Q_F = 1.22$ room exchanges per hour x (21,500,000 $ft^3 \div 3$)

where:

Q_F = fugitive volumetric flow rate, cfh
VER = ventilation exchange rate, room exchange per hour
V_B = packaging building volume

Finally, an ethanol building concentration must be applied to the estimated fugitive volumetric flow rate to calculate an emission rate. Indoor air ethanol sampling was performed on November 5, 1993 at the railroad car staging on the northern third of the packaging building. The average indoor ethanol concentration of the two tests was 0.00505 mg/liter. The packaging fugitive test emission factor, 2.76 lbs/hr, is calculated using the following equation:

$$TEF = (C \times Q_F \times 28.32) \div 453{,}592 \qquad \text{Equation 10}$$

or, $TEF = (0.00505 \times 8{,}740{,}000 \times 28.32) \div 453{,}592$

where:

TEF = packaging fugitives ethanol test emission factor, lbs/hr
C = average railroad car staging area ethanol concentration, mg/liter
Q_F = fugitive volumetric flow rate, cfh
28.32 = liters to cubic feet conversion
453,592 = milligram to pounds conversion

3.4.2 Annex

Ethanol sampling was performed in the annex building on November 4, 1993. Triplicate samples were collected at the depelletizer unit and on the catwalk on the opposite side of the building. Exhaust rates were supplied by Miller based on fan specifications. All annex samples contained detectable levels of ethanol. All charcoal trap mass loadings were within the designed range.

Emissions for the annex building were estimated by averaging the averaged observed ethanol concentrations at both sample locations mentioned above and multiplying by the total annex building exhaust rate. The annex building ethanol mass emission rate or test emission factor is 0.219 lbs/hr of operation, calculated using Equation 10 and substituting the total volumetric flow for each of the three 13,500 acfm exhaust locations. These calculations are provided in Table 3.4.

3.5 Wastewater Treatment Plant

Sampling for ethanol at the Wastewater Treatment Plant, occurred initially as part of the pretest survey where instantaneous values were measured. Grab samples (30-minute duration) were also taken during the full field effort. Both values were used in defining the ethanol release rate from the plant. Meteorological data were collected during field efforts so that diffusion modeling could be applied to calculate ethanol release rates from the various areas of the wastewater treatment plant. The waste water treatment plant, for modeling purposes, was divided into three areas: the equalization tank area, the primary clarifiers and the aeration basins.

Modeling for Ethanol Emissions at the WWTP

The U.S. EPA computer model CAL3QHC was chosen to simulate the ethanol dispersion characteristics in ambient air at the WWTP. This model was selected for its ability to predict near field receptor concentrations. Other similar models have not been as well documented in this regard.

By simulating ethanol dispersion in the air using CAL3QHC and having sampled the air at selected locations (i.e., receptor sites) around the WWTP, emission release rates were developed for the three main WWTP areas (i.e., sources) identified above. Factors upon which the modeling was based included:

WWTP Calculated Ethanol Emission Factors

SOURCE	TOTAL AREA (m)	CALCULATED 1993 EMISSION FACTORS	
		(g/m2 - sec)	(lbs/1000 bbls)
Equalization Tank Area	300	2.66x10	10.5
3 Primary Clarifiers	650	2.56x10	2.2
4 Aeration Basins	2,900	8.25x10	3.2

Table 3.6

- The influent waste stream channel, equalization tank, weir, etc. could be considered individual line sources, each with associated surface areas and then summed to give a total emission factor for the equalization tank area. Similarly, discrete line sources, consisting of those WWTP components contributing emissions to a specified receptor, could have emission factors calculated based upon modeling results which were then weighted and summed to obtain a total source area emission factor.

- Emission factors for the individual line sources could be determined by matching the actual sampled concentrations to the concentration outputs from the model. This was done by initially assuming a source emission factor and then refining this assumption to match the observed data.

- The average sampled receptor concentration for ethanol at the various areas downwind were representative of normal plant operations.

- The meteorological data taken during sampling events was used for determining emission factors.

- No significant ethanol emissions occur after the aeration basins due to the biodegradation processes which occur within these basins limiting the amount of ethyl alcohol remaining in the wastewater.

The emission factors developed from the modeling and field sampling efforts are listed in Table 3.6.

4.0 ACTUAL AND POTENTIAL ANNUAL RELEASE RATES

The results of the emission tests, annual usage rates and other data are used in this section to calculate the actual annual release rates and potential annual release rates.

4.1 Brewhouse

The brewhouse facility test emission factors calculated in Section 3.1 will be applied in this section to the 1993 brewing production values for the generation and presentation of estimated 1993 annual emission rates (AER) associated with brewhouse activities. Potential emission rates (PER) will be based on an extrapolated value of 6,040,000 barrels brewed to produce 8,000,000 finished barrels packaged at peak capacity.

Total Volatile Organic Compounds (VOCs)

The total VOC test emission factors for the brewhouse facility (Table 3.1) have been averaged for each location and presented in Table 4.1. There are five sources of VOC emissions in the brewhouse: kettle, mash tun, hot wort tank, lauter tun and cereal cooker. Each relative average test emission factor is then multiplied through by the 1993 brewery process volume calculated from brew data to obtain an annual emission rate in pounds per year.

All locations had an annual process value of 4,000,000 barrels applied to the average test emission factors except for the cereal cooker. The cereal cooker is responsible for approximately 72 percent of the wort produced and the remaining 28 percent is brewed for brands which do not require the cereal cooker process. Therefore, the annual cereal cooker process volume for 1993 was 2,880,000 barrels.

