CHS-08

# CHS, Inc. - Laurel Refinery
# Laurel, Montana

## Zone A, C &D Selected Process Sources
## Certification/Emission Compliance
## Test Report

**May 3-6 & 10-12, 2010**


**By:**

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## FIELD OBSERVATION CHECKLIST

| | |
|---|---|
| **Test Dates:** | **May 3-6 & 10-12, 2010** |
| **Plant Name:** | **CHS, Inc. - Laurel Refinery** |
| **Company Address:** | **802 Hwy 212 South**<br>**Laurel, Montana 59044** |
| **Sources Tested:** | **FCCU; Boiler #10; Boiler #12; Boiler #11; H1001; SRU; Fuel Gas ($H_2S$)** |
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| **Observers & Affiliation:** | **George Fink - CHS, Inc.** |
| **EEMC Field Team:** | |
| **Team Leader:** | **Dave Wang** |
| **Other Members:** | **Jacob Wiggs**<br>**John Adams** |

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## INTRODUCTION

CHS Inc. - Laurel Refinery contracted with Energy & Environmental Measurement Corporation (EEMC) to conduct a series of compliance/certification evaluations on selected process stacks (streams) at Zones A,C&D of the Laurel Refinery. The purpose of this report is to outline the sampling and analytical methods employed, report field/laboratory data, and provide test results.

## TEST CHRONOLOG

| Date/Time | Run # | Location | Test Description(s) |
|---|---|---|---|
| 05/03/10 | | | |
| 09:10-13:39 | 1-9 $NO_xO_2CO$ | Zone C FCCU | RATA EPA Methods #3A, 7E & 10 |
| 09:10-13:39 | 1-9 $GFH_2O$ | Zone C FCCU | RATA EPA Methods #1-4 |
| 05/04/10 | | | |
| 09:00-13:21 | 1-9 $NO_xO_2CO$ | Boiler 10 | RATA EPA Methods #3A, 7E & 10 |
| 05/05/10 | | | |
| 10:15-14:36 | 1-9 $NO_xO_2CO$ | Boiler 12 | RATA & Compliance EPA Methods #3A, 7E, 10 & 19 |
| 10:15-14:36 | 1-9 $GFH_2O$ | Boiler 12 | RATA & Compliance EPA Methods #1-4 |
| 05/06/10 | | | |
| 09:00-13:21 | 1-9 $NO_xO_2CO$ | Boiler 11 | RATA & Compliance EPA Methods #3A, 7E, 10 & 19 |
| 10:15-14:36 | 1-9 $GFH_2O$ | Boiler 11 | RATA & Compliance EPA Methods #1-4 |
| 05/10/10 | | | |
| 09:30-13:51 | 1-9 $NO_xO_2CO$ | Zone D H1001 | RATA & Compliance EPA Methods #3A, 7E &10 |
| 09:30-13:51 | 1-9 $SO_2GFH_2O$ | Zone D H1001 | RATA & Compliance EPA Methods #1-4 & 6 |
| 05/11/10 | | | |
| 09:15-13:36 | 1-9 $NO_xO_2CO$ | Zone D SRU | RATA & Compliance EPA Methods #3A, 7E &10 |
| 09:15-13:36 | 1-9 $SO_2GFH_2O$ | Zone D SRU | RATA & Compliance EPA Methods #1-4 & 6 |
| 05/12/10 | | | |
| 08:45-13:30 | 1-9 $H_2S$ | Zone A $H_2S$ Monitor | RATA EPA Method #11 |

## CEM/PROCESS DATA

CEM/Process data was supplied by CHS, Inc.- Laurel Refinery, and is included as tabulated. Fd Factors were utilized for calculation of emissions in lbs/MMBtu for compliance purposes as well as relative accuracy determination on Boiler 12.

## SAMPLING EQUIPMENT & PROCEDURES

The test chronolog identifies the tests conducted at each source and whether a relative accuracy (RA) and compliance series was conducted or only a RA series. Compliance series are composed of mathematically combining three RA runs to make one compliance run plus generating the additional data necessary for compliance determination.

Schematics of the sampling train(s) are included in the Test Methods section as tabulated. Following is a synopsis of the test methods utilized.

| Species | Test Methods |
|---|---|
| Gas Flow & Associated Data | EPA Methods #1-4 [1] |
| $O_2$ | EPA Method #3A |
| $SO_2$ | EPA Method #6[1] |
| $NO_x$ | EPA Method #7E [1] |
| CO | EPA Method #10 [1] |
| $H_2S$ | EPA Method #11 [1] |

**Gas Flow and Associated Data**
EPA Methods #1-4[1] were utilized for determination of stack flue gas velocity, density and moisture.

The collection train consisted of a stainless steel (SS) pitobe assembly (S-type pitot tube and a type K thermocouple) leading to a heated EPA Type A glass fiber filter pad (@ ~248 ± 25 °F). The filtered gases were pulled through four Greenberg-Smith impingers where flue gas moisture was condensed (1&2 -100 ml $H_2O$, 3-empty, 4-silica gel). The filtered and dried gases were then pulled, via an umbilical cord, to an RAC type meter box for gas volume metering. A meter box orifice slip stream was utilized for collection of an integrated bag sample.

$CO_2$ concentrations were determined by triplicate orsat analysis. Moisture determination was via gravimetric analysis. [1]

**$O_2$ Emissions**
EPA Method #3A was utilized for determination of stack gas $O_2$ concentration. The stack gases were extracted from the stream and conveyed, via a heated (~230 °F) sample line, to a Servomex 1400 Oxygen analyzer. EPA Protocol 1 calibration gases were utilized for instrument span checks. Zero was checked with zero $N_2$ gas. Results were recorded via an integrating/computer logger on a one-minute basis. Sample range was 0-20.5% v/v dry.

## SAMPLING EQUIPMENT & PROCEDURES (continued)

### $SO_2$ Emissions

EPA Method #6 [1] was utilized for determination of $SO_2$ concentration. The sample train consisted of a stainless steel (SS) button hook nozzle followed by a heated SS pitobe assembly (S-type pitot tube and a Type K thermocouple) leading to four Greenberg-Smith impingers (1&2 150 ml $H_2O_2$, 3-empty, 4-silica gel). The dried gases were then pulled, via an umbilical cord, to a RAC type meter box for gas volume metering. A meter box orifice slip stream (effluent) was utilized for collection of an integrated bag sample.

Upon completion of the test run, $CO_2$ concentrations were determined by triplicate orsat analysis (integrated bag), moisture was determined via gravimetric analysis of the impinger liquid gain. Resultant $SO_2$ samples were then washed from the train on site, and analyzed for $SO_2$ concentration. Duplicate titration was conducted at the Billings laboratory.

### $NO_x$ Emissions

EPA Method #7E [1] was utilized for determination of stack gas $NO_x$ concentration. The stack gases were extracted from the stream and conveyed to a CAI (Model 400) Chemiluminescent analyzer. EPA Protocol 1 calibration gases were utilized for instrument span checks. Zero was checked with zero $N_2$ gas. Results were recorded via an integrating computer/logger on a one-minute basis. Sample range was 0-100.7 ppm v/v dry.

### CO Emissions

A CAI 200 NDIR analyzer was utilized for determination of CO gas stream concentration. A diagram of the sample train is included as tabulated - Test Methods. The train was calibrated using EPA Protocol 1 CO in $N_2$ (span gas). CO data was recorded by an integrating computer/logger on a minute by minute basis. Sample range was 98.0 ppm v/v d.ry.

### Hydrogen Sulfide (Fuel Gas $H_2S$ Monitor)

EPA Method #11 [1] was utilized for determination of fuel gas $H_2S$ concentration. The samples were taken from a pressurized fuel gas sample valve. The resultant samples were titrated on site as per the test method.

## UNITS OF REPORTING

The data is reported with the following units:

1) Gas Flow

| | | |
|---|---|---|
| Flow | - | FPS - feet per second |
| Volume | - | AWCFM - actual wet cubic feet per minute |
| | | SDCFH - standard* dry cubic feet per hour, (*@ 68 °F and 29.92 "Hg) |

**UNITS OF REPORTING** - continued

| | | | |
|---|---|---|---|
| 2) | $SO_2$ | | |
| | ppm v/v Dry or Actual | - | parts per million on a volume basis without or with moisture |
| | ppm v/v D @ 0% $O_2$ | - | parts per million on a volume basis without moisture corrected to zero percent oxygen |
| 3) | $CO_2/O_2$ - % v/v | - | percent on a volume basis |
| 4) | Temperature - °F | - | degrees Fahrenheit |
| | °C | - | degrees Celsius |
| | °K | - | degrees Kelvin |
| 5) | Moisture - % v/v | - | percent moisture on a volume basis |
| 6) | $NO_x$ | | |
| | PPH | - | pounds per hour |
| | ppm v/v dry | - | parts per million without moisture |
| | lbs/MMBtu | - | pounds per million British Thermal Unit |
| 7) | CO | | |
| | ppm v/v dry | - | parts per million without moisture |
| | ppm v/v dry @ 3% $O_2$ | - | parts per million without moisture @ 3% $O_2$ |
| 8) | Fd Factor, dscf/MMBtu | - | dry standard cubic feet per million British Thermal Unit |
| 9) | $H_2S$ | | |
| | mg/dscm | - | milligrams per dry standard* cubic meter (*@ 68 °F & 29.92 "Hg) |
| | ppm v/v D | - | parts per million on a volume basis without moisture |

CEM concentration and mass flow data are employed as previously described for calculation of relative accuracy results (RAA). Twenty-four hour drift requirements for Specs. 2, 3, 4, 6 & 7 have been waived by the State of Montana for this test series.

## RESULTS

This report contains summarizations of all pertinent sampling and analytical results. Field and laboratory data is included as tabulated or indexed. A compliance evaluation is also included as tabulated.

## REFERENCES

[1] 40CFR60, App. A, Methods #1-4, 3A, 6, 7E, 10,11, 19 & EPA Specifications 2, 3, 4, 4A & 6, 7, 7/1/09.

**CHS, Inc. - Laurel Refinery**
**Emission Compliance Statement**
**Laurel, Montana**
**May 3-6 & 10-12, 2010**

**Applicable Rules**

The sources tested are NSPS sources under B.A.C.T. (ARM 17.8.715). Test methods are found in 40CFR60, App. A&B, and Montana Department of Health and Environmental Sciences Air Quality Permit #1821-20. Pages from the permit identifying the limits follow in this section.

| Date/Source | Emission Limit | Measured Result | Status |
|---|---|---|---|
| **05/05/10 Boiler #12** | | | |
| Species | | | |
| $NO_x$ | 4.18 PPH | 4.02 PPH | Pass |
| CO | 15.26 PPH | 0.10 PPH | Pass |
| CO | 400 ppmv d @ 3 % $O_2$ * | 0.7 ppmv d @ 3 % $O_2$ | Pass |
| NSPS $NO_x$ | 0.2 lbs/MMBtu[1] * | 0.023 lbs/MMBtu[2] | Pass |
| **05/06/10 Boiler #11** | | | |
| Species | | | |
| $NO_x$ | 4.18 PPH | 3.1 PPH | Pass |
| CO | 15.26 PPH | 0.05 PPH | Pass |
| CO | 400 ppmv d @ 3 % $O_2$ * | 0.5 ppmv d @ 3 % $O_2$ | Pass |
| NSPS $NO_x$ | 0.2 lbs/MMBtu[1] * | 0.021 lbs/MMBtu[2] | Pass |
| **05/10/10 H-1001** | | | |
| Species | | | |
| $SO_2$ | 5.80 PPH | 0.24 PPH | Pass |
| $NO_x$ | 6.46 PPH | 5.7 | Pass |
| CO | 3.23 PPH | 0.2 | Pass |
| CO | 400 ppmv d @ 3 % $O_2$ * | 1.7 ppmv d @ 3 % $O_2$ | Pass |
| **05/11/10 Zone D SRU** | | | |
| Species | | | |
| $NO_x$ | 0.8 PPH | 0.4 PPH | Pass |
| $SO_2$ | 14.21 PPH | 0.64 PPH | Pass |
| $SO_2$ | 250 ppmv d @ 0% $O_2$* | 24.1 ppmv d @ 0% $O_2$ | Pass |

[1] 40FR60, Subpart Db (30 day rolling average)
[2] $NO_x$ lbs/MMBtu was calculated using EPA Method #19 based on an $F_d$ factor provided by CHS.
*(30 day rolling average)

**CHS, Inc. - Laurel Refinery**
**Laurel, Montana**
**Monitor Relative Accuracy Results**
**May 3-6 & 10-12, 2010**

**Relative Accuracy Standards:**

| | | |
|---|---|---|
| $SO_2$ (concentration and mass) | - | ± 20% (when RM is used in the denominator of Eq. 2-6) or 10% (when applicable emission standard (ES) is used in the denominator of Eq. 2-6) |
| $NO_x$ (concentration and mass) | - | ± 20% (when RM is used in the denominator of Eq. 2-6) or 10% (when applicable emission standard is used in the denominator of Eq. 2-6) |
| CO (concentration and mass) | - | +10% (when RM is used in the denominator of Eq.2-6) or 5% (when applicable emission standard is used in the denominator of Eq. 2-6) or within 5ppmv when the RA is calculated as the absolute difference between the RM and CEMS plus the 2.5 percent confidence coefficient |
| $O_2$ (%) | - | ± 1% (absolute difference (ABS) between reference method mean and CEM mean) |
| Gas Flow (SDCFH) | - | ± 10%RM (Federal Register, 40CFR75, Appendix E, 2008) |
| Fuel Gas $H_2S$ (ppm v/v d) | - | ± 20% (when the RM is used in the denominator of Eq. 2-6) or 10% (when applicable emission standard is used in the denominator of Eq. 2-6) |

Reference
40CFR60 App A, EPA Specifications 2, 3, 4, 4A, 6 & 7, and 40CRF75 App E

**CHS, Inc. - Laurel Refinery**
**Laurel, Montana**
**Monitor Relative Accuracy Results**
**May 3-6 & 10-12, 2010**

**Relative Accuracy Results:**

| Species | Monitor | RA% | Type | Performance |
|---|---|---|---|---|
| **05/03/10** | | | | |
| $SO_2$ - ppm v/v dry | FCCU | 1.1% | ES | Pass |
| $NO_x$ - ppm v/v dry | FCCU | 5.6% | RM | Pass |
| CO - ppm v/v dry | FCCU | 7.6% | RM | Pass |
| $O_2$ - % v/v | FCCU | 0.33% | ABS | Pass |
| Gas Flow - MMSCFH | FCCU | 5.8% | RM | Pass |
| **05/04/10** | | | | |
| $NO_x$ - ppm v/v dry | Boiler #10 | 15.6% | RM | Pass |
| CO - ppm v/v dry | Boiler #10 | 6.4% | RM | Pass |
| $O_2$ - % v/v | Boiler #10 | 0.04% | ABS | Pass |
| **05/05/10** | | | | |
| $NO_x$ - ppm v/v dry | Boiler #12 | 5.4% | RM | Pass |
| $NO_x$ - lbs/hr | Boiler #12 | 6.9% | RM | Pass |
| $NO_x$ - lbs/MMBtu | Boiler #12 | 0.0% | RM | Pass |
| CO - ppm v/v dry | Boiler #12 | 0.64 | ppmv d ABS | Pass |
| CO - ppmv d @ 0% $O_2$ | Boiler #12 | 0.65 | ppmv d ABS | Pass |
| $O_2$ - % v/v | Boiler #12 | 0.09% | ABS | Pass |
| Gas Flow - MMSCFH | Boiler #12 | 2.0% | RM | Pass |
| **05/06/10** | | | | |
| $NO_x$ - ppm v/v dry | Boiler #11 | 14.1% | RM | Pass |
| CO - ppm v/v dry | Boiler #11 | 1.8 | ppmv d ABS | Pass |
| $O_2$ - % v/v | Boiler #11 | 0.08% | ABS | Pass |
| **05/10/10** | | | | |
| $SO_2$ - ppmv d @ 0% $O_2$ | H1001 | 5.1% | ES | Pass |
| CO - ppmv d @ 0% $O_2$ | H1001 | 0.6% | ES | Pass |
| $O_2$ - % v/v dry | H1001 | 0.04% | ABS | Pass |
| **05/11/10** | | | | |
| $SO_2$ - ppm v/v @ 0% $O_2$ | SRU | 11.9% | RM | Pass |
| $O_2$ - % v/v | SRU | 0.38% | ABS | Pass |
| Gas Flow - DSCFH | SRU | 5.8% | RM | Pass |
| **05/12/10** | | | | |
| Zone A Fuel Gas - ppmv d | $H_2S$ Monitor | 2.0% | ES | Pass |

Montana Air Quality Permit

Issued to: CHS Inc.
Laurel Refinery
P.O. Box 909
Laurel, MT 59044-0909

MAQP #1821-20
Application Complete: 8/13/09
Preliminary Determination Issued: 9/22/09
Department Decision Issued: 10/09/09
Permit Final:
AFS #: 111-0012

A Montana Air Quality Permit (MAQP), with conditions, is hereby granted to CHS Inc. (CHS) pursuant to Sections 75-2-204, 211, and 215, Montana Code Annotated (MCA), as amended, and the Administrative Rules of Montana (ARM) 17.8.740, *et seq.*, as amended, for the following:

Section I: Permitted Facilities

A. Plant Location/Description

CHS operates the Laurel petroleum refinery, located in the South ½ of Section 16, Township 2 South, Range 24 East, in Yellowstone County, Montana. The facility includes, but is not limited to, the following permitted equipment, by section:

Section II. Plant-Wide Requirements (including Plant-wide Applicability Limits (PALs)). The refinery flare is not included under the PAL.