From the ratio of barrels brewed at capacity (6,040,000 barrels) to the 1993 process value at the brewery (4,000,000 barrels), a factor of 1.51 is established. This factor is then used to multiply the 1993 annual emission rates to obtain the potential annual emission rates. The estimated 1993 kettle, mash tun, hot wort tank, lauter tun and cereal cooker VOC emission rates are 846, 212, 69, 22 and 20 lbs/yr., respectively. The estimated potential VOC emission rates are 1278, 321, 104, 33 and 31 lbs/yr., respectively. These values are listed in Table 4.1.

Brewhouse Actual and Potential VOC Emissions

COMPOUND/SOURCE	TEST EMISSION FACTOR(1) (lb/1000 bbls)	1993 ANNUAL PRODUCTION(2) (bbls)	1993 ANNUAL AVERAGE EMISSIONS(3) (lb/yr)	POTENTIAL ANNUAL EMISSIONS(4) (lb/yr)
Volatile Organic Compounds				
Kettle	0.212	4000000	846	1278
Mash Tun	0.053	4000000	212	321
Hot Wort	0.017	4000000	69	104
Lauter Tun	0.005	4000000	22	33
Cooker	0.007	2880000	20	31
		Total	**1169(5)**	**1766**

(1) Based on emission factor calculations presented in Section 3.1.
(2) Based on brewhouse process data.
(3) Result of the emission factor multiplied by 1993 annual production.
(4) Potential emissions (lbs/yr) are based upon a 8,000,000 barrel plant production capacity. A 1.51 conversion factor was used to translate the 1993 emissions to a potential emission value (8,000,000 bbls capacity/ 5,300,000 bbls 1993 production).
(5) VOC's Brewhouse = 1169 lbs/yr = 0.292 lbs/1000 bbls of finished beer.

4.2 Cold Services

The cold services facility test emission factors calculated in Section 3.2 will be applied in this section to 1993 brewing production values for generation and presentation of estimated 1993 emissions associated with fermentation, ventilation and heat transfer, filtration, spent yeast tanks and aging processes. Potential emissions will be based on a 6,040,000 barrel plant production capacity from brewing.

The ethanol test emission factors for the cold services facility (Section 3.2) have been provided in Table 4.2 for nine sources including: heat wheel, fermentation, spent yeast, ventilation, surge tanks, primary filter, regular polish filter, draft polish filter, and cold filter. The assigned average emission factor for each source is multiplied by the 1993 annual production values supplied by Miller to calculate the 1995 annual emission rates.

4.2.1 Heat Wheel

To calculate the annual emission rate in pounds per year, the average test emission factor is multiplied by the 1993 annual production of brewed beer. Additionally, the potential annual emission rate is calculated by multiplying the capacity by the 1993 annual potential production factor of 1.51. The estimated 1993 heat wheel ethanol emissions are 5,314 lbs/yr. and the estimated potential ethanol emission is 8,024 lbs/yr.

4.2.2 Fermentation

The fermentation test emission factors listed in Table 3.2 for ethanol have been summarized into one overall test emission factor listed in Table 4.2. This value, as discussed in Section 3.2, was calculated by taking the area under the curve generated by sampling over a 24-hour period and includes the fermentation displacement during the fill sequence and the two hour venting period prior to the fermentation CIP.

Cold Services Actual and Potential Ethanol Emissions

SOURCE	TEST EMISSION FACTOR(1) (lb/1000 bbls)	1993 ANNUAL PRODUCTION(2) (bbls)	1993 ANNUAL AVERAGE EMISSIONS(3) (lb/yr)	POTENTIAL ANNUAL EMISSIONS(4) (lb/yr)
Heat Wheel	1.33E+00	4000000	5314	8024
Fermentation	1.09E+00	4000000	437.84	661.14
Spent Yeast	4.05E-02	4000000	162	245
Ventilation	2.05E-02	4000000	82.2	124.1
Surge Tanks	6.13E-03	4000000	24.5	37
Primary Filter	1.61E-03	4000000	6.45	9.74
Regular Polish Filter	9.24E-04	4028000(5)	3.72	5.62
Draft Polish Filter	8.56E-04	1272000(5)	1.09	1.64
Cold Filter	3.32E-04	1272000(5)	0.42	0.64
		Total	**6,044(6)**	**9,126**

(1) Based on emission factor calculations presented in Section 3.3.
(2) Based on brewhouse process data.
(3) Result of the emission factor multiplied by 1993 annual production.
(4) Potential emissions (lbs/yr) are based upon a 8,000,000 barrel plant production capacity. A 1.51 conversion factor was used to translate the 1993 emissions to a potential emission value (8,000,000 bbls capacity/ 5,300,000 bbls 1993 production).
(5) Based on 1993 finished barrels of 5,300,000.
(6) Ethanol for Cold Services = 6044 lbs/yr = 1.14 lbs/1000 bbls of finished beer.

4.2.3 Primary and Polishing Filters

The estimated 1993 primary filter ethanol emission rate is 6.45 lbs/yr. The estimated potential combined primary filter ethanol emissions rate has been calculated to be 9.74 lbs/yr.

There is approximately a 76 percent and 24 percent split in process volume, between regular and draft beer respectively. Therefore, the 1993 process volume of the regular polish filter is equal to 4,028,000 barrels and the draft polish filter is 1,272,000 barrels. The 1993 process volume in finished barrels for these locations and the test emission factors are presented in Table 4.2.

The estimated 1993 regular polish filter and draft polish filter ethanol emission rates are 3.72 and 1.09 lbs/yr., respectively. The estimated potential regular polish filter and draft polish filter ethanol emission rates are 5.62 and 1.67 lbs/yr., respectively.