Section III. Fuel Gas & Fuel Oil Combustion Devices

Section IV. Hydrodesulfurization (HDS) complex with associated Zone D sulfur recovery unit (SRU) and tail gas treatment unit (TGTU)

Section V. Boiler #10

Section VI. Truck Loading Rack and Vapor Combustion Unit (VCU)

Section VII. No. 1 Crude Unit

Section VIII. Ultra Low Sulfur Diesel (ULSD) Unit and Hydrogen Plant

Section IX. TGTU for Zone A's SRU #1 and SRU #2 trains

Section X. Fluidized Catalytic Cracking Unit (FCCU)

Section XI. Naphtha Hydrotreater (NHT) Unit, Delayed Coker Unit, and Zone E SRU/TGTU and Tail Gas Incinerator (TGI)

Section XII. Boiler #11

Section XIII. Railcar Light Product Loading Rack and VCU

Section XIV. Boiler #12

Section XV. Benzene Reduction Unit

Section XVI. Platformer Heater (P-HTR-1)

required under the CHS Consent Decree (CHS Consent Decree Paragraphs 55).

B. CHS shall comply with all applicable standards and limitations, and the reporting, recordkeeping, and notification requirements specified in 40 CFR Part 63, NESHAPs for Source Categories (ARM 17.8.342):

1. Subpart A – General Provisions applies to all equipment or facilities subject to a NESHAP for source categories subpart as listed below.

2. Subpart CC – Refinery MACT I shall apply to, but not be limited to, certain parts of the FCCU piping.

3. Subpart UUU – Refinery MACT II shall apply to, but not be limited to, the FCCU.

C. CHS shall not cause or authorize emissions to be discharged into the outdoor atmosphere from any source installed on or before November 23, 1968, that exhibit an opacity of 40% or greater averaged over 6 consecutive minutes (ARM 17.8.304).

D. Limitations on Individual Emitting Units

1. FCCU Regenerator Stack

a. CO emissions from the FCCU Regenerator Stack shall not exceed 500 ppm at 0% $O_2$ per 1-hour time period (CHS Consent Decree Paragraph 41, ARM 17.8.340, 40 CFR Part 60, Subpart J; and ARM 17.8.752).

b. CO emissions from the FCCU Regenerator Stack shall not exceed 100 $ppm_{vd}$ at 0% $O_2$, on a 365-day rolling average basis (CHS Consent Decree Paragraph 41).

c. CHS shall not exceed 50 ppm $SO_2$ by volume (corrected to 0% $O_2$) on a 7-day rolling average and shall also comply with an $SO_2$ concentration limit of 25 $ppm_{vd}$ at 0% $O_2$ on a 365-day rolling average basis (CHS Consent Decree Paragraphs 32-33).

d. PM emissions from the FCCU shall be controlled with an ESP. Following the startup of the third air blower in the FCCU, PM emissions from the FCCU shall not exceed 1.0 lb PM/1,000 lb of coke burned (ARM 17.8.752).

e. $NO_x$ emissions from the FCCU shall not exceed 161.1 tons per 12-month rolling average (limit is based on 90 $ppm_{vd}$ at 0% oxygen on a 12-month rolling average) (ARM 17.8.752).

2. FCC Charge Heater (FCC-Heater-1)

a. The FCC Charge Heater (FCC-Heater-1) shall not exceed 49.7 MMBtu/hr on a rolling 12-calendar month basis (ARM 17.8.749).

b. $NO_x$ emissions from the FCC Charge Heater (FCC-Heater-1) shall not exceed (ARM 17.8.749):

i. 22.87 tons/rolling 12-calendar month total
ii. 6.27 lb/hr

c. CO emissions from the FCC Charge Heater (FCC-Heater-1) shall not exceed (ARM 17.8.749):

i. 19.21tons/rolling 12-calendar month total
ii. 5.26 lb/hr

E. Monitoring Requirements

1. CHS shall install and operate the following CEMS/CERMS on the FCCU Regenerator Stack (CHS Consent Decree):

a. CO
b. $NO_x$
c. $SO_2$
d. $O_2$
e. Opacity (40 CFR 63, Subpart UUU)

2. CEMS and CERMS required by this permit shall comply with all applicable provisions of 40 CFR Parts 60.5 through 60.13, Subparts J, 60.100-108 and Appendix B, Performance Specifications 1, 2, 3, 6, and Appendix F. The volumetric flow rate monitor shall comply with the Billings/Laurel SIP Pollution Control Plan Exhibit A, Attachment 1 Methods A-1 and B-1.

3. The FCCU CEMS, stack gas volumetric flow rate CEMS, and the fuel gas flow meters shall comply with all applicable requirements of the Billings/Laurel $SO_2$ SIP Emission Control Plan, including Exhibit A and Attachments, adopted by the Board of Environmental Review, June 12, 1998, and stipulated to by Cenex Harvest States Cooperative and its successor CHS.

4. CEMS are to be in operation at all times when the emission units are operating, except for quality assurance and control checks, breakdowns, and repairs. In the event the primary CEMS is unable to meet minimum availability requirements, the recipient shall provide a back-up or alternative monitoring system and plan such that continuous compliance can be demonstrated.

F. Testing Requirements

1. CHS shall follow the stack protocol specified in 40 CFR 60.106(b)(2) to measure PM emissions from the FCCU Regenerator stack. CHS shall conduct the PM tests on an annual basis or on another testing schedule as may be approved by the Department (CHS Consent Decree Paragraph 38 and ARM 17.8.105).

2. Following the startup of the third blower in the FCCU, the FCC Charge Heater (FCC-Heater-1) shall be tested annually, or according to another testing/ monitoring schedule as may be approved by the Department, for $NO_x$ and CO, concurrently, and the results submitted to the Department in order to demonstrate compliance with the $NO_x$ and CO emission limits contained in Section X.D.2.b and c (ARM 17.8.105 and ARM 17.8.749).

G. Compliance Determinations

1. Compliance determinations for the FCCU Regenerator Stack emission limits in Section X.D for $NO_x$, CO, and $SO_2$ shall be based upon monitor data, as required in Section X.E.1.

the averaging period identified in Sections IV.D.1 through 5.

4. Compliance determinations for hourly, 24-hour, and annual limits specifically allowed in Sections IV.D.1 through 5 (ARM 17.8.749).

5. Reasons for any emissions in excess of those specifically allowed in Sections IV.D.1 through 5 with mitigative measures utilized and corrective actions taken to prevent a recurrence of the situation.

Section V: Limitations and Conditions for Boiler #10

A. CHS shall comply with all applicable standards and limitations, and the monitoring, recordkeeping and reporting requirements contained in 40 CFR Part 60 for Boiler #10. The following subparts, at a minimum, are applicable (ARM 17.8.340):

1. Subpart A - General Provisions applies to all equipment or facilities subject to an NSPS subpart listed below.

2. Subpart Db - Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units.

3. Subpart J - Standards of Performance for Petroleum Refineries. The requirements of this Subpart apply to Boiler #10.

4. Subpart GGG - Standards of Performance for Equipment leaks of VOC in Petroleum Refineries applies to the refinery fuel gas supply lines to Boiler #10.

B. Emission Limitations for Boiler #10 (limitations in Section V.B are applicable prior to startup of Boiler #10 following installation of ultra-low NOx Burners (ULNBs)

1. Fuel oil burning is not allowed in this unit (ARM 17.8.340, ARM 17.8.749, and ARM 17.8.752).

2. $SO_2$ emissions shall not exceed 3.83 lb/hr (ARM 17.8.752).

3. $NO_x$ emissions shall not exceed 0.058 pounds per million British thermal units (lb/MMBtu) fired and 5.79 lb/hr (ARM 17.8.752).

4. CO emissions shall not exceed 0.10 lb/MMBtu fired and 9.99 lb/hr (ARM 17.8.752).

5. VOC emissions shall not exceed 0.015 lb/MMBtu fired and 1.50 lb/hr (ARM 17.8.752).

6. Opacity shall not exceed 20%, averaged over any 6 consecutive minutes (ARM 17.8.304).

7. Boiler #10 shall be fitted with low $NO_x$ burners with flue gas recirculation (FGR) and have a minimum stack height of 75 feet above ground level (ARM 17.8.340 and ARM 17.8.749).

Ba. Emission Limitations for Boiler #10 (limitations in Section V.Ba are applicable upon startup of Boiler #10 following installation of the ULNBs)

1. Fuel oil burning is not allowed in this unit (ARM 17.8.340, ARM 17.8.749, and

ARM 17.8.752).

2. $SO_2$ emissions shall not exceed:

   a. 60 ppmv $H_2S$ in refinery fuel gas, 365-day rolling average (ARM 17.8.752)

   b. 4.14 tons/rolling 12-calendar month total (ARM 17.8.749)

   c. 2.53 lb/hr (ARM 17.8.752)

3. $NO_x$ emissions shall not exceed:

   a. 0.03 pounds per million British thermal units – Higher Heating Value (lb/MMBtu-HHV), 365-day rolling average (ARM 17.8.752)

   b. 13.13 tons/rolling 12-calendar month total (ARM 17.8.749)

   c. 3.0 lb/hr (ARM 17.8.749)

4. During periods of startup or shutdown, CO emissions shall not exceed 10.0 lb/hr, 24-hour rolling average (ARM 17.8.752). Otherwise, CO emissions shall not exceed:

   a. 0.05 lb/MMBtu-HHV, 365-day rolling average (ARM 17.8.752)
   b. 21.88 tons/rolling 12-calendar month total (ARM 17.8.749)
   c. 5.0 lb/hr (ARM 17.8.749)

5. VOC emissions shall not exceed 2.24 tons/rolling 12-calendar month total (ARM 17.8.752).

6. Opacity shall not exceed 20%, averaged over any 6 consecutive minutes (ARM 17.8.304).

7. Boiler #10 shall be fitted with ULNBs, flue gas recirculation (FGR) and steam injection to the flame zone (ARM 17.8.752), and have a minimum stack height of 75 feet above ground level (ARM 17.8.749).

C. Monitoring Requirements

1. CHS shall install, operate, and maintain a CEMS/CERMS on Boiler #10, to monitor and record the $NO_x$ and $O_2$ for demonstration of compliance with the limits in Sections V.B and V.Ba, for each day when the boiler is combusting fuel gas (40 CFR 60, Subpart Db).

2. Boiler #10's continuous $NO_x$ and $O_2$ concentration monitors shall comply with all applicable provisions of 40 CFR Parts 60.5 through 60.13, Subparts Db, Appendix B (Performance Specifications 2 and 3), and Appendix F (Quality Assurance/Quality Control) provisions (ARM 17.8.340, ARM 17.8.105 and ARM 17.8.749).

3. Prior to the startup of Boiler #10 following the installation of the ULNBs, CHS shall install, operate, and maintain a CEMS/CERMS on Boiler #10, to monitor and record the CO for demonstration of compliance with the limits in V.Ba, for each day when the boiler is combusting fuel gas. The CO CEMS shall comply with all

applicable provisions of 40 CFR 60, Appendix B (Performance Specification 4) and Appendix F (Quality Assurance/Quality Control) provisions (ARM 17.8.749).

4. CEMS are to be in operation at all times when the emission units are operating, except for quality assurance and control checks, breakdowns, and repairs. In the event the primary CEMS is unable to meet minimum availability requirements, the recipient shall provide a back-up or alternative monitoring system and plan such that continuous compliance can be demonstrated.

5. Prior to the startup of Boiler #10 following the installation of the ULNBs, CHS shall install and operate a volumetric stack flow rate monitor on Boiler #10. The volumetric flow rate monitor shall comply with the Billings/Laurel SIP Pollution Control Plan Exhibit A, Attachment 1 Methods A-1 and B-1 (ARM 17.8.749).

D. Testing Requirements

Boiler #10 shall be tested for $NO_x$, CO, and VOC concurrently at a minimum of every 5 years or according to another testing/monitoring schedule as may be approved by the Department. Testing shall be conducted for both natural gas and refinery fuel gas (ARM 17.8.105 and ARM 17.8.106).

E. Compliance Determinations

1. Compliance with the opacity limitations shall be determined according to 40 CFR, Part 60, Appendix A, Method 9 Visual Determination of Opacity of Emissions from Stationary Sources (ARM 17.8.749).

2. With exception to the initial performance test period, compliance with the lb/MMBtu limit(s) will be demonstrated using statistically significant F-factor values. The factor will be updated on a regular basis using data from all valid fuel gas samples representative of the fuel gas burned in Boiler #10. The method of compliance demonstration involving F-factor statistical significance is subject to change upon agreement with the Department and CHS (40 CFR 60, Appendix A, Reference Method 19).

3. Compliance with the $NO_x$ lb/hr limit shall be determined using the $NO_x$ CEM and the volumetric stack flow rate monitor (ARM 17.8.749).

4. Compliance with the CO lb/hr limit in Section V.Ba shall be determined using the CO CEM and the volumetric stack flow rate monitor (ARM 17.8.749).

F. Operational and Emission Inventory Reporting Requirements (ARM 17.8.749)

1. CHS shall submit quarterly emission reports to the Department within 30 days of the end of each calendar quarter. Copies of the quarterly emission reports, excess emissions, emission testing reports and other reports required by Sections V.D and V.F.1 shall be submitted to both the Billings regional office and the Helena office. Reporting requirements shall be consistent with 40 CFR Part 60, or as specified by the Department (ARM 17.8.340). The quarterly report shall include the following:
   a. $SO_2$ emission data from the refinery fuel gas system continuous $H_2S$ concentration monitor required by Section III. The $SO_2$ emission rates shall be reported for the following averaging periods:

b. Any particulate emissions in excess of 0.10 gr/dscf corrected to 12% $CO_2$ (ARM 17.8.752).

D. Monitoring and Testing Requirements

1. CHS shall perform the testing and monitoring procedures, as applicable, specified in 40 CFR 63, Subpart R (ARM 17.8.342 and 40 CFR 63, Subpart R).

2. CHS shall install and continuously operate a thermocouple and an associated recorder for temperature monitoring in the firebox or ductwork immediately downstream in a position before any substantial heat occurs and develop an operating parameter value in accordance with the provisions of 40 CFR 63.425 and 63.427 for the VCU. CHS shall install and continuously operate an ultraviolet flame detector and relay system which will render the loading rack inoperable if a flame is not present at the VCU firebox or any other equivalent device, to detect the presence of a flame (ARM 17.8.342 and ARM 17.8.752).

3. The VCU shall be initially tested for VOCs, and compliance demonstrated with the emission limitation contained in Section XIII.C.1 within 180 days of initial startup and continue on an every 2-year basis or according to another testing/monitoring schedule as may be approved by the Department. CHS shall perform the test methods and procedures as specified in 40 CFR 63.425, Subpart R (ARM 17.8.105 and 17.8.342).

4. The VCU shall be initially tested for CO and $NO_x$, concurrently, and compliance demonstrated with the CO and $NO_x$ emission limitations contained in Section XIII.C.2 and 3 within 180 days of initial start up (ARM 17.8.105).

## Section XIV: Limitations and Conditions for Boiler #12

A. CHS shall comply with all applicable standards and limitations, and the monitoring, recordkeeping, and reporting requirements contained in 40 CFR Part 60, NSPS. The following subparts, at a minimum, are applicable (ARM 17.8.340):

1. Subpart A - General Provisions applies to all equipment or facilities subject to an NSPS subpart listed below.

2. Subpart Db – Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units applies to Boiler #12.

3. Subpart Ja - Standards of Performance for Petroleum Refineries for Which Construction, Reconstruction, or Modification Commenced After May 14, 2007 applies to Boiler #12.

4. Subpart GGG – Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries applies to the refinery fuel gas supply lines to Boiler #12.

B. CHS shall not cause or authorize emissions to be discharged into the outdoor atmosphere from any source installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes. This applies to the sources in Boiler #12 (ARM 17.8.304 (2)).

C. Limitations on Boiler #12

1. $SO_2$ emissions from Boiler #12 shall not exceed (ARM 17.8.752):

   a. 0.05 grains/dscf $H_2S$ refinery fuel gas, rolling 12-month average
   b. 7.88 tons/rolling 12-calendar month total
   c. 3.60 lb/hr

2. $NO_x$ emissions from Boiler #12 shall not exceed (ARM 17.8.752):

   a. 0.02 lbs/MMBtu-HHV, on a rolling 365-calendar day average
   b. 18.31 tons/rolling 12-calendar month total
   c. 4.18 lb/hr

3. CO emissions from Boiler #12 shall not exceed (ARM 17.8.752):

   a. 400 $ppm_{vd}$ at 3% oxygen on a 30-day rolling average
   b. 36.63 tons/rolling 12-calendar month total
   c. 15.26 lb/hr

4. VOC Emissions from the Boiler #12 shall not exceed 4.81 tons/rolling 12-calendar month total (ARM 17.8.752).

5. Boiler #12 shall be fitted with ultra low $NO_x$ burners with FGR (ARM 17.8.752).

6. CHS shall not fire fuel oil in this unit (ARM 17.8.749 and ARM 17.8.752).

7. Within 180 days of initial startup of Boiler #12, CHS shall no longer operate Boiler #4. One year after initial startup of Boiler #12, CHS shall no longer operate Boiler #5 (ARM 17.8.749).

D. Monitoring requirements

1. CHS shall install and operate the following (CEMS/CERMS) for Boiler #12:

   a. $NO_x$ (40 CFR 60, Subpart Db and Consent Decree Paragraph 52)
   b. $O_2$ (40 CFR 60, Subpart Db)

2. CEMS and CERMS required by this permit shall comply with all applicable provisions of 40 CFR Part 60.5 through 60.13, Subpart Db 60.40b through 60.49b, Subparts J, 60.100-108, and Appendix A, Appendix B, Performance Specifications 2, 3, 4 or 4A, 6, and Appendix F (ARM 17.8.749 and ARM 17.8.342).

3. CEMS are to be in operation at all times when the emission units are operating, except for quality assurance and control checks, breakdowns, and repairs. In the event the primary CEMS is unable to meet minimum availability requirements, the recipient shall provide a back-up or alternative monitoring system and plan such that continuous compliance can be demonstrated (ARM 17.8.749).