4.2.4 Ceramic Filtration System (Cold Filter)

The ethanol test emission factor for the ceramic filtration system calculated in Section 3.2 is presented in Table 4.2. The ceramic filter is responsible for the cold filtering of all nonpasteurized beer. The annual process volume for the nonpasteurized beer has been estimated from the total barrels brewed in 1993 and a 24 percent production of cold filtered beer; this being equivalent to 1,272,000 barrels as a process volume.

From these values, listed in Table 4.2, the estimated 1993 ceramic filter ethanol emission rate has been calculated to be 0.42 lbs/yr.. The potential ceramic filter ethanol emission rate has been calculated to be 0.64 lbs/yr..

4.2.5 Spent Yeast Tank

The ethanol test emission factor for the spent yeast tank calculated in Section 3.2 is presented in Table 4.2. The spent yeast tank is a storage unit for all fermentation yeast filtered out of the beer. The annual process value for the spent yeast tank is equivalent to the annual barrels of beer brewed in 1993 and is listed in Table 4.2.

Based on the test emission factor and process volume, the estimated 1993 spent yeast tank ethanol emission rate has been calculated to be 162 lbs/yr.. The potential spent yeast tank ethanol emission rate has been calculated to be 245 lbs/yr..

4.2.6 Ventilation

The ethanol test emission factor for the cold services ventilation calculated in Section 3.2 is presented in Table 4.2. Unlike the heat wheel, this source is a general ventilation unit. The annual process volume for this source is equivalent to the annual barrels of beer brewed in 1993 and is presented in Table 4.2.

From the test emission factor and annual process volume data, the estimated 1993 ethanol emission rate from ventilation has been calculated to be 82.2 lbs/year. The estimated potential ventilation ethanol emission rate has been calculated to be 124.1 lbs/year.

4.2.7 Surge Tanks

The ethanol test emission factor for the surge tank calculated in Section 3.2 is presented in Table 4.2. The calculation in Section 3.2 was based completely on the fill cycles of the surge tank. The annual process volume of the surge tank is equivalent to the annual barrels of beer brewed in 1993 and is presented in Table 4.2.

From the test emission factor and annual process volume, the estimated 1993 surge tanks ethanol emission rate has been calculated to be 24.5 lbs/yr. The estimated potential surge tank ethanol emission rate has been calculated to be 37 lbs/yr.

4.3 Utilities

The utilities facility test emission factors calculation in Section 3.3 was applied to 1993 brewing production values for generation and presentation of estimated 1993 emissions associated with carbon bed regeneration and utility ventilation units. Potential emissions will be based on a 6,040,000 barrel plant production capacity from brewing.

The carbon regeneration emission factor used to calculate the annual emission rates is presented in Table 4.3. The ethanol test emission factor per exhaust area for the utilities facility was calculated (Section 3.3) and is used to determine the total actual annual 1993 emission rate. Four exhaust areas are assumed to be operating under average conditions. The total Utilities test emission factor is then multiplied by the 1993 annual production values supplied by Miller to calculate an annual emission rate. The estimated 1993 carbon regeneration and Utilities ventilation ethanol emission rates are 140 lbs/yr. and 10,467 lbs/yr., respectively. The estimated potential ethanol emission rates for the carbon regeneration and utilities vents are 211 lbs/yr. and 15,804 lbs/yr., respectively.

4.4 Packaging and Annex

Packaging and annex facility test emission factors calculated in Section 3.4 were applied to 1993 packaging production values for generation and presentation of estimated 1993 emissions associated with packaging and annex activities. Potential emissions will be based on a 8,000,000 barrel plant production capacity of finished product.

4.4.1 Packaging

Ethanol test emission factors for the packaging facility derived in Section 3.4 are presented in Table 4.4. As noted in Table 4.4, there are five major sources of ethanol emissions: bottling and canning lines, beer dump, bottle wash roof vents, keg-o-matic and fugitives. The assigned emission factor for each source is then multiplied by the 1993 annual production values as supplied by Miller Brewing Company.

The bottling and canning lines 1993 annual production value was based on the facility's total 1993 production (5,300,000 barrels) of which 85.9 percent (4,500,000 barrels) consisted of bottled and canned beer. This production value was also assumed for the bottle wash roof vents where ethanol emissions are primarily influenced by bottling and canning activities.

The beer dump pass through volume was estimated by assuming 10 percent of the total 1993 packaging facility losses are processed at the beer dump. Packaging losses for 1993 are estimated to be 5.7 percent (average from January to August 1993) or 302,000 barrels. Ten percent of the 1993 total 302,000 barrel packaging loss (assumed beer dump pass through) would be 30,200 barrels. The keg-o-matic line production was provided by Miller Brewing Company.

Utilities Actual and Potential Ethanol Emissions

SOURCE	TEST EMISSION FACTOR (1) (lb/1000 bbl)	1993 ANNUAL VOLUME PRODUCTION (2) (bbls/yr)-brew	1993 ANNUAL AVERAGE EMISSIONS (3) (lb/yr)	POTENTIAL ANNUAL EMISSIONS (4) (lb/yr)
Utilities Ventilation	2.62E+00	4000000	10467	15804
Carbon Regeneration	3.00E-02	4000000	140	211
		Total	**10,607(5)**	**16,015**

(1) Based on emission factor calculations presented in Section 3.4.
(2) Based on brewhouse process data.
(3) Result of the emission factor multiplied by 1993 annual production.
(4) Potential emissions (lbs/yr) are based upon a 8,000,000 barrel plant production capacity. A 1.51 conversion factor was used to translate the 1993 emissions to a potential emission value (8,000,000 bbls capacity/ 5,300,000 bbls 1993 production).
(5) Ethanol for Utilities = 10,607 lbs/yr = 2.00 lbs/1000 bbls of finished beer.