4. With exception to the initial performance test period, compliance with the lb/MMBtu limit(s) will be demonstrated using statistically significant F-factor values. The factor will be updated on a regular basis using data from all valid fuel gas samples representative of the fuel gas burned in Boiler #12. The method of compliance demonstration involving F-factor statistical significance is subject to change upon agreement with the Department and CHS (40 CFR 60, Appendix A, Reference Method 19).

each calendar day. Copies of the quarterly emission report shall be submitted to both the Billings regional office and the Helena office of the Department. The quarterly report shall also include the following:

a. Source or unit operating time during the reporting period and quarterly fuel gas consumption rates.

b. Monitoring downtime that occurred during the reporting period.

c. A summary of excess emissions or applicable concentrations for each pollutant and the averaging period identified in XI.D.1 through 2, 7 and 8.

d. Compliance determinations for hourly, 24-hour, and annual limits specifically allowed in Section XI.G.

e. Reasons for any emissions in excess of those specifically allowed in Section XI.D.1 through 2, 7 and 8 with mitigative measures utilized and corrective actions taken to prevent a recurrence of the situation.

f. A summary of the number of batches of coke that were processed using the alternative coke handling method (ARM 17.8.749).

2. For non-minor (defined in the June 12, 1998 Stipulation) flaring events, CHS shall comply with the reporting requirements identified in Section (3)(A)(5) of Exhibit A-1 of the Stipulation signed by the Board of Environmental Review on June 12, 1998 (ARM 17.8.749).

## Section XII: Limitations and Conditions for Boiler #11

A. CHS shall comply with all applicable standards and limitations, and the monitoring, recordkeeping, and reporting requirements contained in 40 CFR Part 60, NSPS. The following subparts, at a minimum, are applicable (ARM 17.8.340):

1. Subpart A - General Provisions applies to all equipment or facilities subject to an NSPS subpart listed below.

2. Subpart J - Standards of Performance for Petroleum Refineries applies to Boiler #11.

3. Subpart Db – Standards of Performance for Steam Generating Units applies to Boiler #11.

B. CHS shall not cause or authorize emissions to be discharged into the outdoor atmosphere from any source installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes. This applies to the sources in Boiler #11 (ARM 17.8.304 (2)).

C. Limitations on Boiler #11

1. $SO_2$ emissions from Boiler #11 shall not exceed (ARM 17.8.752):

a. 8.59 tons/rolling 12-calendar month total
b. 3.92 lb/hr

2. $NO_x$ emissions from Boiler #11 shall not exceed (ARM 17.8.752):

   a. 18.3 tons/rolling 12-calendar month total
   b. 4.18 lb/hr

3. CO emissions from Boiler #11 shall not exceed (ARM 17.8.752):

   a. 400 $ppm_{vd}$ at 3% oxygen on a 30-day rolling average
   b. 36.63 tons/rolling 12-calendar month total
   c. 15.26 lb/hr

4. VOC Emissions from the Boiler #11 shall not exceed 4.83 tons/rolling 12-calendar month total (ARM 17.8.752).

5. CHS shall not fire fuel oil in this unit (ARM 17.8.340; 40 CFR 60, Subpart J; and ARM 17.8.752).

D. Monitoring requirements

1. CHS shall install and operate the following (CEMS/CERMS) for Boiler #11:

   a. $NO_x$ (40 CFR 60, Subpart Db)
   b. $O_2$ (40 CFR 60, Subpart Db)

2. CEMS and CERMS required by this permit shall comply with all applicable provisions of 40 CFR Part 60.5 through 60.13, Subpart Db 60.40b through 60.49b, Subparts J, 60.100-108, and Appendix A, Appendix B, Performance Specifications 2, 3, 4 or 4A, 6, and Appendix F.

3. CEMS are to be in operation at all times when the emission units are operating, except for quality assurance and control checks, breakdowns, and repairs. In the event the primary CEMS is unable to meet minimum availability requirements, the recipient shall provide a back-up or alternative monitoring system and plan such that continuous compliance can be demonstrated.

4. With exception to the initial performance test period, compliance with the lb/MMBtu limit(s) will be demonstrated using statistically significant F-factor values. The factor will be updated on a regular basis using data from all valid fuel gas samples representative of the fuel gas burned in Boiler #11. The method of compliance demonstration involving F-factor statistical significance is subject to change upon agreement with the Department and CHS (40 CFR 60, Appendix A, Reference Method 19).

E. Testing Requirements

Boiler #11 shall be tested annually, or according to another testing/monitoring schedule as may be approved by the Department, for $NO_x$ and CO, concurrently, and the results submitted to the Department in order to demonstrate compliance with the $NO_x$ and CO emission limits contained in Sections XII.C.2 and 3 (ARM 17.8.105 and ARM 17.8.749).

i. 1.96 tons/rolling 12-calendar month total
ii. 0.90 lb/hr

b. $NO_x$ emissions from H-901 shall not exceed (ARM 17.8.752):

i. 2.19 tons/rolling 12-calendar month total
ii. 0.50 lb/hr

c. CO emissions from H-901 shall not exceed (ARM 17.8.752):

i. 9.00 tons/rolling 12-calendar month total
ii. 2.05 lb/hr

d. VOC Emissions from H-901 shall not exceed 0.59 tons/rolling 12-calendar month total (ARM 17.8.752).

e. CHS shall not fire fuel oil in this unit (ARM 17.8.752 and ARM 17.8.749).

2. Fractionator Reboiler H-902

a. $SO_2$ emissions from H-902 shall not exceed (ARM 17.8.752):

i. 3.95 tons/rolling 12-calendar month total
ii. 1.80 lb/hr

b. $NO_x$ emissions from H-902 shall not exceed (ARM 17.8.752):

i. 4.40 tons/rolling 12-calendar month total
ii. 1.00 lb/hr

c. CO emissions from H-902 shall not exceed (ARM 17.8.752):

i. 8.50 tons/rolling 12-calendar month total
ii. 1.94 lb/hr

d. VOC Emissions from H-902 shall not exceed 1.19 tons/rolling 12-calendar month total (ARM 17.8.752).

e. CHS shall not fire fuel oil in this unit (ARM 17.8.752 and ARM 17.8.749).

3. Reformer Heater H-1001

a. $SO_2$ emissions from H-1001 shall not exceed (ARM 17.8.752):

i. 12.69 tons/rolling 12-calendar month total
ii. 5.80 lb/hr

b. $NO_x$ emissions from H-1001 shall not exceed (ARM 17.8.752):

i. 28.31 tons/rolling 12-calendar month total
ii. 6.46 lb/hr

c. CO emissions from H-1001 shall not exceed (ARM 17.8.752):

i. 400 ppmvd at 3% oxygen on a 30-day rolling average
ii. 14.15 tons/rolling 12-calendar month total
iii. 3.23 lb/hr

d. VOC Emissions from H-1001 shall not exceed 3.82 tons/rolling 12-calendar month total (ARM 17.8.752).

e. CHS shall not fire fuel oil in this unit (ARM 17.8.752 and ARM 17.8.749).

E. Monitoring Requirements (ARM 17.8.340).

1. CHS shall install and operate the following (CEMS/CERMS) for H-1001:

a. $O_2$ (40 CFR 60, Subpart J)
b. $SO_2$ (40 CFR 60, Subpart J)

2. CEMS and CERMS required by this permit shall comply with all applicable provisions of 40 CFR Part 60.5 through 60.13, Subpart Db 60.40b through 60.49b, Subparts J, 60.100-108, and Appendix B, Performance Specifications 2, 3, 4 or 4A, and Appendix F. The volumetric flow rate monitor shall, if required, comply with the Billings/Laurel SIP Pollution Control Plan Exhibit A, Attachment 1 Methods A-1 and B-1.

3. CEMS are to be in operation at all times when the emission units are operating, except for quality assurance and control checks, breakdowns, and repairs. In the event the primary CEMS is unable to meet minimum availability requirements, the recipient shall provide a back-up or alternative monitoring system and plan such that continuous compliance can be demonstrated.

F. Testing Requirements

1. The Reactor Charge Heater (H-901) shall be tested annually, or according to another testing/monitoring schedule as may be approved by the Department, for $NO_x$ and CO, concurrently, and the results submitted to the Department in order to demonstrate compliance with the $NO_x$ and CO emission limits contained in Section VIII.D.1.b and c (ARM 17.8.105 and ARM 17.8.749).

2. The Fractionator Reboiler (H-902) shall be tested annually, or according to another testing/monitoring schedule as may be approved by the Department, for $NO_x$ and CO, concurrently, and the results submitted to the Department in order to demonstrate compliance with the $NO_x$ and CO emission limits contained in Section VIII. D.2.b and c (ARM 17.8.105 and ARM 17.8.749).

3. The Reformer Heater (H-1001) shall be tested annually, or according to another testing/monitoring schedule as may be approved by the Department, for $NO_x$ and CO, concurrently, and the results submitted to the Department in order to demonstrate compliance with the $NO_x$ and CO emission limits contained in Section VIII.D.3.b and c (ARM 17.8.105 and ARM 17.8.749).

G. Compliance Determinations (ARM 17.8.749).

1. In addition to stack testing required in Section VIII.F, compliance determinations for the $SO_2$ limit in Section VIII.D.3 for H-1001 shall also be based upon monitoring data as required in Section VIII.E.

2. Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines. This applies to the replacement C-201B Compressor installed in 2006.

C. CHS shall not cause or authorize emissions to be discharged into the outdoor atmosphere from any source installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes. This applies to the sources in the HDS complex (ARM 17.8.304 (2)).

D. Limitations on Individual Sources

The HDS complex desulfurizes fluidized catalytic cracking unit feedstocks. The SRU and TGTU shall together utilize up to 70.7 long tons per day (LTD) of equivalent sulfur obtained from the equipment, to manufacture elemental sulfur.

1. Zone D SRU Incinerator Stack (E-407 & INC-401)

a. $SO_2$ emissions from the Zone D SRU incinerator stack shall not exceed (ARM 17.8.749):

i. 31.1 tons/rolling 12-calendar month total,

ii. 125 $ppm_{vd}$, rolling 12-month average corrected to 0% oxygen, on a dry basis,

iii. 341.04 lb/day,

iv. 14.21 lb/hr, and

v. 250 $ppm_{vd}$, rolling 12-hour average corrected to 0% oxygen, on a dry basis.

b. CHS shall operate and maintain the TGTU on the Zone D SRU to limit $SO_2$ emissions from the Zone D SRU incinerator stack (E-407 & INC-401) to no more than 125 $ppm_{vd}$ on a rolling 12-month average corrected to 0% oxygen on a dry basis (ARM 17.8.752).

c. $NO_x$ emissions from the Zone D SRU incinerator stack shall not exceed (ARM 17.8.749):

i. 3.5 tons/rolling 12-calendar month total,
ii. 19.2 lb/day, and
iii. 0.8 lb/hr.

d. CHS shall not fire fuel oil in this unit (ARM 17.8.749).

2. Compressor Gas Engine Stack (C-201B)

a. $NO_x$ emissions from C-201B shall not exceed (ARM 17.8.749):

i. 30.43 tons/rolling 12-calendar month total
ii. 7.14 lb/hr

b. CO emissions from C-201B shall not exceed (ARM 17.8.749):

i. 68.59 tons/rolling 12-calendar month total

## Review and Certification

All work, calculations, and other activities and tasks performed and documented in this report were carried out under my direction and supervision. This test project conforms to EEMC's Quality Manual and to the requirements of ASTM D-7036.

David Wang
Division Manager, EEMC

5 - 19 - 10
Date

I have reviewed all testing details, calculations, results, conclusions and other appropriate written materials contained herein, and hereby certify that the presented material is authentic and accurate.

Ed Wadington
President, EEMC

6 - 8 - 10
Date

I have reviewed, and accept, the production and test data contained in this report, and hereby certify that it is authentic.

Signature

Date

Name (Printed)

Title

Company

## Relative Accuracy Summaries

## CEM RELATIVE ACCURACY DETERMINATION
**$SO_2$ - ppm v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/03/10
**Location:** Laurel, Montana
**Source:** Zone C FCCU

| Run # | Reference Run Time | Reference Method ppm v/v d | CEM Average ppm v/v d | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:10-09:31 | 10.4 | 8.0 | 2.4 | 5.76 |
| 2 | 09:41-10:02 | 10.0 | 7.8 | 2.2 | 4.84 |
| 3 | 10:12-10:33 | 11.2 | 9.0 | 2.2 | 4.84 |
| 4 | 10:43-11:04 | 9.8 | 7.8 | 2.0 | 4.00 |
| 5 | 11:14-11:35 | 10.6 | 8.3 | 2.3 | 5.29 |
| 6 | 11:45-12:06 | 10.6 | 7.9 | 2.7 | 7.29 |
| 7 | 12:16-12:37 | 10.4 | 7.9 | 2.5 | 6.25 |
| 8 | 12:47-13:08 | 10.1 | 7.7 | 2.4 | 5.76 |
| 9 | 13:18-13:39 | 10.0 | 7.7 | 2.3 | 5.29 |
| | | | | | |
| | Sum: | | | 21.0 | 49.32 |
| | Mean: | 10.34 | 8.01 | 2.33 | |
| | \|Mean\|: | | | 2.33 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.15 |
| Sd (Standard Deviation) = | 0.20 |

**Relative Accuracy (RA):** **1.1 %ES***
**Emission Standard (ES):*** **220 ***

*The emission standard is given as 250 ppmv d @ 0% $O_2$ so this is 'back' calculated using the average reference oxygen value from this test series (2.6 %$O_2$).

***CEM Spec. 2:**
The Relative Accuracy of the CEMS must be no greater than 20% when the reference mean (RM) is used to calculate RA, 10% when the applicable emissions standard (ES) is used to calculate RA.
Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard
Relative Accuracy is calculated based on the reference mean when the reference mean (RM) is greater than 50% of the emission standard or when there is no emisson standard.

## CEM RELATIVE ACCURACY DETERMINATION

**$NO_x$ - ppm v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/03/10
**Location:** Laurel, Montana
**Source:** Zone C FCCU

| Run # | Reference Run Time | Reference Method ppm v/v d | CEM Average ppm v/v d | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:10-09:31 | 37.5 | 35.5 | 2.0 | 4.00 |
| 2 | 09:41-10:02 | 37.4 | 35.2 | 2.2 | 4.84 |
| 3 | 10:12-10:33 | 36.7 | 35.1 | 1.6 | 2.56 |
| 4 | 10:43-11:04 | 38.4 | 36.5 | 1.9 | 3.61 |
| 5 | 11:14-11:35 | 37.6 | 35.5 | 2.1 | 4.41 |
| 6 | 11:45-12:06 | 37.2 | 35.0 | 2.2 | 4.84 |
| 7 | 12:16-12:37 | 38.7 | 36.8 | 1.9 | 3.61 |
| 8 | 12:47-13:08 | 38.8 | 37.0 | 1.8 | 3.24 |
| 9 | 13:18-13:39 | 38.0 | 35.9 | 2.1 | 4.41 |
| | | | | | |
| | Sum: | | | 17.80 | 35.52 |
| | Mean: | 37.81 | 35.83 | 1.98 | |
| | \|Mean\|: | | | 1.98 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.15 |
| Sd (Standard Deviation) = | 0.20 |

**Relative Accuracy (RA):** **5.6 %RM***

***CEM Spec. 2:**
The Relative Accuracy of the CEMS must be no greater than 20% when the reference mean (RM) is used to calculate RA, 10% when the applicable emissions standard (ES) is used to calculate RA.
Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard
Relative Accuracy is calculated based on the reference mean when the reference mean (RM) is greater than 50% of the emission standard or when there is no emisson standard.

## CEM RELATIVE ACCURACY DETERMINATION

**CO - ppm v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/03/10
**Location:** Laurel, Montana
**Source:** Zone C FCCU

| Run # | Reference Run Time | Reference Method ppm v/v d | CEM Average ppm v/v d | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:10-09:31 | 37.1 | 34.1 | 3.0 | 9.00 |
| 2 | 09:41-10:02 | 37.7 | 35.3 | 2.4 | 5.76 |
| 3 | 10:12-10:33 | 39.9 | 38.0 | 1.9 | 3.61 |
| 4 | 10:43-11:04 | 32.9 | 31.0 | 1.9 | 3.61 |
| 5 | 11:14-11:35 | 36.3 | 33.7 | 2.6 | 6.76 |
| 6 | 11:45-12:06 | 37.3 | 34.6 | 2.7 | 7.29 |
| 7 | 12:16-12:37 | 31.6 | 30.4 | 1.2 | 1.44 |
| 8 | 12:47-13:08 | 34.5 | 32.7 | 1.8 | 3.24 |
| 9 | 13:18-13:39 | 36.7 | 33.7 | 3.0 | 9.00 |
| | | | | | |
| | Sum: | | | 20.50 | 49.71 |
| | Mean: | 36.00 | 33.72 | 2.28 | |
| | \|Mean\|: | | | 2.28 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.47 |
| Sd (Standard Deviation) = | 0.61 |

**Relative Accuracy (RA):** **7.6 %RM***

***CEM Spec. 4:**
The Relative Accuracy of the CEMS must be no greater than 10% when the reference mean (RM) is used to calculate RA, 5% when the applicable emissions standard (ES) is used to calculate RA.
Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard.
Relative Accuracy is calculated based on the reference mean when the reference mean (RM) is greater than 50% of the emission standard or when there is no emission standard.

## CEM RELATIVE ACCURACY DETERMINATION

**$O_2$ - % v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/03/10
**Location:** Laurel, Montana
**Source:** Zone C FCCU

| Run # | Reference Run Time | Reference Method % v/v dry | CEM Average % v/v dry | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:10-09:31 | 2.5 | 2.2 | 0.3 | 0.09 |
| 2 | 09:41-10:02 | 2.6 | 2.2 | 0.4 | 0.16 |
| 3 | 10:12-10:33 | 2.3 | 2.1 | 0.2 | 0.04 |
| 4 | 10:43-11:04 | 2.6 | 2.4 | 0.2 | 0.04 |
| 5 | 11:14-11:35 | 2.5 | 2.1 | 0.4 | 0.16 |
| 6 | 11:45-12:06 | 2.6 | 2.3 | 0.3 | 0.09 |
| 7 | 12:16-12:37 | 2.7 | 2.2 | 0.5 | 0.25 |
| 8 | 12:47-13:08 | 2.6 | 2.3 | 0.3 | 0.09 |
| 9 | 13:18-13:39 | 2.6 | 2.2 | 0.4 | 0.16 |
| | | | | | |
| | Sum: | | | 3.00 | 1.08 |
| | Mean: | 2.56 | 2.22 | 0.33 | |
| | \|Mean\|: | | | 0.33 | |

**Statistical Data:**
**N (number of data points):** **9**

**Relative Accuracy (RA):** **0.33 % Abs.***

* **CEM Spec. 3:** The Relative Accuracy of the CEMS must be no greater than 1% when the RA is calculated as the absolute mean difference between the reference mean (RM) and the CEM mean.

## CEM RELATIVE ACCURACY DETERMINATION

**Gas Flow - DSCFH**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/03/10
**Location:** Laurel, Montana
**Source:** Zone C FCCU

| Run # | Reference Run Time | Reference Method DSCFH | CEM Average DSCFH | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:10-09:31 | 1,919,849 | 1,929,251 | -9,402 | 88,397,604 |
| 2 | 09:41-10:02 | 1,912,740 | 1,821,806 | 90,934 | 8,268,992,356 |
| 3 | 10:12-10:33 | 1,929,026 | 1,825,265 | 103,761 | 10,766,345,121 |
| 4 | 10:43-11:04 | 1,901,314 | 1,798,857 | 102,457 | 10,497,436,849 |
| 5 | 11:14-11:35 | 1,921,290 | 1,805,711 | 115,579 | 13,358,505,241 |
| 6 | 11:45-12:06 | 1,892,098 | 1,808,870 | 83,228 | 6,926,899,984 |
| 7 | 12:16-12:37 | 1,886,526 | 1,800,519 | 86,007 | 7,397,204,049 |
| 8 | 12:47-13:08 | 1,898,827 | 1,809,743 | 89,084 | 7,935,959,056 |
| 9 | 13:18-13:39 | 1,911,623 | 1,830,791 | 80,832 | 6,533,812,224 |
| | | | | | |
| | Sum: | | | 742,480 | 71,773,552,484 |
| | Mean: | 1,908,144 | 1,825,646 | 82,498 | |
| | \|Mean\|: | | | 82,498 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 27,874.9 |
| Sd (Standard Deviation) = | 36,264.0 |

**Relative Accuracy (RA):** **5.8 %RM***

## CEM RELATIVE ACCURACY DETERMINATION

**$NO_x$ - ppm v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/04/10
**Location:** Laurel, Montana
**Source:** Boiler #10

| Run # | Reference Run Time | Reference Method ppm v/v d | CEM Average ppm v/v d | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:00-09:21 | 29.8 | 33.8 | -4.0 | 16.00 |
| 2 | 09:30-09:51 | 29.8 | 34.2 | -4.4 | 19.36 |
| 3 | 10:00-10:21 | 29.8 | 34.1 | -4.3 | 18.49 |
| 4 | 10:30-10:51 | 29.8 | 34.2 | -4.4 | 19.36 |
| 5 | 11:00-11:21 | 29.9 | 34.4 | -4.5 | 20.25 |
| 6 | 11:30-11:51 | 29.6 | 34.3 | -4.7 | 22.09 |
| 7 | 12:00-12:21 | 29.9 | 34.4 | -4.5 | 20.25 |
| 8 | 12:30-12:51 | 29.7 | 34.4 | -4.7 | 22.09 |
| 9 | 13:00-13:21 | 29.9 | 34.6 | -4.7 | 22.09 |
| | | | | | |
| | Sum: | | | -40.20 | 179.98 |
| | Mean: | 29.80 | 34.27 | -4.47 | |
| | \|Mean\|: | | | 4.47 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.18 |
| Sd (Standard Deviation) = | 0.23 |

**Relative Accuracy (RA):** **15.6 %RM***

***CEM Spec. 2:**
The Relative Accuracy of the CEMS must be no greater than 20% when the reference mean (RM) is used to calculate RA, 10% when the applicable emissions standard (ES) is used to calculate RA.
Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard
Relative Accuracy is calculated based on the reference mean when the reference mean (RM) is greater than 50% of the emission standard or when there is no emisson standard.

## CEM RELATIVE ACCURACY DETERMINATION

**CO - ppm v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/04/10
**Location:** Laurel, Montana
**Source:** Boiler #10

| Run # | Reference Run Time | Reference Method ppm v/v d | CEM Average ppm v/v d | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:00-09:21 | 79.4 | 73.7 | 5.7 | 32.49 |
| 2 | 09:30-09:51 | 81.7 | 77.3 | 4.4 | 19.36 |
| 3 | 10:00-10:21 | 80.7 | 78.1 | 2.6 | 6.76 |
| 4 | 10:30-10:51 | 80.6 | 77.0 | 3.6 | 12.96 |
| 5 | 11:00-11:21 | 81.8 | 79.8 | 2.0 | 4.00 |
| 6 | 11:30-11:51 | 82.6 | 77.7 | 4.9 | 24.01 |
| 7 | 12:00-12:21 | 81.7 | 76.8 | 4.9 | 24.01 |
| 8 | 12:30-12:51 | 83.0 | 77.5 | 5.5 | 30.25 |
| 9 | 13:00-13:21 | 82.7 | 77.8 | 4.9 | 24.01 |
| | | | | | |
| | Sum: | | | 38.50 | 177.85 |
| | Mean: | 81.58 | 77.30 | 4.28 | |
| | \|Mean\|: | | | 4.28 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.98 |
| Sd (Standard Deviation) = | 1.28 |

**Relative Accuracy (RA):** **6.4 %RM***

***CEM Spec. 4:**
The Relative Accuracy of the CEMS must be no greater than 10% when the reference mean (RM) is used to calculate RA, 5% when the applicable emissions standard (ES) is used to calculate RA.
Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard.
Relative Accuracy is calculated based on the reference mean when the reference mean (RM) is greater than 50% of the emission standard or when there is no emission standard.

## CEM RELATIVE ACCURACY DETERMINATION

**$O_2$ - % v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/04/10
**Location:** Laurel, Montana
**Source:** Boiler #10

| Run # | Reference Run Time | Reference Method % v/v dry | CEM Average % v/v dry | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:00-09:21 | 5.9 | 6.0 | -0.1 | 0.01 |
| 2 | 09:30-09:51 | 6.0 | 5.9 | 0.1 | 0.01 |
| 3 | 10:00-10:21 | 5.9 | 5.8 | 0.1 | 0.01 |
| 4 | 10:30-10:51 | 5.9 | 5.9 | 0.0 | 0.00 |
| 5 | 11:00-11:21 | 5.8 | 5.8 | 0.0 | 0.00 |
| 6 | 11:30-11:51 | 5.9 | 5.8 | 0.1 | 0.01 |
| 7 | 12:00-12:21 | 5.9 | 5.9 | 0.0 | 0.00 |
| 8 | 12:30-12:51 | 5.9 | 5.8 | 0.1 | 0.01 |
| 9 | 13:00-13:21 | 5.9 | 5.8 | 0.1 | 0.01 |
| | | | | | |
| | Sum: | | | 0.40 | 0.06 |
| | Mean: | 5.90 | 5.86 | 0.04 | |
| | \|Mean\|: | | | 0.04 | |

**Statistical Data:**
**N (number of data points):** **9**

**Relative Accuracy (RA):** **0.04 % Abs.***

* **CEM Spec. 3:** The Relative Accuracy of the CEMS must be no greater than 1% when the RA is calculated as the absolute mean difference between the reference mean (RM) and the CEM mean.

## Relative Accuracy Example Calculation Sheet

COMPANY NAME: CHS
PLANT LOCATION: Laurel, Montana
SOURCE TESTED: B-12
TEST DATE: 5/5/10
SPECIES: WOX

| Run # | Time | Reference Data (RD) | CEM Data | Difference $d_i$ | (Difference)$^2$ $d_i^2$ |
|---|---|---|---|---|---|
| 1 | 1015-1036 | 20.1 | 18.9 | +1.2 | 1.44 |
| 2 | 1045-1106 | 19.9 | 19.0 | +0.9 | 0.81 |
| 3 | 1115-1136 | 19.9 | 19.3 | +0.6 | 0.36 |
| 4 | 1145-1206 | 19.9 | 18.8 | +1.1 | 1.21 |
| 5 | 1215-1236 | 20.0 | 19.0 | +1.0 | 1.00 |
| 6 | 1245-1306 | 19.4 | 18.6 | +0.8 | 0.64 |
| 7 | 1315-1336 | 19.8 | 18.7 | +1.1 | 1.21 |
| 8 | 1345-1406 | 19.4 | 18.7 | +0.7 | 0.49 |
| 9 | 1415-1436 | 19.5 | 18.7 | +0.8 | 0.64 |
| 10 | | | | | |
| 11 | | | | | |
| 12 | | | | | |
| Sum ($\Sigma$) | | — | — | 8.2 | 7.80 |
| Mean ($\bar{x}$) | | 19.77 | 18.86 | 0.91 | |

n (number of data points utilized) = 9

t.975 (t-value) = 2.306

CC (Confidence Coefficient) = $\frac{(2.306)(Sd)}{\sqrt{n}} = \frac{(2.306)(.202)}{\sqrt{9}} = .155$

Sd (Standard deviation) = $\sqrt{\frac{\sum d_i^2 - \frac{(\sum d_i)^2}{n}}{n-1}} = \sqrt{\frac{7.8 - \frac{67.24}{9}}{8}} = .202$

% RA (Relative Accuracy) = $\frac{\bar{x}|d_i| + CC}{\bar{x}RD} \times 100 = \frac{.91 + .155}{19.77} = 5.4$

Shared Documents/Forms/Relative Accuracy 3-19-10

## CEM RELATIVE ACCURACY DETERMINATION

**$NO_x$ - ppm v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/05/10
**Location:** Laurel, Montana
**Source:** Boiler 12

| Run # | Reference Run Time | Reference Method ppm v/v d | CEM Average ppm v/v d | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 10:15-10:36 | 20.1 | 18.9 | 1.2 | 1.44 |
| 2 | 10:45-11:06 | 19.9 | 19.0 | 0.9 | 0.81 |
| 3 | 11:15-11:36 | 19.9 | 19.3 | 0.6 | 0.36 |
| 4 | 11:45-12:06 | 19.9 | 18.8 | 1.1 | 1.21 |
| 5 | 12:15-12:36 | 20.0 | 19.0 | 1.0 | 1.00 |
| 6 | 12:45-13:06 | 19.4 | 18.6 | 0.8 | 0.64 |
| 7 | 13:15-13:36 | 19.8 | 18.7 | 1.1 | 1.21 |
| 8 | 13:45-14:06 | 19.4 | 18.7 | 0.7 | 0.49 |
| 9 | 14:15-14:36 | 19.5 | 18.7 | 0.8 | 0.64 |
| | | | | | |
| | Sum: | | | 8.20 | 7.80 |
| | Mean: | 19.77 | 18.86 | 0.91 | |
| | \|Mean\|: | | | 0.91 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.15 |
| Sd (Standard Deviation) = | 0.20 |

**Relative Accuracy (RA):** **5.4 %RM***

***CEM Spec. 2:**
The Relative Accuracy of the CEMS must be no greater than 20% when the reference mean (RM) is used to calculate RA, 10% when the applicable emissions standard (ES) is used to calculate RA.
Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard
Relative Accuracy is calculated based on the reference mean when the reference mean (RM) is greater than 50% of the emission standard or when there is no emisson standard.

## CEM RELATIVE ACCURACY DETERMINATION

**$NO_x$ - lbs/hr**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/05/10
**Location:** Laurel, Montana
**Source:** Boiler 12

| Run # | Reference Run Time | Reference Method lbs/hr | CEM Average lbs/hr | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 10:15-10:36 | 4.10 | 3.81 | 0.29 | 0.0841 |
| 2 | 10:45-11:06 | 4.03 | 3.74 | 0.29 | 0.0841 |
| 3 | 11:15-11:36 | 4.04 | 3.85 | 0.19 | 0.0361 |
| 4 | 11:45-12:06 | 4.06 | 3.79 | 0.27 | 0.0729 |
| 5 | 12:15-12:36 | 4.05 | 3.80 | 0.25 | 0.0625 |
| 6 | 12:45-13:06 | 3.95 | 3.74 | 0.21 | 0.0441 |
| 7 | 13:15-13:36 | 4.04 | 3.77 | 0.27 | 0.0729 |
| 8 | 13:45-14:06 | 3.93 | 3.76 | 0.17 | 0.0289 |
| 9 | 14:15-14:36 | 3.98 | 3.74 | 0.24 | 0.0576 |
| | | | | | |
| | Sum: | | | 2.18 | 0.5432 |
| | Mean: | 4.020 | 3.778 | 0.242 | |
| | \|Mean\|: | | | 0.242 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.0334 |
| Sd (Standard Deviation) = | 0.0435 |

**Relative Accuracy (RA):** **6.9 %RM***

***CEM Spec. 6:**
The Relative Accuracy of the CEMS must be no greater than 20% when the reference mean (RM) is used to calculate RA, 10% when the applicable emissions standard (ES) is used to calculate RA.
Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard
Relative Accuracy is calculated based on the reference mean when the reference mean (RM) is greater than 50% of the emission standard or when there is no emisson standard.

## CEM RELATIVE ACCURACY DETERMINATION

**$NO_x$ - lbs/MMBtu**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/05/10
**Location:** Laurel, Montana
**Source:** Boiler 12

| Run # | Reference Run Time | Reference Method lbs/MMBtu | CEM Average lbs/MMBtu | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 10:15-10:36 | 0.02 | 0.02 | 0.00 | 0.00 |
| 2 | 10:45-11:06 | 0.02 | 0.02 | 0.00 | 0.00 |
| 3 | 11:15-11:36 | 0.02 | 0.02 | 0.00 | 0.00 |
| 4 | 11:45-12:06 | 0.02 | 0.02 | 0.00 | 0.00 |
| 5 | 12:15-12:36 | 0.02 | 0.02 | 0.00 | 0.00 |
| 6 | 12:45-13:06 | 0.02 | 0.02 | 0.00 | 0.00 |
| 7 | 13:15-13:36 | 0.02 | 0.02 | 0.00 | 0.00 |
| 8 | 13:45-14:06 | 0.02 | 0.02 | 0.00 | 0.00 |
| 9 | 14:15-14:36 | 0.02 | 0.02 | 0.00 | 0.00 |
| | | | | | |
| | Sum: | | | 0.00 | 0.00 |
| | Mean: | 0.020 | 0.020 | 0.00 | |
| | \|Mean\|: | | | 0.00 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | - |
| Sd (Standard Deviation) = | - |

**Relative Accuracy (RA):** **0.0 %RM***

***CEM Spec. 6:**

The Relative Accuracy of the CEMS must be no greater than 20% when the reference mean (RM) is used to calculate RA, 10% when the applicable emissions standard (ES) is used to calculate RA.

Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard

Relative Accuracy is calculated based on the reference mean when the reference mean (RM) is greater than 50% of the emission standard or when there is no emisson standard.

## CEM RELATIVE ACCURACY DETERMINATION

**CO - ppm v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/05/10
**Location:** Laurel, Montana
**Source:** Boiler 12

| Run # | Reference Run Time | Reference Method ppm v/v d | CEM Average ppm v/v d | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 10:15-10:36 | 0.8 | 0.9 | -0.1 | 0.01 |
| 2 | 10:45-11:06 | 0.7 | 0.9 | -0.2 | 0.04 |
| 3 | 11:15-11:36 | 0.7 | 1.1 | -0.4 | 0.16 |
| 4 | 11:45-12:06 | 0.8 | 1.0 | -0.2 | 0.04 |
| 5 | 12:15-12:36 | 0.7 | 1.0 | -0.3 | 0.09 |
| 6 | 12:45-13:06 | 0.6 | 1.0 | -0.4 | 0.16 |
| 7 | 13:15-13:36 | 0.7 | 1.0 | -0.3 | 0.09 |
| 8 | 13:45-14:06 | 0.6 | 0.9 | -0.3 | 0.09 |
| 9 | 14:15-14:36 | 0.9 | 1.0 | -0.1 | 0.01 |
| | | | | | |
| | Sum: | | | -2.30 | 0.69 |
| | Mean: | 0.72 | 0.98 | -0.26 | |
| | \|Mean\|: | | | 0.26 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.08 |
| Sd (Standard Deviation) = | 0.11 |

**Relative Accuracy (RA):** **0.64 * < 5 ppm v/v d**

ABS(RM - CC) = 0.64

***CEM Spec. 4A**: The relative Accuracy of the CEM must be no greater than 10% when the reference mean (RM) is used to calculate RA; 5% when the applicable Emission Standard** (ES) is used to calculate RA or within 5ppmv when the RA is calculated as the absolute difference between the RM and CEMS plus the 2.5 percent confidence coefficient.

## CEM RELATIVE ACCURACY DETERMINATION

**CO - ppm v/v dry @ 3% $O_2$**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/05/10
**Location:** Laurel, Montana
**Source:** Boiler 12

| Run # | Reference Run Time | Reference Method ppmv d @ 3% $O_2$ | CEM Average ppmv d @ 3% $O_2$ | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 10:15-10:36 | 0.8 | 0.9 | -0.1 | 0.01 |
| 2 | 10:45-11:06 | 0.7 | 0.9 | -0.2 | 0.04 |
| 3 | 11:15-11:36 | 0.7 | 1.0 | -0.3 | 0.09 |
| 4 | 11:45-12:06 | 0.8 | 1.0 | -0.2 | 0.04 |
| 5 | 12:15-12:36 | 0.7 | 1.0 | -0.3 | 0.09 |
| 6 | 12:45-13:06 | 0.6 | 1.0 | -0.4 | 0.16 |
| 7 | 13:15-13:36 | 0.7 | 1.0 | -0.3 | 0.09 |
| 8 | 13:45-14:06 | 0.7 | 0.9 | -0.2 | 0.04 |
| 9 | 14:15-14:36 | 0.9 | 1.0 | -0.1 | 0.01 |
| | | | | | |
| | Sum: | | | -2.10 | 0.57 |
| | Mean: | 0.73 | 0.97 | -0.23 | |
| | \|Mean\|: | | | 0.23 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.08 |
| Sd (Standard Deviation) = | 0.10 |

**Relative Accuracy (RA):** **0.65 * < 5 ppm v/v d**

ABS(RM - CC) = 0.65

***CEM Spec. 4A**: The relative Accuracy of the CEM must be no greater than 10% when the reference mean (RM) is used to calculate RA; 5% when the applicable Emission Standard** (ES) is used to calculate RA or within 5ppmv when the RA is calculated as the absolute difference between the RM and CEMS plus the 2.5 percent confidence coefficient.