Fugitive emissions at the Miller Brewing facility were considered during a 24-hour per day, 5-day per week, 52-week per year production schedule. Therefore the test emission factor will be applied to 6,240 hours per year.

The estimated 1993 packaging facility ethanol emissions are calculated by multiplying the assigned test emission factor by the corresponding 1993 annual production value for each location presented in Table 4.4. The estimated total 1993 packaging facility ethanol emissions are 163,000 pounds (81.5 tons/year). The potential annual emissions are calculated by multiplying each 1993 emission value by the ratio of the facility's capacity to the actual 1993 production (8,000,000 barrel capacity/5,300,000 barrel 1993 production), 1.51. The resulting total potential packaging facility annual ethanol emission is 246,000 pounds per year (123 tons/year).

4.4.2 Annex

The annex ethanol test emission factor derived in Section 3.4 is presented in Table 4.5. The three annex exhaust fans were assumed to operate 24 hours per day, 365 days per year (8,760 hours per year). The annex building 1993 ethanol emission for each exhaust area was calculated by multiplying the test emission factor by the 1993 hours of operation. The individual 1993 ethanol emission for each area was 1,918 pounds. The estimated total 1993 packaging facility ethanol emissions are 5,755 pounds per year. Once again, the potential annual ethanol emission rate for the annex was calculated by multiplying with the standard 1.51 conversion factor (8,000,000 barrel capacity/5,3000,000 1993 barrel production). Thus, the potential annual annex ethanol emission is 8,688 pounds/year.

4.5 Results of WWTP Ethanol Emission Modeling

4.5.1. Modeling Results

The output of the CAL3QHC modeling using field sampling results determined the ethanol emission factors in lbs/1,000 barrels for each source area as shown in Table 4.9. These emission factors were then applied to the 1993 annual production of 5,300,000 barrels and potential annual production of 8,000,000 barrels to determine the total annual ethanol emissions for each source area (see Table 4.6). These figures were totaled for the

Packaging Actual and Potential Ethanol Emissions

SOURCE	TEST EMISSION FACTOR(1)	1993 ANNUAL PRODUCTION(2)	1993 ANNUAL AVERAGE EMISSIONS (3) (lb/yr)	POTENTIAL ANNUAL EMISSIONS(4) (lb/yr)
Bottling/Canning lines	30.7 lb/1,000 bbls	4,550,000 bbls	140,000	211,000
Beer dump	1.74 lb/1,000 bbls	30,200 bbls (5)	52.5	79.37
Bottle wash roof area	0.623 lb/1,000 bbls x2	4,550,000 bbls	5,670	8,560
Keg-o-matic	0.338 lb/1,000 bbls	750,000 bbls (6)	254	384
Fugitives	2.76 lb/hr	6,240 hrs/yr (7)	17,200	26,000
		Total	approx. 163,000 (8)	approx. 246000

(1) Based on test emission factor calculations presented in Section 3.5.
(2) 1993 annual production values provided by Miller except for ethanol fugitives which are released 24 hours per day, 5 days per week, 52 weeks per year.
(3) Result of the emission factor multiplied by 1993 annual production.
(4) Potential emissions (lbs/yr) are based upon a 8,000,000 barrel plant production capacity. A 1.51 conversion factor was used to translate the 1993 emissions to a potential emission value (8,000,000 bbls capacity/ 5,300,000 bbls 1993 production).
(5) Based on the assumption that 10% of the packaging beer losses pass through the beer dump. 1993 packaging beer losses are estimated to be 5.7% (average from January to August 1993) or 302,000 barrels.
(6) Keg-o-matic (keg 80) line consisted of 14.1% (750,000 bbls) of the 1993 production (5,300,000 bbls).
(7) 24 hours per day, 5 days per week 52 weeks per year.
(8) Ethanol Packaging = 163,000 lb/yr = 30.8 lbs/1000 bbls finished beer

WWTP: 1993 actual emissions were 84,300 lbs. or 42.2 tons and potential annual ethanol emissions could be 63.7 tons.

4.5.2 Comparison to the 1992 Coors Study

The Coors Study (Coors, 1992) used the BASTE model developed by CH2M-Hill to represent the Golden, Colorado brewery's Process Waste Treatment Plant (PWTP). The average influent to the Coors PWTP was 5.7 million gallons per day with an average ethanol concentration of 600 parts per million. The output of the BASTE model indicated an annual emissions of 77.5 tons of ethanol. In comparison, Fulton's WWTP had an average of 3.5 million gallons per day with an average ethanol concentration of 570 parts per million. The CAL3QHC modeling resulted in estimated 1993 ethanol emissions of 42.2 tons. If the Fulton WWTP processed the same quantity of liquid waste as the Coors PWTP, the Fulton WWTP 1993 ethanol emissions would be 68.7 tons. Given all the variables involved, these results are consistent and add validity to the modeling procedure.

Annex Actual and Potential Ethanol Emissions

SOURCE	TEST EMISSION FACTOR (1) (lb/hr)	1993 ANNUAL HOURS OF OPERATION(2)	1993 ANNUAL AVERAGE EMISSIONS (3) (lb/yr)	POTENTIAL ANNUAL EMISSIONS(4) (lb/yr)
Roof area #1	0.219	8,760 hrs	1,918	2,896
Roof area #2	0.219	8,760 hrs	1,918	2,896
Roof area #3	0.219	8,760 hrs	1,918	2,896
		Total	**5,755**	**8,688**

(1) Based on emission factor calculations presented in Section 3.5.
(2) 1993 annual production values based on exhaust fans running 24 hours per day 365 days per year.
(3) Result of the emission factor multiplied by 1993 annual production.
(4) Potential emissions (lbs/yr) are based upon a 8,000,000 barrel plant production capacity. A 1.51 conversion factor was used to translate the 1993 emissions to a potential emission value (8,000,000 bbls capacity/5,300,000 bbls 1993 production).
(5) Ethanol Annex = 5,755 lb/yr = 1.09 lbs/1000 bbls finished beer.