## CEM RELATIVE ACCURACY DETERMINATION

**$O_2$ - % v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/05/10
**Location:** Laurel, Montana
**Source:** Boiler 12

| Run # | Reference Run Time | Reference Method % v/v dry | CEM Average % v/v dry | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 10:15-10:36 | 2.7 | 2.8 | -0.1 | 0.01 |
| 2 | 10:45-11:06 | 2.6 | 2.8 | -0.2 | 0.04 |
| 3 | 11:15-11:36 | 2.6 | 2.7 | -0.1 | 0.01 |
| 4 | 11:45-12:06 | 2.6 | 2.7 | -0.1 | 0.01 |
| 5 | 12:15-12:36 | 2.7 | 2.8 | -0.1 | 0.01 |
| 6 | 12:45-13:06 | 2.7 | 2.7 | 0.0 | 0.00 |
| 7 | 13:15-13:36 | 2.7 | 2.7 | 0.0 | 0.00 |
| 8 | 13:45-14:06 | 2.7 | 2.8 | -0.1 | 0.01 |
| 9 | 14:15-14:36 | 2.6 | 2.7 | -0.1 | 0.01 |
| | | | | | |
| | Sum: | | | -0.80 | 0.10 |
| | Mean: | 2.66 | 2.74 | -0.09 | |
| | \|Mean\|: | | | 0.09 | |

**Statistical Data:**
**N (number of data points):** 9

**Relative Accuracy (RA):** 0.09 % Abs.*

*** CEM Spec. 3: The Relative Accuracy of the CEMS must be no greater than 1% when the RA is calculated as the absolute mean difference between the reference mean (RM) and the CEM mean.**

## CEM RELATIVE ACCURACY DETERMINATION

**Gas Flow - MMDSCFH**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/05/10
**Location:** Laurel, Montana
**Source:** Boiler 12

| Run # | Reference Run Time | Reference Method MMDSCFH | CEM Average MMDSCFH | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 10:15-10:36 | 1.71 | 1.69 | 0.02 | 0.0003 |
| 2 | 10:45-11:06 | 1.69 | 1.65 | 0.04 | 0.0019 |
| 3 | 11:15-11:36 | 1.70 | 1.67 | 0.03 | 0.0010 |
| 4 | 11:45-12:06 | 1.71 | 1.68 | 0.03 | 0.0008 |
| 5 | 12:15-12:36 | 1.70 | 1.68 | 0.02 | 0.0002 |
| 6 | 12:45-13:06 | 1.70 | 1.68 | 0.02 | 0.0006 |
| 7 | 13:15-13:36 | 1.71 | 1.68 | 0.03 | 0.0009 |
| 8 | 13:45-14:06 | 1.70 | 1.69 | 0.01 | 0.0001 |
| 9 | 14:15-14:36 | 1.71 | 1.67 | 0.04 | 0.0014 |
| | | | | | |
| | Sum: | | | 0.24 | 0.0072 |
| | Mean: | 1.703 | 1.677 | 0.026 | |
| | \|Mean\|: | | | 0.026 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.0077 |
| Sd (Standard Deviation) = | 0.0100 |

**Relative Accuracy (RA):** **2.0 %RM***

## CEM RELATIVE ACCURACY DETERMINATION

**$NO_x$ - ppm v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/06/10
**Location:** Laurel, Montana
**Source:** Boiler 11

| Run # | Reference Run Time | Reference Method ppm v/v d | CEM Average ppm v/v d | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:00-09:21 | 17.5 | 19.9 | -2.4 | 5.76 |
| 2 | 09:30-09:51 | 17.7 | 20.0 | -2.3 | 5.29 |
| 3 | 10:00-10:21 | 17.9 | 19.9 | -2.0 | 4.00 |
| 4 | 10:30-10:51 | 17.7 | 20.0 | -2.3 | 5.29 |
| 5 | 11:00-11:21 | 17.9 | 20.4 | -2.5 | 6.25 |
| 6 | 11:30-11:51 | 17.9 | 20.3 | -2.4 | 5.76 |
| 7 | 12:00-12:21 | 18.2 | 20.8 | -2.6 | 6.76 |
| 8 | 12:30-12:51 | 18.2 | 20.8 | -2.6 | 6.76 |
| 9 | 13:00-13:21 | 18.2 | 20.6 | -2.4 | 5.76 |
| | | | | | |
| | Sum: | | | -21.5 | 51.63 |
| | Mean: | 17.91 | 20.30 | -2.39 | |
| | \|Mean\|: | | | 2.39 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.14 |
| Sd (Standard Deviation) = | 0.18 |

**Relative Accuracy (RA):** **14.1 %RM***

***CEM Spec. 2:**
The Relative Accuracy of the CEMS must be no greater than 20% when the reference mean (RM) is used to calculate RA, 10% when the applicable emissions standard (ES) is used to calculate RA.
Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard
Relative Accuracy is calculated based on the reference mean when the reference mean (RM) is greater than 50% of the emission standard or when there is no emisson standard.

## CEM RELATIVE ACCURACY DETERMINATION

**CO - ppm v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/06/10
**Location:** Laurel, Montana
**Source:** Boiler 11

| Run # | Reference Run Time | Reference Method ppm v/v d | CEM Average ppm v/v d | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:00-09:21 | 0.4 | 1.0 | -0.6 | 0.36 |
| 2 | 09:30-09:51 | 2.7 | 0.9 | 1.8 | 3.24 |
| 3 | 10:00-10:21 | 2.6 | 1.3 | 1.3 | 1.69 |
| 4 | 10:30-10:51 | 2.6 | 1.2 | 1.4 | 1.96 |
| 5 | 11:00-11:21 | 2.7 | 0.9 | 1.8 | 3.24 |
| 6 | 11:30-11:51 | 2.8 | 1.0 | 1.8 | 3.24 |
| 7 | 12:00-12:21 | 2.8 | 0.8 | 2.0 | 4.00 |
| 8 | 12:30-12:51 | 2.8 | 0.8 | 2.0 | 4.00 |
| 9 | 13:00-13:21 | 2.8 | 1.0 | 1.8 | 3.24 |
| | | | | | |
| | Sum: | | | 13.3 | 24.97 |
| | Mean: | 2.47 | 0.99 | 1.48 | |
| | \|Mean\|: | | | 1.48 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.63 |
| Sd (Standard Deviation) = | 0.82 |

**Relative Accuracy (RA):** **1.8 * < 5 ppm v/v d**

ABS(RM - CC) = 1.84 **ppm v/v d**

***CEM Spec. 4A**: The relative Accuracy of the CEM must be no greater than 10% when the reference mean (RM) is used to calculate RA; 5% when the applicable Emission Standard** (ES) is used to calculate RA or within 5ppmv when the RA is calculated as the absolute difference between the RM and CEMS plus the 2.5 percent confidence coefficient.

## CEM RELATIVE ACCURACY DETERMINATION

**$O_2$ - % v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/06/10
**Location:** Laurel, Montana
**Source:** Boiler 11

| Run # | Reference Run Time | Reference Method % v/v dry | CEM Average % v/v dry | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:00-09:21 | 2.7 | 2.9 | -0.2 | 0.04 |
| 2 | 09:30-09:51 | 2.7 | 2.8 | -0.1 | 0.01 |
| 3 | 10:00-10:21 | 2.6 | 2.7 | -0.1 | 0.01 |
| 4 | 10:30-10:51 | 2.6 | 2.7 | -0.1 | 0.01 |
| 5 | 11:00-11:21 | 2.7 | 2.8 | -0.1 | 0.01 |
| 6 | 11:30-11:51 | 2.8 | 2.8 | 0.0 | 0.00 |
| 7 | 12:00-12:21 | 2.8 | 2.9 | -0.1 | 0.01 |
| 8 | 12:30-12:51 | 2.8 | 2.8 | 0.0 | 0.00 |
| 9 | 13:00-13:21 | 2.8 | 2.8 | 0.0 | 0.00 |
| | | | | | |
| | Sum: | | | -0.70 | 0.09 |
| | Mean: | 2.72 | 2.80 | -0.08 | |
| | \|Mean\|: | | | 0.08 | |

**Statistical Data:**
**N (number of data points):** **9**

**Relative Accuracy (RA):** **0.08 % Abs.***

* **CEM Spec. 3:** The Relative Accuracy of the CEMS must be no greater than 1% when the RA is calculated as the absolute mean difference between the reference mean (RM) and the CEM mean.

## CEM RELATIVE ACCURACY DETERMINATION

**$SO_2$ - ppm v/v dry @ 0% $O_2$**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/10/10
**Location:** Laurel, Montana
**Source:** Zone D H1001

| Run # | Reference Run Time | Reference Method ppmv d @0%$O_2$ | CEM Average ppmv d @0%$O_2$ | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:30-09:51 | 0.7 | 0.0 | 0.7 | 0.49 |
| 2 | 10:00-10:21 | 1.0 | 0.0 | 1.0 | 1.00 |
| 3 | 10:30-10:51 | 1.3 | 0.0 | 1.3 | 1.69 |
| 4 | 11:00-11:21 | 0.7 | 0.0 | 0.7 | 0.49 |
| 5 | 11:30-11:51 | 1.0 | 0.0 | 1.0 | 1.00 |
| 6 | 12:00-12:21 | 1.4 | 0.0 | 1.4 | 1.96 |
| 7 | 12:30-12:51 | 1.3 | 0.0 | 1.3 | 1.69 |
| 8 | 13:00-13:21 | 0.7 | 0.0 | 0.7 | 0.49 |
| 9 | 13:30-13:51 | 0.9 | 0.0 | 0.9 | 0.81 |
| | Sum: | | | 9.00 | 9.62 |
| | Mean: | 1.00 | 0.00 | 1.00 | |
| | \|Mean\|: | | | 1.00 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.22 |
| Sd (Standard Deviation) = | 0.28 |
| **Relative Accuracy (RA):** | **5.1 %ES*** |
| Emission Standard (ES) | 23.9 ppmv d @0%$O_2$ |

*The emission standard (ES) is 5.8 lb/hr. In order to evaluate the CEMS compliance, this has been 'back calculated' utilizing the average gas stream characteristics during testing as follows:
(5.8 lb/hr) * (590.527 V/M) / (60x10-6)*(64 MW)*(44,098.6 adcfm) = 20.2 ppm v/v dry
(20.2 ppm v/v dry)*(20.9/(20.9 - 2.6% O2)) = 23.9 ppm v/v dry @ 0% O2

CEM Spec. 2:
The Relative Accuracy of the CEMS must be no greater than 20% when the reference mean (RM) is used to calculate RA, 10% when the applicable emissions standard (ES) is used to calculate RA.
Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard
Relative Accuracy is calculated based on the reference mean when the reference mean (RM) is greater than 50% of the emission standard or when there is no emisson standard.

## CEM RELATIVE ACCURACY DETERMINATION

**CO - ppm v/v dry @ 0% $O_2$**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/10/10
**Location:** Laurel, Montana
**Source:** Zone D H1001

| Run # | Reference Run Time | Reference Method ppmv d @0%$O_2$ | CEM Average ppmv d @0%$O_2$ | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:30-09:51 | 1.8 | 3.8 | -2.0 | 4.00 |
| 2 | 10:00-10:21 | 1.7 | 4.0 | -2.3 | 5.29 |
| 3 | 10:30-10:51 | 1.7 | 4.1 | -2.4 | 5.76 |
| 4 | 11:00-11:21 | 1.7 | 4.1 | -2.4 | 5.76 |
| 5 | 11:30-11:51 | 1.7 | 4.1 | -2.4 | 5.76 |
| 6 | 12:00-12:21 | 1.8 | 4.1 | -2.3 | 5.29 |
| 7 | 12:30-12:51 | 1.7 | 4.1 | -2.4 | 5.76 |
| 8 | 13:00-13:21 | 1.8 | 4.1 | -2.3 | 5.29 |
| 9 | 13:30-13:51 | 1.8 | 4.2 | -2.4 | 5.76 |
| | | | | | |
| | Sum: | | | -20.90 | 48.67 |
| | Mean: | 1.74 | 4.07 | -2.32 | |
| | \|Mean\|: | | | 2.32 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.10 |
| Sd (Standard Deviation) = | 0.13 |

**Relative Accuracy (RA):** **0.6 %ES***
**Emission Standard (ES)** **400 ppmv d @0%$O_2$**

*CEM Spec. 4:

The Relative Accuracy of the CEMS must be no greater than 10% when the reference mean (RM) is used to calculate RA, 5% when the applicable emissions standard (ES) is used to calculate RA.

Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard.

Relative Accuracy is calculated based on the reference mean when the reference mean (RM) is greater than 50% of the emission standard or when there is no emission standard.

## CEM RELATIVE ACCURACY DETERMINATION

**$O_2$ - % v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/10/10
**Location:** Laurel, Montana
**Source:** Zone D H1001

| Run # | Reference Run Time | Reference Method % v/v dry | CEM Average % v/v dry | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:30-09:51 | 2.6 | 2.9 | -0.3 | 0.09 |
| 2 | 10:00-10:21 | 2.6 | 2.6 | 0.0 | 0.00 |
| 3 | 10:30-10:51 | 2.8 | 2.7 | 0.1 | 0.01 |
| 4 | 11:00-11:21 | 2.6 | 2.6 | 0.0 | 0.00 |
| 5 | 11:30-11:51 | 2.7 | 2.8 | -0.1 | 0.01 |
| 6 | 12:00-12:21 | 2.7 | 2.6 | 0.1 | 0.01 |
| 7 | 12:30-12:51 | 2.6 | 2.7 | -0.1 | 0.01 |
| 8 | 13:00-13:21 | 2.5 | 2.6 | -0.1 | 0.01 |
| 9 | 13:30-13:51 | 2.6 | 2.6 | 0.0 | 0.00 |
| | | | | | |
| | Sum: | | | -0.40 | 0.14 |
| | Mean: | 2.63 | 2.68 | -0.04 | |
| | \|Mean\|: | | | 0.04 | |

**Statistical Data:**
**N (number of data points):** **9**

**Relative Accuracy (RA):** **0.04 % Abs.***

* **CEM Spec. 3:** The Relative Accuracy of the CEMS must be no greater than 1% when the RA is calculated as the absolute mean difference between the reference mean (RM) and the CEM mean.

## CEM RELATIVE ACCURACY DETERMINATION

**$SO_2$ - ppm v/v dry @ 0% $O_2$**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/11/10
**Location:** Laurel, Montana
**Source:** Zone D SRU

| Run # | Reference Run Time | Reference Method ppmv d @0% $O_2$ | CEM Average ppmv d @0% $O_2$ | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:15-09:36 | 21.4 | 19.3 | 2.1 | 4.41 |
| 2 | 09:45-10:06 | 22.1 | 20.0 | 2.1 | 4.41 |
| 3 | 10:15-10:36 | 23.6 | 20.6 | 3.0 | 9.00 |
| 4 | 10:45-11:06 | 26.0 | 23.6 | 2.4 | 5.76 |
| 5 | 11:15-11:36 | 24.7 | 21.7 | 3.0 | 9.00 |
| 6 | 11:45-12:06 | 25.4 | 22.2 | 3.2 | 10.24 |
| 7 | 12:15-12:36 | 24.9 | 23.2 | 1.7 | 2.89 |
| 8 | 12:45-13:06 | 25.1 | 22.5 | 2.6 | 6.76 |
| 9 | 13:15-13:36 | 23.3 | 21.7 | 1.6 | 2.56 |
| | | | | | |
| | Sum: | | | 21.70 | 55.03 |
| | Mean: | 24.06 | 21.64 | 2.41 | |
| | \|Mean\|: | | | 2.41 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.45 |
| Sd (Standard Deviation) = | 0.58 |

**Relative Accuracy (RA):** **11.9 %RM***

***CEM Spec. 2:**

The Relative Accuracy of the CEMS must be no greater than 20% when the reference mean (RM) is used to calculate RA, 10% when the applicable emissions standard (ES) is used to calculate RA.
Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard
Relative Accuracy is calculated based on the reference mean when the reference mean (RM) is greater than 50% of the emission standard or when there is no emisson standard.

## CEM RELATIVE ACCURACY DETERMINATION

**$O_2$ - % v/v dry**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/11/10
**Location:** Laurel, Montana
**Source:** Zone D SRU

| Run # | Reference Run Time | Reference Method % v/v dry | CEM Average % v/v dry | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:15-09:36 | 7.9 | 7.5 | 0.4 | 0.16 |
| 2 | 09:45-10:06 | 8.2 | 7.7 | 0.5 | 0.25 |
| 3 | 10:15-10:36 | 8.5 | 8.0 | 0.5 | 0.25 |
| 4 | 10:45-11:06 | 8.5 | 8.3 | 0.2 | 0.04 |
| 5 | 11:15-11:36 | 8.1 | 7.7 | 0.4 | 0.16 |
| 6 | 11:45-12:06 | 8.4 | 8.0 | 0.4 | 0.16 |
| 7 | 12:15-12:36 | 8.5 | 8.1 | 0.4 | 0.16 |
| 8 | 12:45-13:06 | 8.5 | 8.1 | 0.4 | 0.16 |
| 9 | 13:15-13:36 | 8.5 | 8.3 | 0.2 | 0.04 |
| | | | | | |
| | Sum: | | | 3.40 | 1.38 |
| | Mean: | 8.34 | 7.97 | 0.38 | |
| | \|Mean\|: | | | 0.38 | |

**Statistical Data:**
**N (number of data points):** **9**

**Relative Accuracy (RA):** **0.38 % Abs.***

* **CEM Spec. 3:** The Relative Accuracy of the CEMS must be no greater than 1% when the RA is calculated as the absolute mean difference between the reference mean (RM) and the CEM mean.

## CEM RELATIVE ACCURACY DETERMINATION

**Gas Flow - DSCFH**

**Client:** CHS, Inc. - Laurel Refinery **Date:** 05/11/10
**Location:** Laurel, Montana
**Source:** Zone D SRU

| Run # | Reference Run Time | Reference Method DSCFH | CEM Average DSCFH | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 09:15-09:36 | 265,851 | 258,568 | 7,283 | 53,042,089 |
| 2 | 09:45-10:06 | 266,985 | 284,304 | -17,319 | 299,947,761 |
| 3 | 10:15-10:36 | 267,937 | 278,762 | -10,825 | 117,180,625 |
| 4 | 10:45-11:06 | 265,850 | 283,588 | -17,738 | 314,636,644 |
| 5 | 11:15-11:36 | 267,950 | 281,762 | -13,812 | 190,771,344 |
| 6 | 11:45-12:06 | 265,131 | 275,882 | -10,751 | 115,584,001 |
| 7 | 12:15-12:36 | 268,586 | 278,271 | -9,685 | 93,799,225 |
| 8 | 12:45-13:06 | 264,145 | 274,021 | -9,876 | 97,535,376 |
| 9 | 13:15-13:36 | 268,212 | 269,733 | -1,521 | 2,313,441 |
| | | | | | |
| | Sum: | | | -84,244 | 1,284,810,506 |
| | Mean: | 266,739 | 276,099 | -9,360 | |
| | \|Mean\|: | | | 9,360 | |

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 6,054.0 |
| Sd (Standard Deviation) = | 7,876.0 |

**Relative Accuracy (RA):** **5.8 %RM***

## CEM RELATIVE ACCURACY DETERMINATION

**$H_2S$ - ppm v/v dry**

**Client:** CHS Inc. - Laurel Refinery **Date:** 05/12/10
**Location:** Laurel, Montana
**Source:** Zone A $H_2S$ Monitor

| Run # | Reference Run Time | Reference Method ppm v/v dry | CEM Average ppm v/v dry | Difference | (Diff.)^2 |
|---|---|---|---|---|---|
| 1 | 08:45-08:55 | 7.98 | 7.14 | 0.84 | 0.7056 |
| 2 | 09:15-09:25 | 9.37 | 7.16 | 2.21 | 4.8841 |
| 3 | 09:45-09:55 | 10.04 | 7.16 | 2.88 | 8.2944 |
| 4 | 10:50-11:00 | 11.34 | 8.02 | 3.32 | 11.0224 |
| 5 | 11:20-11:30 | 10.07 | 7.31 | 2.76 | 7.6176 |
| 6 | 11:50-12:00 | 9.39 | 7.31 | 2.08 | 4.3264 |
| 7 | 12:20-12:30 | 10.06 | 7.04 | 3.02 | 9.1204 |
| 8 | 12:50-13:00 | 10.76 | 7.69 | 3.07 | 9.4249 |
| 9 | 13:20-13:30 | 10.76 | 7.60 | 3.16 | 9.9856 |
| | Sum: | | | 23.34 | 65.3814 |
| | Mean: | 9.974 | 7.381 | 2.593 | |
| | \|Mean\|: | | | 2.593 | |

* Run not utilized in calculations

**Statistical Data:**

| | |
|---|---|
| N (number of data points) = | 9 |
| t.975 (t-value) = | 2.306 |
| CC (Confidence Coefficient) = | 0.60 |
| Sd (Standard Deviation) = | 0.78 |

**Relative Accuracy(RA):** **2.0 %ES****
**Emission Standard:** **161 ppm**

****CEM Spec. 7**

The Relative Accuracy of the CEMS must be no greater than 20% when the reference mean (RM) is used to calculate RA, 10% when the applicable emissions standard (ES) is used to calculate RA.

Relative Accuracy is calculated based on the emission standard when the reference mean (RM) is less than 50% of the emission standard.

## Emissions and Compliance Data Summaries

**Summary of CHS, Inc. - Laurel Refinery**
**Zone C FCCU**
**Laurel, Montana**
**Emission Data**
**05/03/10**

| Time | Run # | $NO_X$ - ppm v/v d | CO - ppm v/v d | $O_2$ - % v/v d |
|---|---|---|---|---|
| 09:10-09:31 | 1 | 37.5 | 37.1 | 2.5 |
| 09:41-10:02 | 2 | 37.4 | 37.7 | 2.6 |
| 10:12-10:33 | 3 | 36.7 | 39.9 | 2.3 |
| 10:43-11:04 | 4 | 38.4 | 32.9 | 2.6 |
| 11:14-11:35 | 5 | 37.6 | 36.3 | 2.5 |
| 11:45-12:06 | 6 | 37.2 | 37.3 | 2.6 |
| 12:16-12:37 | 7 | 38.7 | 31.6 | 2.7 |
| 12:47-13:08 | 8 | 38.8 | 34.5 | 2.6 |
| 13:18-13:39 | 9 | 38.0 | 36.7 | 2.6 |

**Summary of CHS, Inc. - Laurel Refinery**
**Laurel, Montana**
**Zone C FCCU**
**Gas Flow/ Moisture Data**
**05/03/10**

**EPA Methods #1-4 Gas Stream Characteristics**

| Time | Run # | AWCFM | ADCFM | WSCFH | DSCFH | Ts °F | % $H_2O$ v/v | % $CO_2$ v/v Dry | % $O_2$ v/v Dry |
|---|---|---|---|---|---|---|---|---|---|
| 09:10-09:31 | 1 | 72,782.8 | 66,589.0 | 2,098,424.8 | 1,919,848.8 | 507 | 8.51 | 15.7 | 2.5 |
| 09:41-10:02 | 2 | 72,413.4 | 66,685.5 | 2,077,033.3 | 1,912,740.0 | 512 | 7.91 | 15.7 | 2.6 |
| 10:12-10:33 | 3 | 72,598.1 | 66,630.5 | 2,101,792.9 | 1,929,025.5 | 503 | 8.22 | 15.8 | 2.3 |
| 10:43-11:04 | 4 | 72,043.9 | 66,150.7 | 2,070,696.9 | 1,901,313.9 | 510 | 8.18 | 15.9 | 2.6 |
| 11:14-11:35 | 5 | 72,413.4 | 66,294.5 | 2,098,624.1 | 1,921,290.4 | 502 | 8.45 | 15.9 | 2.5 |
| 11:45-12:06 | 6 | 71,674.5 | 66,033.7 | 2,053,726.2 | 1,892,097.9 | 513 | 7.87 | 16.0 | 2.6 |
| 12:16-12:37 | 7 | 71,743.7 | 65,839.2 | 2,055,711.1 | 1,886,526.1 | 513 | 8.23 | 16.0 | 2.6 |
| 12:47-13:08 | 8 | 71,789.9 | 65,723.7 | 2,074,087.6 | 1,898,827.2 | 505 | 8.45 | 15.9 | 2.6 |
| 13:18-13:39 | 9 | 72,344.1 | 66,440.8 | 2,081,470.7 | 1,911,622.7 | 509 | 8.16 | 15.8 | 2.6 |

| Time | Run # | $SO_2$ Emissions ppmv d | PPH |
|---|---|---|---|
| 09:10-09:31 | 1 | 10.4 | 3.30 |
| 09:41-10:02 | 2 | 10.0 | 3.18 |
| 10:12-10:33 | 3 | 11.2 | 3.57 |
| 10:43-11:04 | 4 | 9.8 | 3.12 |
| 11:14-11:35 | 5 | 10.6 | 3.38 |
| 11:45-12:06 | 6 | 10.6 | 3.33 |
| 12:16-12:37 | 7 | 10.4 | 3.26 |
| 12:47-13:08 | 8 | 10.1 | 3.19 |
| 13:18-13:39 | 9 | 10.0 | 3.17 |

**Summary of CHS, Inc. - Laurel Refinery**
**Boiler 10 Stack**
**Laurel, Montana**
**Emission Data**
**05/04/10**

| Time | Run # | EPA #7E $NO_X$ | EPA #10 CO | EPA #3A $O_2$ |
|---|---|---|---|---|
| | | ppm | ppm | % |
| | | v/v d | v/v d | v/v d |
| 09:00-09:21 | 1 | 29.8 | 79.4 | 5.9 |
| 09:30-09:51 | 2 | 29.8 | 81.7 | 6.0 |
| 10:00-10:21 | 3 | 29.8 | 80.7 | 5.9 |
| 10:30-10:51 | 4 | 29.8 | 80.6 | 5.9 |
| 11:00-11:21 | 5 | 29.9 | 81.8 | 5.8 |
| 11:30-11:51 | 6 | 29.6 | 82.6 | 5.9 |
| 12:00-12:21 | 7 | 29.9 | 81.7 | 5.9 |
| 12:30-12:51 | 8 | 29.7 | 83.0 | 5.9 |
| 13:00-13:21 | 9 | 29.9 | 82.7 | 5.9 |

**Summary of CHS, Inc. - Laurel Refinery**
**Boiler 12**
**Laurel, Montana**
**Emission Data**
**05/05/10**

| Time | Run # | EPA #7E $NO_X$ | | | | EPA #10 CO | | | $O_2$ | Fd Factor $O_2$ Basis | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm v/v d | PPH | lbs/MMBtu*** | | ppm v/v d | ppm v/v d @ 3% $O_2$ | PPH | % v/v d | dscf/MMBtu | |
| 10:15-10:36 | 1 | 20.1 | 4.10 | 0.024 | 0.024 | 0.8 | 0.8 | 0.1 | 2.7 | 8,608 | 8,642 |
| 10:45-11:06 | 2 | 19.9 | 4.03 | 0.023 | 0.023 | 0.7 | 0.7 | 0.1 | 2.6 | 8,608 | 8,642 |
| 11:15-11:36 | 3 | 19.9 | 4.04 | 0.023 | 0.023 | 0.7 | 0.7 | 0.1 | 2.6 | 8,608 | 8,642 |
| Cmp 1 | | | 4.06 | 0.023 | 0.023 | | 0.7 | 0.1 | | | |
| 11:45-12:06 | 4 | 19.9 | 4.06 | 0.023 | 0.023 | 0.8 | 0.8 | 0.1 | 2.6 | 8,608 | 8,642 |
| 12:15-12:36 | 5 | 20.0 | 4.05 | 0.024 | 0.024 | 0.7 | 0.7 | 0.1 | 2.7 | 8,608 | 8,642 |
| 12:45-13:06 | 6 | 19.4 | 3.95 | 0.023 | 0.023 | 0.6 | 0.6 | 0.1 | 2.7 | 8,608 | 8,642 |
| Cmp 2 | | | 4.02 | 0.023 | 0.023 | | 0.7 | 0.1 | | | |
| 13:15-13:36 | 7 | 19.8 | 4.04 | 0.023 | 0.023 | 0.7 | 0.7 | 0.1 | 2.7 | 8,608 | 8,642 |
| 13:45-14:06 | 8 | 19.4 | 3.93 | 0.023 | 0.023 | 0.6 | 0.7 | 0.1 | 2.7 | 8,608 | 8,642 |
| 14:15-14:36 | 9 | 19.5 | 3.98 | 0.023 | 0.023 | 0.9 | 0.9 | 0.1 | 2.6 | 8,608 | 8,642 |
| Cmp 3 | | | 3.98 | 0.023 | 0.023 | | 0.8 | 0.1 | | | |
| **Mean Cmp 1,2,3** | | | **4.02** | **0.023** | **0.023** | | **0.7** | **0.1** | | | |
| | | | | * | ** | | | | | * | ** |

* Fd Factor from compliance test time
** Fd Factor utilized in CHS CEM program
*** lbs/MMBtu =( $NO_x$ ppmv d)*(1.194e-7)*(Fd)*(20.9/(20.9/(20.9-%$O_2$))
*** Ex Run #1 : 0.024 lbs/MMBtu = (20.1 ppmv d)*(1.194e-7)*(8,608)*(20.9/(20.9-2.7))

**Summary of CHS, Inc. - Laurel Refinery**
**Laurel, Montana**
**Boiler 12**
**Gas Flow/ Moisture Data**
**05/05/10**

| | | | | EPA Methods #1-4 Gas Stream Characteristics | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Time** | **Run #** | **AWCFM** | **ADCFM** | **WSCFH** | **DSCFH** | **Ts** | **% $H_2O$** | **% $CO_2$** | **% $O_2$** |
| | | | | | | **°F** | **v/v** | **v/v Dry** | |
| 10:15-10:36 | 1 | 53,737.2 | 45,193.0 | 2,029,826.9 | 1,707,084.4 | 284 | 15.90 | 10.8 | 2.7 |
| 10:45-11:06 | 2 | 53,971.1 | 45,028.1 | 2,030,475.3 | 1,694,025.5 | 287 | 16.57 | 10.7 | 2.6 |
| 11:15-11:36 | 3 | 53,790.3 | 45,103.2 | 2,029,107.8 | 1,701,406.9 | 285 | 16.15 | 10.6 | 2.6 |
| 11:45-12:06 | 4 | 54,066.8 | 45,664.8 | 2,023,241.5 | 1,708,829.8 | 291 | 15.54 | 10.7 | 2.6 |
| 12:15-12:36 | 5 | 54,247.5 | 45,068.8 | 2,040,875.7 | 1,695,559.5 | 287 | 16.92 | 10.7 | 2.7 |
| 12:45-13:06 | 6 | 53,747.8 | 45,185.8 | 2,027,503.4 | 1,704,522.1 | 285 | 15.93 | 10.8 | 2.7 |
| 13:15-13:36 | 7 | 53,641.5 | 45,203.7 | 2,028,939.3 | 1,709,787.1 | 283 | 15.73 | 10.7 | 2.7 |
| 13:45-14:06 | 8 | 53,960.4 | 44,970.6 | 2,038,261.1 | 1,698,686.8 | 284 | 16.66 | 10.6 | 2.7 |
| 14:15-14:36 | 9 | 53,822.2 | 45,022.3 | 2,041,270.9 | 1,707,523.1 | 281 | 16.35 | 10.6 | 2.6 |

**Summary of CHS, Inc. - Laurel Refinery**
**Boiler 11**
**Laurel, Montana**
**Emission Data**
**05/06/10**

| Time | Run # | EPA Method #7E $NO_x$ | | | EPA Method #10 CO | | | EPA #3A $O_2$ |
|---|---|---|---|---|---|---|---|---|
| | | ppm v/v d | PPH | #/MMBtu | ppm v/v d | ppm v/v d @ 3% $O_2$ | PPH | % v/v d |
| 09:00-09:21 | 1 | 17.5 | 3.1 | 0.021 | 0.4 | 0.4 | 0.04 | 2.7 |
| 09:30-09:51 | 2 | 17.7 | 3.1 | 0.021 | 2.7 | 0.4 | 0.04 | 2.7 |
| 10:00-10:21 | 3 | 17.9 | 3.1 | 0.021 | 2.6 | 0.3 | 0.03 | 2.6 |
| Cmp 1 | | | 3.1 | 0.021 | | 0.4 | 0.04 | 2.7 |
| 10:30-10:51 | 4 | 17.7 | 3.1 | 0.021 | 2.6 | 0.5 | 0.05 | 2.6 |
| 11:00-11:21 | 5 | 17.9 | 3.1 | 0.021 | 2.7 | 0.5 | 0.05 | 2.7 |
| 11:30-11:51 | 6 | 17.9 | 3.1 | 0.021 | 2.8 | 0.4 | 0.04 | 2.8 |
| Cmp 2 | | | 3.1 | 0.021 | | 0.5 | 0.05 | 2.7 |
| 12:00-12:21 | 7 | 18.2 | 3.2 | 0.022 | 2.8 | 0.3 | 0.03 | 2.8 |
| 12:30-12:51 | 8 | 18.2 | 3.2 | 0.022 | 2.8 | 0.5 | 0.05 | 2.8 |
| 13:00-13:21 | 9 | 18.2 | 3.2 | 0.022 | 2.8 | 0.6 | 0.06 | 2.8 |
| Cmp 3 | | | 3.2 | 0.022 | | 0.5 | 0.05 | 2.8 |
| **Mean Cmp 1-3** | | | **3.1** | **0.021** | | **0.5** | **0.05** | **2.7** |

**Summary of CHS, Inc. - Laurel Refinery**
**Laurel, Montana**
**Boiler 11**
**Gas Flow/ Moisture Data**
**05/06/10**

| | | | | EPA Methods #1-4 Gas Stream Characteristics | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Time** | **Run #** | **AWCFM** | **ADCFM** | **WSCFH** | **DSCFH** | **Ts** | **% $H_2O$** | **% $CO_2$** | **% $O_2$** |
| | | | | | | **°F** | **v/v** | **v/v Dry** | |
| 09:00-09:21 | 1 | 45,103.5 | 37,778.7 | 1,754,643.5 | 1,469,689.4 | 263 | 16.24 | 10.7 | 2.7 |
| 09:30-09:51 | 2 | 45,263.0 | 37,622.6 | 1,751,159.8 | 1,455,564.0 | 267 | 16.88 | 10.6 | 2.7 |
| 10:00-10:21 | 3 | 44,933.4 | 37,685.6 | 1,726,533.2 | 1,448,043.4 | 272 | 16.13 | 10.7 | 2.6 |
| 10:30-10:51 | 4 | 45,241.7 | 37,794.9 | 1,747,932.7 | 1,460,223.0 | 268 | 16.46 | 10.7 | 2.6 |
| 11:00-11:21 | 5 | 45,146.0 | 37,471.2 | 1,756,298.1 | 1,457,727.4 | 263 | 17.00 | 10.8 | 2.7 |
| 11:30-11:51 | 6 | 45,029.1 | 37,608.3 | 1,746,915.7 | 1,459,024.0 | 265 | 16.48 | 10.7 | 2.8 |
| 12:00-12:21 | 7 | 45,294.9 | 37,970.7 | 1,749,986.7 | 1,467,013.9 | 268 | 16.17 | 10.6 | 2.8 |
| 12:30-12:51 | 8 | 45,071.6 | 37,477.0 | 1,750,980.8 | 1,455,940.5 | 264 | 16.85 | 10.7 | 2.8 |
| 13:00-13:21 | 9 | 44,965.3 | 37,550.5 | 1,742,037.9 | 1,454,775.9 | 266 | 16.49 | 10.8 | 2.8 |