WWTP Actual and Potential Ethanol Emissions

SOURCE	1993 ACTUAL EMISSION ESTIMATE (lbs/yr)	POTENTIAL ANNUAL EMISSIONS (lbs/yr)
- Equalization Tank Area	55,400	83,700
- 3 Clarifiers	11,700	17,700
- 4 Aeration Basins	17,200	26,000
Total	**84,300**	**127,400**

5.0 SUMMARY

The development of an air emissions investigation for VOCs and ethanol at the Fulton facility required extensive source testing and data analysis due to the complexity and magnitude of the operations at the source. The investigation process provides a view of the VOC and ethanol emissions from the plant under typical operating conditions. The study provides an accurate representation of actual and potential emission rates. The intimate process knowledge of the Miller personnel and the experience of the SBE team were utilized to establish and successfully complete this testing program.

The pollutants of concern for the investigation were volatile organic compounds from the brewhouse and ethanol emissions from the remainder of the plant. It is recognized that, although extensive, the investigation has certain limitations. For example, the report has been compiled in a fashion that would allow the data collected and the factors developed to be adjusted for use at other facilities. However, a small amount of field testing to confirm or adjust values for areas where processes are not directly comparable would be appropriate.

A summary of the emission investigation results for each tested compound is provided in Table 5.1. The data are presented in pounds per year and in pounds per 1,000 barrels of finished product. The pounds per year values are divided by the 1993 Fulton facility finished product volume of 5,300,000 barrels per year to also provide the release rate in pounds per 1,000 barrels of finished product.

The individual emission factors that comprise each of the sources identified in Table 5.1 are provided in Section 4.0. The specific rationale associated with the emission factors from these sources are provided in Section 3.0.

Summary of 1993 Actual Emissions: Ethanol and VOCs

COMPOUND/ SOURCE AREA	1993 ACTUAL ANNUAL EMISSIONS (lb/yr)	FULTON 1993 EMISSION FACTOR (lbs/1000 bbls)
Ethanol:		
Cold Services Area	6,044	1.14
Utilities Area	10,606	2.00
Packaging Area	163,000	30.8
Annex Area	5,755	1.09
Wastewater Treatment Area	84,300	15.9
Total	**269,705**	**50.9**
Volatile Organic Compounds:		
Brewhouse Area	1,169	0.292

Note: lbs/1000 bbls of finished product.

REFERENCES

EPA, 1991, Standards of Performance for Stationary Sources, 40 CFR Part 60, Appendix A.

Heidt, W. Zimmerman J., and Varani F., Coors Brewing Company 1992, Clean Air Act Impacts on the Brewing Industry.

Leonardos G., Kendall, D. & Barnard, N., (1969). Odor Threshold Determinations of 53 Odorant Chemicals. J. Air Pollution Control Association, 19, 91-95

Miller Brewing Company, 1993, NYSDEC 1992 Fuel Industrial Process Emission Survey for Fulton Facility

Parsons, Brinkerhoff, Quade, Douglas for USEPA 1990, User's Guide to CAL3QHC

Radian Corporation for USEPA 1990, Industrial Wastewater Volatile Organic Compound Emissions --Background Information for BACT/LAER Determinations.

APPENDIX A
ANALYTICAL METHODS

Miller Brewing Company
Fulton, New York

AIR EMISSION INVESTIGATION REPORT

February 1994

MIRAN 1B2 Analyzer Standard Specifications

GENERAL DESCRIPTION

The MIRAN 1B2 is a single-beam infrared spetrophotometer It consists of a portable gas analyzer and a separate ac/dc converter as shown in Figure 1. Analyzer portability is provided by an internal nickel-cadmium battery pack. The ac/dc converter allows the analyzer to be powered from an ac supply. It is also used to recharge the battery pack.

The gas analyzer monitors the air in workplace environments to warn personnel if toxic gases are present. It is pre-programmed to measure many of these gases. The analyzer is also user-programmable to measure other gases. Pre-programmed gases are in the analyzer's "fixed library"; user-programmed gases are in the analyzer's "user library".

A microprocessor automatically controls the spectrophotometer, averages the measurement signal, and calculates absorbance values. Analysis results are displayed either in parts per million (ppm) or absorbance units (AU).

****
* WARNING *
****

> The MIRAN 1B2 Analyzer is not designed for use in a hazardous area. For monitoring air in such areas, use a MIRAN 1BX Analyzer.

STANDARD SPECIFICATIONS

Materials of Construction
- Enclosure: Noryl Structural Foam
- Sample Line: Corrugated Polyethylene
- Gas Cell: Teflon-Lined Aluminum
- Lenses: Silver Bromide (AgBr)
- Valve: Polyethylene

Dimensions: Appoximately 706 mm (27.8 in) long by 229 mm (9 in) wide by 279 mm (11 in) high.

Mass: Approximately 13.6 kg (30 lb).

Measurement Range
- Concentration: 0 to 99 999 ppm
- Absorbance: 0.000 to 2.000 AU

Measurable Gases
- Fixed Library: See Appendix
- User Library: User-programmable to measure up to 10 additional gases.

Output: Digital readout of concentration (ppm), absorbance (AU), or analysis parameters. A connector is provided for 0 to 10 V analog readout of wavelength scan.