**Summary of CHS, Inc. - Laurel Refinery**
**Zone D H1001**
**Laurel, Montana**
**Emission Data**
**05/10/10**

| Time | Run # | EPA #7E $NO_x$ | | EPA #10 CO | | | EPA #3A $O_2$ |
|---|---|---|---|---|---|---|---|
| | | ppm v/v d | PPH | ppm v/v d | ppm v/v d @ 3% $O_2$ | PPH | % v/v d |
| 09:30-09:51 | 1 | 29.7 | 5.7 | 1.8 | 1.8 | 0.2 | 2.6 |
| 10:00-10:21 | 2 | 30.4 | 5.9 | 1.7 | 1.7 | 0.2 | 2.6 |
| 10:30-10:51 | 3 | 29.6 | 5.7 | 1.7 | 1.7 | 0.2 | 2.8 |
| Cmp 1 | | | 5.8 | | 1.7 | 0.2 | 2.7 |
| 11:00-11:21 | 4 | 29.5 | 5.7 | 1.7 | 1.7 | 0.2 | 2.6 |
| 11:30-11:51 | 5 | 29.7 | 5.8 | 1.7 | 1.7 | 0.2 | 2.7 |
| 12:00-12:21 | 6 | 29.3 | 5.7 | 1.8 | 1.8 | 0.2 | 2.7 |
| Cmp 2 | | | 5.7 | | 1.7 | 0.2 | 2.7 |
| 12:30-12:51 | 7 | 29.9 | 5.8 | 1.7 | 1.7 | 0.2 | 2.6 |
| 13:00-13:21 | 8 | 29.5 | 5.7 | 1.8 | 1.8 | 0.2 | 2.5 |
| 13:30-13:51 | 9 | 29.7 | 5.7 | 1.8 | 1.8 | 0.2 | 2.6 |
| Cmp 3 | | | 5.7 | | 1.8 | 0.2 | 2.6 |
| **Mean Cmp 1-3** | | | **5.7** | | **1.7** | **0.2** | **2.7** |

**Summary of CHS, Inc. - Laurel Refinery**
**Zone D H1001**
**$SO_2$/Gas Flow/ Moisture Data**
**05/10/10**

**EPA Methods #1-4 Gas Stream Characteristics**

| Time | Run # | AWCFM | ADCFM | WSCFH | DSCFH | Ts °F | % $H_2O$ v/v | % $CO_2$ v/v Dry | % $O_2$ v/v Dry | Ps "Hg |
|---|---|---|---|---|---|---|---|---|---|---|
| 09:30-09:51 | 1 | 53,823.2 | 47,418.2 | 1,858,062.3 | 1,636,952.9 | 350 | 11.90 | 17.7 | 2.6 | 26.409 |
| 10:00-10:21 | 2 | 53,483.5 | 46,889.0 | 1,841,787.8 | 1,614,695.4 | 352 | 12.33 | 17.7 | 2.6 | 26.409 |
| 10:30-10:51 | 3 | 52,942.5 | 46,806.5 | 1,834,453.5 | 1,621,840.3 | 347 | 11.59 | 17.6 | 2.8 | 26.409 |
| 11:00-11:21 | 4 | 53,231.9 | 46,748.3 | 1,844,480.2 | 1,619,822.5 | 347 | 12.18 | 17.5 | 2.6 | 26.409 |
| 11:30-11:51 | 5 | 53,143.8 | 46,846.3 | 1,848,299.6 | 1,629,276.1 | 344 | 11.85 | 17.5 | 2.7 | 26.409 |
| 12:00-12:21 | 6 | 53,257.1 | 47,084.6 | 1,840,790.0 | 1,627,442.4 | 349 | 11.59 | 17.6 | 2.7 | 26.409 |
| 12:30-12:51 | 7 | 53,370.3 | 46,741.7 | 1,844,703.8 | 1,615,591.6 | 349 | 12.42 | 17.7 | 2.6 | 26.409 |
| 13:00-13:21 | 8 | 53,294.8 | 46,968.7 | 1,848,951.1 | 1,629,480.6 | 346 | 11.87 | 17.7 | 2.5 | 26.409 |
| 13:30-13:51 | 9 | 53,005.4 | 46,517.5 | 1,841,196.3 | 1,615,833.9 | 345 | 12.24 | 17.8 | 2.6 | 26.409 |
| Mean 1-9 | | 53,283.6 | 46,891.2 | 1,844,747.2 | 1,623,437.3 | 348 | 12.00 | 17.6 | 2.6 | 26.409 |

| Run # | $SO_2$ Emissions ppm v/v d | ppmv d @0%$O_2$* | PPH |
|---|---|---|---|
| 1 | 0.6 | 0.7 | 0.17 |
| 2 | 0.9 | 1.0 | 0.25 |
| 3 | 1.1 | 1.3 | 0.29 |
| Cmp 1 | | 1.0 | 0.24 |
| 4 | 0.6 | 0.7 | 0.17 |
| 5 | 0.9 | 1.0 | 0.25 |
| 6 | 1.2 | 1.4 | 0.33 |
| Cmp 2 | | 1.0 | 0.25 |
| 7 | 1.1 | 1.3 | 0.29 |
| 8 | 0.6 | 0.7 | 0.17 |
| 9 | 0.8 | 0.9 | 0.21 |
| Cmp 3 | | 1.0 | 0.22 |
| Mean Cmp 1-3 | | **1.0** | **0.24** |

Mean V/M = ((359*(29.92/492)*(714 Ts°A)/(26.409 Ps"Hg) = 667.684

*ppmvd @0% $O_2$ = (ppmvd)*(20.9/(20.9-%$O_2$))

* Example Run 1:

0.7 ppmvd @0% $O_2$ = (0.6 ppmvd)*(20.9/(20.9 - 2.6 %$O_2$))

**Summary of CHS, Inc. - Laurel Refinery**
**Laurel, Montana**
**Zone D SRU**
**Emission Data**
**05/11/10**

| Time | Run # | $NO_x$ Emissions | | $SO_2$ Emissions | | | %$O_2$ |
|---|---|---|---|---|---|---|---|
| | | ppm v/v d | PPH | ppm v/v d | ppm v/v d * @ 0% $O_2$ | PPH | v/v d |
| 09:15-09:36 | 1 | 13.1 | 0.4 | 13.3 | 21.4 | 0.58 | 7.9 |
| 09:45-10:06 | 2 | 13.8 | 0.4 | 13.4 | 22.1 | 0.59 | 8.2 |
| 10:15-10:36 | 3 | 13.8 | 0.4 | 14.0 | 23.6 | 0.62 | 8.5 |
| #1 Cmp | | 13.6 | 0.4 | 13.6 | 22.4 | 0.60 | 8.2 |
| 10:45-11:06 | 4 | 10.9 | 0.4 | 15.4 | 26.0 | 0.69 | 8.5 |
| 11:15-11:36 | 5 | 13.6 | 0.4 | 15.1 | 24.7 | 0.67 | 8.1 |
| 11:45-12:06 | 6 | 14.0 | 0.5 | 15.2 | 25.4 | 0.66 | 8.4 |
| #2 Cmp | | 12.8 | 0.4 | 15.2 | 25.4 | 0.67 | 8.3 |
| 12:15-12:36 | 7 | 13.4 | 0.4 | 14.8 | 24.9 | 0.67 | 8.5 |
| 12:45-13:06 | 8 | 13.6 | 0.4 | 14.9 | 25.1 | 0.66 | 8.5 |
| 13:15-13:36 | 9 | 13.9 | 0.4 | 13.8 | 23.3 | 0.62 | 8.5 |
| #3 Cmp | | 13.6 | 0.4 | 14.5 | 24.4 | 0.65 | 8.5 |
| **Mean Cmp #1-3** | | **13.3** | **0.4** | **14.4** | **24.1** | **0.64** | **8.3** |

* $SO_2$ ppm v/v d @ 0% $O_2$ = ($SO_2$ ppm v/v d)*(20.9/(20.9-%$O_2$))

**Summary of CHS, Inc. - Laurel Refinery**
**Laurel, Montana**
**Zone D SRU**
**$SO_2$/Gas Flow/ Moisture Data**
**05/11/10**

**EPA Methods #1-4 Gas Stream Characteristics**

| Time | Run # | AWCFM | ADCFM | WSCFH | DSCFH | Ts °F | % $H_2O$ v/v | % $CO_2$ v/v Dry | % $O_2$ v/v Dry |
|---|---|---|---|---|---|---|---|---|---|
| 09:15-09:36 | 1 | 15,002.0 | 12,972.2 | 307,448.6 | 265,850.8 | 908 | 13.53 | 3.7 | 7.9 |
| 09:45-10:06 | 2 | 14,999.7 | 12,884.7 | 310,809.5 | 266,985.4 | 893 | 14.10 | 3.8 | 8.2 |
| 10:15-10:36 | 3 | 14,912.4 | 12,835.1 | 311,301.3 | 267,937.0 | 883 | 13.93 | 3.7 | 8.5 |
| 10:45-11:06 | 4 | 14,949.2 | 12,792.0 | 310,680.7 | 265,849.5 | 889 | 14.43 | 3.7 | 8.5 |
| 11:15-11:36 | 5 | 14,914.7 | 12,740.1 | 313,685.0 | 267,949.7 | 873 | 14.58 | 3.6 | 8.1 |
| 11:45-12:06 | 6 | 15,130.7 | 13,003.3 | 308,506.6 | 265,130.6 | 915 | 14.06 | 3.5 | 8.4 |
| 12:15-12:36 | 7 | 14,827.4 | 12,818.3 | 310,683.5 | 268,585.9 | 878 | 13.55 | 3.5 | 8.5 |
| 12:45-13:06 | 8 | 15,059.5 | 12,898.5 | 308,400.2 | 264,144.8 | 909 | 14.35 | 3.6 | 8.5 |
| 13:15-13:36 | 9 | 14,822.8 | 12,723.9 | 312,455.4 | 268,211.7 | 870 | 14.16 | 3.7 | 8.5 |

**EPA Method #6 $SO_2$ Emissions**

| Time | Run # | $SO_2$ - ppm | | $SO_2$ |
|---|---|---|---|---|
| | | v/v D | v/v D @0% $O_2$ | lbshr |
| 09:15-09:36 | 1 | 13.3 | 21.4 | 0.58 |
| 09:45-10:06 | 2 | 13.4 | 22.1 | 0.59 |
| 10:15-10:36 | 3 | 14.0 | 23.6 | 0.62 |
| 10:45-11:06 | 4 | 15.4 | 26.0 | 0.69 |
| 11:15-11:36 | 5 | 15.1 | 24.7 | 0.67 |
| 11:45-12:06 | 6 | 15.2 | 25.4 | 0.66 |
| 12:15-12:36 | 7 | 14.8 | 24.9 | 0.67 |
| 12:45-13:06 | 8 | 14.9 | 25.1 | 0.66 |
| 13:15-13:36 | 9 | 13.8 | 23.3 | 0.62 |

**Summary of CHS, Inc. - Laurel Refinery**
**Zone A $H_2S$ Monitor**
**Reference Data**
**05/12/10**

| Time | Run # | EPA Method #11 $H_2S$ ppm v/v dry |
|---|---|---|
| 08:45-08:55 | 1 | 7.98 |
| 09:15-09:25 | 2 | 9.37 |
| 09:45-09:55 | 3 | 10.04 |
| 10:50-11:00 | 4 | 11.34 |
| 11:20-11:30 | 5 | 10.07 |
| 11:50-12:00 | 6 | 9.39 |
| 12:20-12:30 | 7 | 10.06 |
| 12:50-13:00 | 8 | 10.76 |
| 13:20-13:30 | 9 | 10.76 |
| **Mean 1-9** | | **9.97** |

## Stack Parameters

## CHS, Inc. - Laurel Refinery
## Zone C FCCU

$SO_2$/Gas Flow/Species

Diameter of Stack @ 84.0 in. (7.0 ft.)
Area of Stack @ 38.485 sq. ft.

Distance/duct diameters downstream from flow disturbance
(port location with respect to process) @ ~30.0 ft. / ~4.3 diameters

Distance/duct diameters upstream from flow disturbance
(port location with respect to stack) @ ~118 ft. / ~16.9 diameters

Number of sample ports = 2 at 90 degrees
Number of sample (traverse) points (gas flow) - 16 (8/port)

Location of $SO_2$/Gas Flow traverse points:
(from inside wall)

1) 2.69 inches
2) 8.82 inches
3) 16.30 inches
4) 27.13 inches
5) 56.87 inches
6) 67.70 inches
7) 75.18 inches
8) 81.31 inches

The location of the gas species sampling probe was as follows:

1) 14.03 inches (16.7%)
2) 42.00 inches (50.0%)
3) 69.97 inches (83.3%)

## Stack Parameters

## CHS, Inc. - Laurel Refinery
## Boiler #10 Stack

| | | |
|---|---|---|
| Diameter of Stack | @ | 47.0 in. (3.917 ft.) |
| Area of Stack | @ | 12.050 sq. ft. |

| | | |
|---|---|---|
| Distance/duct diameters downstream from flow disturbance (port location with respect to process) | @ | ~32 ft./ ~8.2 diameters |
| Distance/duct diameters upstream from flow disturbance (port location with respect to stack) | @ | ~10 ft./ ~2.6 diameters |

Number of sample ports = 2 at 90 degrees

The location of the gas species sampling probe was as follows:

1) 7.849 inches (16.7%)
2) 23.500 inches (50.0%)
3) 39.151 inches (83.3%)

## Stack Parameters

## CHS, Inc. - Laurel Refinery
## Boiler #12 Stack

| | | |
|---|---|---|
| Diameter of Stack | @ | 57.0 in. (4.75 ft.) |
| Area of Stack | @ | 17.721 sq. ft. |

Distance/duct diameters downstream from flow disturbance
(port location with respect to process) @ ~11.6 ft./ 2.4 diameters
Distance/duct diameters upstream from flow disturbance
(port location with respect to stack) @ ~37.5 ft./ 7.9 diameters

Number of sample ports = 2 at 90 degrees
Number of sample (traverse) points (gas flow) - 8 (4/port)

The location of the gas flow traverse points:

1) 1.32 inches
2) 5.99 inches
3) 11.06 inches
4) 18.41 inches
5) 38.59 inches
6) 45.94 inches
7) 51.02 inches
8) 55.18 inches

The location of the gas species sampling probe was as follows:

1) 9.52 inches (16.7%)
2) 28.50 inches (50.0%)
3) 47.48 inches (83.3%)

## Stack Parameters

## CHS, Inc. - Laurel Refinery
## Boiler #11 Stack

| | | |
|---|---|---|
| Diameter of Stack | @ | 57.0 in. (4.75 ft.) |
| Area of Stack | @ | 17.721 sq. ft. |

| | | |
|---|---|---|
| Distance/duct diameters downstream from flow disturbance (port location with respect to process) | @ | 11.6 ft./ 2.4 diameters |
| Distance/duct diameters upstream from flow disturbance (port location with respect to stack) | @ | 37.5 ft./ 7.9 diameters |

Number of sample ports = 2 at 90 degrees
Number of sample (traverse) points (gas flow) - 16 (8/port)

The location of the gas flow traverse points were as follows:

1) 1.32 inches
2) 5.99 inches
3) 11.06 inches
4) 18.41 inches
5) 38.59 inches
6) 45.94 inches
7) 51.02 inches
8) 55.18 inches

The location of the gas species sampling probe was as follows:

1) 9.519 inches (16.7%)
2) 28.500 inches (50.0%)
3) 47.481 inches (83.3%)

## Stack Parameters

## CHS, Inc. - Laurel Refinery
## Incinerator Stack (SRU)

$SO_2$/Gas Flow/Species

| | | |
|---|---|---|
| Diameter of Stack | @ | 26.5 in. (2.208) |
| Area of Stack | @ | 3.829ft. |

| | | |
|---|---|---|
| Distance to upstream flow disturbance | @ | >17.0 ft. |
| Distance to downstream flow disturbance | @ | 98 ft. |

| | | |
|---|---|---|
| Number of diameters upstream | @ | >17.0 ft/2.208. = >7.70 d |
| Number of diameters downstream | @ | 98 ft./2.208 ft. = 44.4 d |

Number of sample ports = 2 at 90 degrees
Number of sample (traverse) points (gas flow) - 12 (6/port)

Location of $SO_2$/Gas Flow traverse points:

1) 1.166 Inches
2) 3.869 Inches
3) 7.844 Inches
4) 18.656 Inches
5) 22.631 Inches
6) 25.334 Inches

The location of the gas species sampling probe was as follows:

1) 4.43 inches (16.7%)
2) 13.25 inches (50.0%)
3) 22.07 inches (83.3%)

## Stack Parameters

## CHS, Inc. - Laurel Refinery
## Zone D H1001 Reformer Heater

$SO_2$/Gas Flow/Species

| | | |
|---|---|---|
| Diameter of Stack | @ | 62 Inches (5.167 ft.) |
| Area of Stack | @ | 20.969 sq. ft. |

Distance/duct diameters downstream from flow disturbance
(port location with respect to process) @ ~40.0 ft. / ~7.7 d

Distance/duct diameters upstream from flow disturbance
(port location with respect to stack exit) @ ~17.0 ft. / ~3.3 d

Number of sample ports = 2 at 90 degrees
Number of sample (traverse) points (gas flow) - 16 (8/port)

Location of $SO_2$/Gas Flow traverse points:

1) 1.98 Inches
2) 6.51 Inches
3) 12.03 Inches
4) 20.03 Inches
5) 41.97 Inches
6) 49.97 Inches
7) 55.49 Inches
8) 60.02 Inches

The location of the gas species sampling probe was as follows:

1) 10.35 inches (16.7%)
2) 31.00 inches (50.0%)
3) 51.65 inches (83.3%)