Operator Error Alarm: Single beep

Concentration Alarm(1): Upper-limit mode or Geiger-counter mode, as selected.

Power Requirements (ac/dc Converter):
120 V, +10%, -15% at 60 ±3 Hz; or
220 V, +10%, -15% at 50 ±3 Hz

Power Consumption: 70 W maximum

Battery Pack
- Type: Nickel-cadmium
- Operating Time: Up to 4 hours
- Recharge Time: Between 14 and 16 hours after complete discharge

Pump Flow Rate: 25 to 30 L/min (0.88 to 1.06 cfm) with no blockage in sampling hose.

Operating Conditions: See table below.

INFLUENCE	REFERENCE OPERATING CONDITIONS	NORMAL OPERATING CONDITION LIMITS
Ambient Temperature	23 ±2°C (73 ±4°F)	5 and 40°C (40 and 110°F)
Relative Humidity	50 ±10%	5 and 95% at 30°C (87°F)
Supply Voltages	120 or 220 V, ±5%	120 or 220 V, +10, -15%
Supply Frequency	50 or 60 Hz, ±0.5%	50 or 60 Hz, ±3%

Storage Limits: Ambient temperature limits of -10 and +55°C(14 and 131°F); Relative humidity limits of 0 and 95% at 35°C (95°F).

Accuracy: ±15% of reading between five times minimum detectable concentration and the upper range value of each gas in the fixed compound library. (User-calibrated gases can have better accuracy.) This specification applies within the temperature range between 15 and 35°C (59 and 95°F) when analyzer is zeroed within these limits. For operation outside these limits, between 5 and 15°C or 35 and 40°C (40 and 59°F or 95 and 110°F), analyzer must be rezeroed to maintain the specified accuracy.

Noise: Maximum of 0.004 absorbance units (AU) with 20.25 m pathlength at 12.0μm wavelength, and with AgBr lenses at 23°C (73°F) operating temperature

Drift: Maximum of 0.004 AU per 8 hours with conditions as specified for noise level above.

INSTRUMENT CHECKOUT

Unpacking

Remove instrument from its shipping container and check it for visible damage. If instrument has been damaged, notify the carrier immediately and request an inspection report. Obtain a signed copy of report from the carrier. Check contents of the shipping package against Table 1; there should be one of each item. Immediately report any shortages to Foxboro.

****
* CAUTION *
****

> To avoid damaging the MIRAN 1B2 Analyzer during transportation, use original packing. Package all components in same manner as they were when shipped from factory.

---

(1) In upper-limit mode, a series of beeps of constant frequency will be sounded when alarm set point is exceeded. In Geiger-counter mode, beeps of increasing frequency are sounded as alarm set point is approached; beeps of constant maximum frequency are sounded when set point has been exceeded.

NIOSH Method 1400 (Excerpt): ETHANOL

ALCOHOLS I

METHOD: 1400
ISSUED: 2/15/84

FORMULA: Table 1

M.W.: Table 1

OSHA/NIOSH/ACGIH: Table 1

PROPERTIES: Table 1

COMPOUNDS AND SYNONYMS:
(1) ethanol: [ethyl alcohol; CAS #64-17-5];
(2) isopropyl alcohol: [2-propanol; CAS #67-63-0]; and
(3) tert-butyl alcohol: [2-methyl-2-propanol; CAS #75-65-0].

SAMPLING

SAMPLER: SOLID SORBENT TUBE
(coconut shell charcoal, 100 mg/50 mg)

FLOW RATE: 0.01 to 0.2 L/min
(0.05 L/min for ethyl alcohol)

	(1)	(2)	(3)
VOL-MIN:	0.1 L	0.2 L	0.5 L
-MAX:	1 L	3 L	10 L

SHIPMENT: refrigerated

SAMPLE STABILITY: store in freezer; analyze as sooh as possible

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: see EVALUATION OF METHOD

BIAS: not significant [1]

OVERALL PRECISION (s_r): see EVALUATION OF METHOD

MEASUREMENT

TECHNIQUE: GAS CHROMATOGRAPHY, FID

ANALYTE: compounds above

DESORPTION: 1 mL 1% 2-butanol in CS_2

INJECTION VOLUME: 5 µL

TEMPERATURE-INJECTION: 200 °C
-DETECTOR: 250 - 300 °C
-COLUMN: 65 - 70 °C

CARRIER GAS: N_2 or He, 30 mL/min

COLUMN: glass, 2 m x 4 mm ID, 0.2% Carbowax 1500 on 60/80 Carbopack C or equivalent

CALIBRATION: solutions of analyte in eluent with internal standard

RANGE AND PRECISION: see EVALUATION OF METHOD

ESTIMATED LOD: 0.01 mg per sample [4]

APPLICABILITY: This method employs a simple desorption and may be used to determine two or more analytes simultaneously by varying GC conditions (e.g., temperature programming).

INTERFERENCES: High humidity reduces sampling efficiency. The methods were validated using a 3 m x 3 mm stainless steel column packed with 10% FFAP on Chromosorb W-AW; other columns with equal or better resolution (e.g., capillary) may be used. Less volatile compounds may displace more volatile compounds on the charcoal.

OTHER METHODS: This method combines and replaces Methods S56, S65 and S63 [3].

Table 1. General information.

Compound	OSHA NIOSH ACGIH (ppm)	Formula	mg/m³ = 1 ppm @ NTP	M.W.	Density @ 20 °C (g/mL)	BP (°C)	VP @ 20 °C, kPa (mm Hg)
Ethanol	1000 — 1000	CH_3CH_2OH; C_2H_6O	1.883	46.07	0.789	78.5	5.6 (42)
Isopropyl alcohol	400 400 500	$CH_3CH(OH)CH_3$; C_3H_8O	2.46	60.09	0.785	82.5	4.4 (33)
tert-Butyl alcohol	100 100 150	$(CH_3)_3COH$; $C_4H_{10}O$	3.03	74.12	0.786	82.4; MP = 25.6 °C	4.1 (31)

NIOSH Method P&CAM127 (Excerpt): Organic Solvents in Air Analytical Method

Analyte:	Organic Solvents (See Table 1)	**Method No.:**	P&CAM 127
Matrix:	Air	**Range:**	For the specific compound, refer to Table 1
Procedure:	Adsorption on charcoal desorption with carbon disulfide, GC		
Date Issued:	9/15/72	**Precision:**	10.5% RSD
Date Revised:	2/15/77	**Classification:**	See Table 1

1. Principle of the Method

1.1 A known volume of air is drawn through a charcoal tube to trap the organic vapors present.

1.2 The charcoal in the tube is transferred to a small, graduated test tube and desorbed with carbon disulfide.

1.3 An aliquot of the desorbed sample is injected into a gas chromatograph.

1.4 The area of the resulting peak is determined and compared with areas obtained from the injection of standards.

2. Range and Sensitivity

The lower limit in mg/sample for the specific compound at 16 × 1 attenuation on a gas chromatograph fitted with a 10:1 splitter is shown in Table 1. This value can be lowered by reducing the attenuation or by eliminating the 10:1 splitter.

3. Interferences

3.1 When the amount of water in the air is so great that condensation actually occurs in the tube, organic vapors will not be trapped. Preliminary experiments indicate that high humidity severely decreases the breakthrough volume.

3.2 When two or more solvents are known or suspected to be present in the air, such information (including their suspected identities), should be transmitted with the sample, since with differences in polarity, one may displace another from the charcoal.

3.3 It must be emphasized that any compound which has the same retention time as the specific compound under study at the operating conditions described in this method is an interference. Hence, retention time data on a single column, or even on a number of columns, cannot be considered as proof of chemical identity. For this reason it is important that a sample of the bulk solvent(s) be submitted at the same time so that identity(ies) can be established by other means.

AP-42 Section 9.12.1
Reference 20
Report Sect. 4
Reference 29

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STATIONARY SOURCE SAMPLING REPORT
REFERENCE NO. 21691

Anheuser-Busch Brewery
Fort Collins, Colorado

EMISSIONS TESTING FOR:
ANHEUSER-BUSCH COMPANIES
ONE BUSCH PLACE
ST. LOUIS, MISSOURI
63118-1852

FILLING ROOM VENTS

PERFORMED FOR: ROBERT LANHAM

JULY 26-28, 1994

STATIONARY SOURCE SAMPLING REPORT
REFERENCE NO. 21691

Anheuser-Busch Brewery
Fort Collins, Colorado

EMISSIONS TESTING FOR:
ANHEUSER-BUSCH COMPANIES
ONE BUSCH PLACE
ST. LOUIS, MISSOURI
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FILLING ROOM VENTS

PERFORMED FOR: ROBERT LANHAM

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

1.0 INTRODUCTION

1.1 Background

The Anheuser-Busch Company contracted Entropy, Inc. to conduct a testing program to quantify ethanol emissions from filling room vents at the Anheuser-Busch Brewery in Fort Collins, Colorado. The Anheuser-Busch Brewery manufactures and packages malt beverages. In the filling operation for bottles, cans, and kegs, some of the product is spilled onto the filling room floor. While most of the spilled product is removed via floor drains, some liquid evaporates and is emitted from roof vents above the filling lines.

In order to determine the amount of ethanol emitted in this manner, simultaneous testing was performed using three different analytical techniques from a number of roof vents above the filling room operation. The techniques employed included EPA Test Method 18 (direct interface gas chromatography), EPA Test Method 25A (direct interface total hydrocarbon determination), and FTIR (Fourier Transform Infrared) spectroscopy. Test Method 18 and FTIR allow the speciation of emitted organic compounds, and Test Method 25A provides a measure of the total organic content of the vent emissions. Ethanol was anticipated to be the only organic compound emitted in measurable quantities, and the use of these analytical techniques would both quantify the emission and identify the emitted compound(s). EPA Test Methods 1-4 were performed to determine the temperature, moisture content, and flow rate for several of the vents where a stack extension had been installed by Anheuser Busch. Stratification tests using Method 25A were also performed for the vents with stack extensions. Testing took place July 26th through July 28th, 1994.

The test locations were air exhaust fan vents above the filling room, including those directly above bottling and canning lines and vents removed from the filling process. For the vents above filling lines, the facility turned off all nearby exhaust fans in order to obtain a measurement of emissions due to the particular filling operation. Ambient measurements were also performed by sampling air on the roof near Vent 212; in this case, the sampling probes lay on the roof surface, approximately 10 feet from the vent. Due to the direction of prevailing winds and the size of the filling room roof, Entropy could not sample air that was upwind of roof vent emissions. Therefore, the low concentrations of ethanol detected in ambient samples are from roof vent emissions, and no correction for the ambient ethanol concentration has been made.

1.2 Outline of Test Program

Tables 1-1, 1-2, and 1-3 are test logs which present the sampling locations, sampling objectives, sampling methods, test dates, and run numbers for the test program.

1.3 Test Participants

Table 1-4 lists the personnel involved in the test program.

TABLE 1-1
DAY 1 TEST LOG

Vent Tested	Sampling Objective	Test Method	Test Date	Run Numbers	Flue Gas Composition	Volumetric Air Flow Rate (ACFM)
Vent 227	Ethanol	Method 18	7/26/94	Vent1-Run1 Vent1-Run2 Vent1-Run3	Filling Room Vent	46893 46893 47637
Vent 227	Total Hydrocarbon	Method 25A	7/26/94	Vent1-Run1 Vent1-Run2 Vent1-Run3	Filling Room Vent	46893 46893 47637
Vent 227	Ethanol	FTIR	7/26/94	V1_R1xx V1_R2xx V1_R3xx	Filling Room Vent	46893 46893 47637
Vent 227	Flow, Temperature, Moisture	Methods 1-4	7/26/94	V1-M2-1 V1-M2-2 V1-M2-3	Filling Room Vent	46893 46893 47637
Vent 224	Ethanol	Method 18	7/26/94	Vent2-Run1 Vent2-Run2 Vent2-Run3	Filling Room Vent	47531 48275 48594
Vent 224	Total Hydrocarbon	Method 25A	7/26/94	Vent2-Run1 Vent2-Run2 Vent2-Run3	Filling Room Vent	47531 48275 48594
Vent 224	Ethanol	FTIR	7/26/94	V2_R1xx V2_R2xx V2_R3xx	Filling Room Vent	47531 48275 48594
Vent 224	Flow, Temperature, Moisture	Methods 1-4	7/26/94	V2-M2-1 V2-M2-2 V2-M2-3	Filling Room Vent	47531 48275 48594

TABLE 1-2
DAY 2 TEST LOG

Vent Tested	Sampling Objective	Test Method	Test Date	Run Numbers	Flue Gas Composition	Volumetric Air Flow Rate (ACFM)
Vent 212	Ethanol	Method 18	7/27/94	Vent1-Run1	Filling Room Vent	41500 (spec)
Vent 212	Total Hydrocarbon	Method 25A	7/27/94	Vent1-Run1	Filling Room Vent	41500 (spec)
Vent 212	Ethanol	FTIR	7/27/94	V1_R1xx	Filling Room Vent	41500 (spec)
Vent 213	Ethanol	Method 18	7/27/94	Vent2-Run1	Filling Room Vent	41500 (spec)
Vent 213	Total Hydrocarbon	Method 25A	7/27/94	Vent2-Run1	Filling Room Vent	41500 (spec)
Vent 213	Ethanol	FTIR	7/27/94	V2_R1xx	Filling Room Vent	41500 (spec)
Vent 233	Ethanol	Method 18	7/27/94	Vent3-Run1	Filling Room Vent	43500 (spec)
Vent 233	Total Hydrocarbon	Method 25A	7/27/94	Vent3-Run1	Filling Room Vent	43500 (spec)
Vent 233	Ethanol	FTIR	7/27/94	V3_R1xx	Filling Room Vent	43500 (spec)
Vent 260	Ethanol	Method 18	7/27/94	Vent4-Run1	Filling Room Vent	43500 (spec)
Vent 260	Total Hydrocarbon	Method 25A	7/27/94	Vent4-Run1	Filling Room Vent	43500 (spec)
Vent 260	Ethanol	FTIR	7/27/94	V4_R1xx	Filling Room Vent	43500 (spec)
Vent 257	Ethanol	Method 18	7/27/94	Vent5-Run1	Filling Room Vent	26000 (spec)
Vent 257	Total Hydrocarbon	Method 25A	7/27/94	Vent5-Run1	Filling Room Vent	26000 (spec)
Vent 257	Ethanol	FTIR	7/27/94	V5_R1xx	Filling Room Vent	26000 (spec)
Ambient Air	Ethanol	Method 18	7/27/94	Ambient Air	Ambient Roof Air	NA
Ambient Air	Total Hydrocarbon	Method 25A	7/27/94	Location2-Ambient Air	Ambient Roof Air	NA
Ambient Air	Ethanol	FTIR	7/27/94	AMBIENxx	Ambient Roof Air	NA

NOTE: Flow measurements were not made on Day 2; flow rates in Table 1-2 are plant specifications reported by Anheuser-Busch.

TABLE 1-3
DAY 3 TEST LOG

Vent Tested	Sampling Objective	Test Method	Test Date	Run Numbers	Flue Gas Composition	Volumetric Air Flow Rate (ACFM)
Vent 211	Ethanol	Method 18	7/28/94	Vent1-Run1 Vent1-Run2 Vent1-Run3	Filling Room Vent	51146 50165 47906
Vent 211	Total Hydrocarbon	Method 25A	7/28/94	Vent1-Run1 Vent1-Run2 Vent1-Run3	Filling Room Vent	51146 50165 47906
Vent 211	Ethanol	FTIR	7/28/94	V1_R1xx V1_R2xx V1_R3xx	Filling Room Vent	51146 50165 47906
Vent 211	Flow, Temperature, Moisture	Methods 1-4	7/28/94	V1-M2-1 V1-M2-2 V1-M2-3	Filling Room Vent	51146 50165 47906
Vent 214	Ethanol	Method 18	7/28/94	Vent2-Run1 Vent2-Run2 Vent2-Run3	Filling Room Vent	47637 47637 49020
Vent 214	Total Hydrocarbon	Method 25A	7/28/94	Vent2-Run1 Vent2-Run2 Vent2-Run3	Filling Room Vent	47637 47637 49020
Vent 214	Ethanol	FTIR	7/28/94	V2_R1xx V2_R2xx V2_R3xx	Filling Room Vent	47637 47637 49020
Vent 214	Flow, Temperature, Moisture	Methods 1-4	7/28/94	V2-M2-1 V2-M2-2 V2-M2-3	Filling Room Vent	47637 47637 49020