## CHS, Inc. - Laurel Refinery
## Fuel Gas Analytical Data - Refinery Fuel Gas
## Boiler 12 CEM Data

| Date / Time | Boiler 12 NOx ppm - 1 Hour Average | Boiler 12 CO ppm - 1 Hour Average | Boiler 12 O2 % - 1 Hour Average | Boiler 12 Fuel Gas Flow MMSCFD - 1 Hour Average | Boiler 12 NOx lbs/MMbtu - 1 Hour Average | *Calculated* Boiler 12 NOx lbs/MMbtu - 1 Hour Average | Boiler 12 NOx lbs/hr - 1 Hour Average | Boiler 12 CO lbs/hr - 1 Hour Average |
|---|---|---|---|---|---|---|---|---|
| 5/5/2010 10:00 | 18.78 | 0.84 | 2.81 | 2.936 | 0.022 | 0.022 | 3.69 | 0.10 |
| 5/5/2010 11:00 | 19.07 | 1.00 | 2.71 | 3.007 | 0.023 | 0.023 | 3.82 | 0.12 |
| 5/5/2010 12:00 | 18.83 | 0.98 | 2.73 | 3.03 | 0.022 | 0.022 | 3.78 | 0.12 |
| 5/5/2010 13:00 | 18.67 | 0.95 | 2.75 | 3.026 | 0.022 | 0.022 | 3.76 | 0.12 |
| 5/5/2010 14:00 | 18.68 | 0.95 | 2.76 | 3.012 | 0.022 | 0.022 | 3.74 | 0.12 |
| 5/5/2010 15:00 | 18.15 | 0.78 | 2.87 | 2.941 | 0.022 | 0.022 | 3.50 | 0.09 |
| | | | | | | | | |

Fuel Gas HHV: 1234 Btu/scf
Fd Factor: 8608

## CHS, Inc. - Laurel Refinery

Start Date 5/5/2010
End Date 5/6/2010

## CHS Refinery Fuel Gas Compostion (Excluding Coker Unit)

| TAG | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| AI84019-D | Hydrogen | 20.57 | mol % |
| AI84020-D | H2S | 4.37 | PPM |
| AI84021-D | N2 | 2.21 | mol % |
| AI84022-D | Methane | 47.64 | mol % |
| AI84023-D | CO2 | 0.46 | mol % |
| AI84024-D | Ethylene | 2.51 | mol % |
| AI84025-D | Ethane | 11.54 | mol % |
| AI84026-D | 1-Butene | 0.06 | mol % |
| AI84027-D | Isobutylene | 0.05 | mol % |
| AI84028-D | Propane | 7.88 | mol % |
| AI84029-D | Propylene | 1.65 | mol % |
| AI84030-D | Isobutane | 2.69 | mol % |
| AI84031-D | N-Butane | 2.89 | mol % |
| AI84032-D | Trans-2-butene | 0.00 | mol % |
| AI84033-D | Cis-2-butene | 0.04 | mol % |
| AI84034-D | N-Pentane | 0.26 | mol % |
| AI84035-D | Water | 0.00 | mol % |
| AI84036-D | C6+ | 0.32 | mol % |
| **AI84037-D** | **HHV** | **1234** | **btu/scf** |
| AI84038-D | LHV | 1121 | btu/scf |
| AI84040-D | Compressibility Factor | 1.00 | |
| AI84043-D | SG | 0.72 | |

**Fd Factor:** **8608**

**CEM Fd Factor:** **8642**

**CHS, Inc. - Laurel Refinery**
**Fuel Gas Analytical Data - Refinery Fuel Gas**
**Boiler 11 CEM Data**

| Date / Time | 5 - B11: NOx ppm - 1 Hour Avg | 7 - B11: O2 % - 1 Hour Avg | 8 - B11: Fuel Gas Flow MMSCFD - 1 Hour Avg | 12 - B11: NOx lbs/MMbtu - 1 Hour Avg |
|---|---|---|---|---|
| 5/6/2010 8:00 | 20.11 | 3.01 | 2.717 | 0.024 |
| 5/6/2010 9:00 | 19.89 | 2.85 | 2.761 | 0.024 |
| 5/6/2010 10:00 | 20.02 | 2.75 | 2.78 | 0.024 |
| 5/6/2010 11:00 | 20.38 | 2.8 | 2.751 | 0.024 |
| 5/6/2010 12:00 | 20.74 | 2.86 | 2.718 | 0.025 |
| 5/6/2010 13:00 | 20.92 | 2.8 | 2.724 | 0.025 |
| 5/6/2010 14:00 | 20.81 | 2.81 | 2.676 | 0.025 |
| 5/6/2010 15:00 | 20.07 | 3.46 | 2.325 | 0.025 |

## CHS, Inc. - Laurel Refinery

| | |
|---|---|
| Start Date | 5/6/2010 |
| End Date | 5/7/2010 |

### CHS Refinery Fuel Gas Composition (Excluding Coker Unit)

| TAG | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| AI84019-D | Hydrogen | 19.79 | mol % |
| AI84020-D | H2S | 4.19 | PPM |
| AI84021-D | N2 | 2.54 | mol % |
| AI84022-D | Methane | 49.15 | mol % |
| AI84023-D | CO2 | 0.42 | mol % |
| AI84024-D | Ethylene | 2.84 | mol % |
| AI84025-D | Ethane | 12.25 | mol % |
| AI84026-D | 1-Butene | 0.06 | mol % |
| AI84027-D | Isobutylene | 0.05 | mol % |
| AI84028-D | Propane | 6.55 | mol % |
| AI84029-D | Propylene | 1.00 | mol % |
| AI84030-D | Isobutane | 2.52 | mol % |
| AI84031-D | N-Butane | 2.95 | mol % |
| AI84032-D | Trans-2-butene | 0.04 | mol % |
| AI84033-D | Cis-2-butene | 0.04 | mol % |
| AI84034-D | N-Pentane | 0.30 | mol % |
| AI84035-D | Water | 0.00 | mol % |
| AI84036-D | C6+ | 0.35 | mol % |
| **AI84037-D** | **HHV** | **1217** | **btu/scf** |
| AI84038-D | LHV | 1106 | btu/scf |
| AI84040-D | Compressibility Factor | 1.00 | |
| AI84043-D | SG | 0.71 | |

**Fd Factor:** **8610**

CHS, Inc.
Zone D H-1001 Reformer
Process Data

5/10/2010 9:00
5/10/2010 14:00

| Date and time | FI10124-D H1001 nat gas MSCFH | FI10109-D H1001 PSA tailgas MSCFH | LHV (Btu/SCF) 175 Natural Gas MMBtu/hr LHV | LHV (Btu/SCF) 993 PSA Tailgas MMBtu/hr LHV |
|---|---|---|---|---|
| 10-May-10 09:00:00 | 75.3 | 308.9 | 13.18 | 306.69 |
| 10-May-10 09:01:00 | 73.4 | 306.2 | 12.86 | 303.99 |
| 10-May-10 09:02:00 | 73.9 | 303.1 | 12.93 | 300.90 |
| 10-May-10 09:03:00 | 77.4 | 306.1 | 13.55 | 303.89 |
| 10-May-10 09:04:00 | 78.5 | 304.5 | 13.75 | 302.34 |
| 10-May-10 09:05:00 | 78.6 | 303.7 | 13.77 | 301.51 |
| 10-May-10 09:06:00 | 79.2 | 307.0 | 13.87 | 304.77 |
| 10-May-10 09:07:00 | 78.3 | 308.1 | 13.71 | 305.87 |
| 10-May-10 09:08:00 | 80.4 | 300.4 | 14.07 | 298.29 |
| 10-May-10 09:09:00 | 80.6 | 309.9 | 14.12 | 307.70 |
| 10-May-10 09:10:00 | 74.5 | 315.9 | 13.04 | 313.62 |
| 10-May-10 09:11:00 | 73.4 | 313.8 | 12.85 | 311.60 |
| 10-May-10 09:12:00 | 74.9 | 312.3 | 13.12 | 310.11 |
| 10-May-10 09:13:00 | 76.5 | 309.8 | 13.39 | 307.59 |
| 10-May-10 09:14:00 | 81.2 | 304.2 | 14.22 | 302.00 |
| 10-May-10 09:15:00 | 81.5 | 303.0 | 14.28 | 300.88 |
| 10-May-10 09:16:00 | 81.4 | 300.8 | 14.25 | 298.65 |
| 10-May-10 09:17:00 | 81.0 | 302.9 | 14.17 | 300.72 |
| 10-May-10 09:18:00 | 78.9 | 304.6 | 13.82 | 302.43 |
| 10-May-10 09:19:00 | 79.2 | 301.7 | 13.87 | 299.57 |
| 10-May-10 09:20:00 | 81.3 | 299.5 | 14.23 | 297.41 |
| 10-May-10 09:21:00 | 79.4 | 304.1 | 13.91 | 301.96 |
| 10-May-10 09:22:00 | 77.6 | 307.2 | 13.59 | 305.05 |
| 10-May-10 09:23:00 | 76.1 | 310.2 | 13.32 | 307.97 |
| 10-May-10 09:24:00 | 73.9 | 308.4 | 12.94 | 306.24 |
| 10-May-10 09:25:00 | 75.5 | 302.0 | 13.22 | 299.85 |
| 10-May-10 09:26:00 | 77.4 | 304.8 | 13.56 | 302.66 |
| 10-May-10 09:27:00 | 77.7 | 304.3 | 13.61 | 302.12 |
| 10-May-10 09:28:00 | 78.6 | 308.9 | 13.77 | 306.73 |
| 10-May-10 09:29:00 | 79.5 | 307.3 | 13.92 | 305.11 |
| 10-May-10 09:30:00 | 78.6 | 308.0 | 13.76 | 305.81 |
| 10-May-10 09:31:00 | 80.1 | 305.2 | 14.02 | 303.03 |
| 10-May-10 09:32:00 | 79.5 | 314.3 | 13.92 | 312.06 |
| 10-May-10 09:33:00 | 76.2 | 316.4 | 13.34 | 314.14 |
| 10-May-10 09:34:00 | 77.9 | 314.4 | 13.64 | 312.13 |
| 10-May-10 09:35:00 | 78.6 | 310.8 | 13.77 | 308.60 |
| 10-May-10 09:36:00 | 78.1 | 316.5 | 13.67 | 314.25 |
| 10-May-10 09:37:00 | 78.1 | 314.6 | 13.67 | 312.41 |
| 10-May-10 09:38:00 | 78.2 | 310.4 | 13.69 | 308.17 |
| 10-May-10 09:39:00 | 79.6 | 309.5 | 13.94 | 307.32 |
| 10-May-10 09:40:00 | 80.9 | 310.5 | 14.16 | 308.33 |
| 10-May-10 09:41:00 | 80.0 | 311.3 | 14.01 | 309.11 |
| 10-May-10 09:42:00 | 78.9 | 307.8 | 13.82 | 305.65 |
| 10-May-10 09:43:00 | 78.7 | 311.6 | 13.77 | 309.42 |
| 10-May-10 09:44:00 | 75.8 | 312.9 | 13.28 | 310.68 |
| 10-May-10 09:45:00 | 75.8 | 315.7 | 13.27 | 313.42 |
| 10-May-10 09:46:00 | 75.9 | 319.2 | 13.29 | 316.96 |
| 10-May-10 09:47:00 | 76.8 | 317.9 | 13.44 | 315.63 |
| 10-May-10 09:48:00 | 79.5 | 321.4 | 13.92 | 319.08 |
| 10-May-10 09:49:00 | 80.2 | 322.5 | 14.05 | 320.25 |
| 10-May-10 09:50:00 | 80.6 | 321.4 | 14.11 | 319.10 |
| 10-May-10 09:51:00 | 78.1 | 331.4 | 13.68 | 329.01 |
| 10-May-10 09:52:00 | 76.6 | 334.8 | 13.42 | 332.39 |
| 10-May-10 09:53:00 | 80.0 | 323.7 | 14.00 | 321.45 |
| 10-May-10 09:54:00 | 80.1 | 322.7 | 14.02 | 320.42 |
| 10-May-10 09:55:00 | 80.3 | 321.6 | 14.07 | 319.30 |
| 10-May-10 09:56:00 | 80.4 | 324.0 | 14.08 | 321.66 |
| 10-May-10 09:57:00 | 79.4 | 320.4 | 13.90 | 318.08 |
| 10-May-10 09:58:00 | 81.2 | 314.0 | 14.22 | 311.81 |
| 10-May-10 09:59:00 | 81.8 | 316.4 | 14.32 | 314.20 |
| 10-May-10 10:00:00 | 82.2 | 309.4 | 14.39 | 307.15 |
| 10-May-10 10:01:00 | 82.7 | 314.9 | 14.49 | 312.61 |
| 10-May-10 10:02:00 | 81.7 | 313.9 | 14.31 | 311.63 |
| 10-May-10 10:03:00 | 79.1 | 314.9 | 13.85 | 312.71 |
| 10-May-10 10:04:00 | 79.6 | 317.2 | 13.94 | 314.93 |
| 10-May-10 10:05:00 | 78.6 | 321.6 | 13.76 | 319.36 |
| 10-May-10 10:06:00 | 79.9 | 320.9 | 13.98 | 318.59 |
| 10-May-10 10:07:00 | 80.2 | 316.4 | 14.04 | 314.15 |
| 10-May-10 10:08:00 | 80.7 | 317.4 | 14.13 | 315.18 |
| 10-May-10 10:09:00 | 82.5 | 313.5 | 14.44 | 311.31 |
| 10-May-10 10:10:00 | 82.8 | 306.7 | 14.50 | 304.51 |
| 10-May-10 10:11:00 | 85.2 | 302.4 | 14.91 | 300.29 |
| 10-May-10 10:12:00 | 84.4 | 302.5 | 14.78 | 300.36 |
| 10-May-10 10:13:00 | 83.8 | 309.0 | 14.67 | 306.77 |
| 10-May-10 10:14:00 | 83.6 | 310.0 | 14.63 | 307.78 |

CHS, Inc.
Zone D H-1001 Reformer
Process Data

| Date and time | FI10124-D H1001 nat gas MSCFH | FI10109-D H1001 PSA tailgas MSCFH | LHV (Btu/SCF) 175 Natural Gas MMBtu/hr LHV | LHV (Btu/SCF) 993 PSA Tailgas MMBtu/hr LHV |
|---|---|---|---|---|
| 10-May-10 10:15:00 | 83.3 | 309.5 | 14.58 | 307.27 |
| 10-May-10 10:16:00 | 81.0 | 314.7 | 14.19 | 312.44 |
| 10-May-10 10:17:00 | 80.1 | 317.5 | 14.03 | 315.22 |
| 10-May-10 10:18:00 | 78.7 | 321.3 | 13.79 | 319.03 |
| 10-May-10 10:19:00 | 78.6 | 318.3 | 13.76 | 316.00 |
| 10-May-10 10:20:00 | 81.5 | 318.5 | 14.27 | 316.24 |
| 10-May-10 10:21:00 | 81.2 | 320.3 | 14.22 | 318.02 |
| 10-May-10 10:22:00 | 82.1 | 318.9 | 14.37 | 316.66 |
| 10-May-10 10:23:00 | 81.4 | 319.7 | 14.25 | 317.39 |
| 10-May-10 10:24:00 | 80.7 | 322.6 | 14.14 | 320.33 |
| 10-May-10 10:25:00 | 80.3 | 323.5 | 14.07 | 321.24 |
| 10-May-10 10:26:00 | 80.8 | 325.1 | 14.15 | 322.79 |
| 10-May-10 10:27:00 | 78.9 | 325.5 | 13.82 | 323.23 |
| 10-May-10 10:28:00 | 79.2 | 327.1 | 13.87 | 324.82 |
| 10-May-10 10:29:00 | 78.6 | 326.3 | 13.76 | 323.95 |
| 10-May-10 10:30:00 | 78.5 | 327.7 | 13.75 | 325.38 |
| 10-May-10 10:31:00 | 79.6 | 326.7 | 13.93 | 324.37 |
| 10-May-10 10:32:00 | 80.2 | 320.8 | 14.05 | 318.57 |
| 10-May-10 10:33:00 | 81.6 | 319.3 | 14.30 | 317.05 |
| 10-May-10 10:34:00 | 81.3 | 319.7 | 14.23 | 317.47 |
| 10-May-10 10:35:00 | 81.3 | 320.6 | 14.23 | 318.36 |
| 10-May-10 10:36:00 | 81.8 | 313.7 | 14.33 | 311.47 |
| 10-May-10 10:37:00 | 82.0 | 317.0 | 14.35 | 314.76 |
| 10-May-10 10:38:00 | 79.8 | 318.6 | 13.98 | 316.36 |
| 10-May-10 10:39:00 | 80.3 | 323.2 | 14.07 | 320.93 |
| 10-May-10 10:40:00 | 78.8 | 318.4 | 13.79 | 316.14 |
| 10-May-10 10:41:00 | 78.3 | 317.3 | 13.71 | 315.03 |
| 10-May-10 10:42:00 | 81.4 | 315.5 | 14.25 | 313.28 |
| 10-May-10 10:43:00 | 81.7 | 313.6 | 14.31 | 311.33 |
| 10-May-10 10:44:00 | 82.7 | 315.4 | 14.47 | 313.15 |
| 10-May-10 10:45:00 | 81.9 | 315.2 | 14.35 | 313.01 |
| 10-May-10 10:46:00 | 81.9 | 318.9 | 14.33 | 316.61 |
| 10-May-10 10:47:00 | 80.4 | 315.9 | 14.08 | 313.70 |
| 10-May-10 10:48:00 | 80.3 | 317.0 | 14.06 | 314.78 |
| 10-May-10 10:49:00 | 80.2 | 318.6 | 14.05 | 316.33 |
| 10-May-10 10:50:00 | 80.1 | 323.1 | 14.02 | 320.79 |
| 10-May-10 10:51:00 | 78.5 | 322.6 | 13.74 | 320.27 |
| 10-May-10 10:52:00 | 78.2 | 321.3 | 13.69 | 319.06 |
| 10-May-10 10:53:00 | 80.9 | 319.9 | 14.16 | 317.64 |
| 10-May-10 10:54:00 | 81.0 | 317.1 | 14.19 | 314.80 |
| 10-May-10 10:55:00 | 82.1 | 317.1 | 14.37 | 314.82 |
| 10-May-10 10:56:00 | 81.0 | 318.0 | 14.19 | 315.76 |
| 10-May-10 10:57:00 | 80.3 | 325.7 | 14.06 | 323.34 |
| 10-May-10 10:58:00 | 79.7 | 322.5 | 13.96 | 320.26 |
| 10-May-10 10:59:00 | 80.5 | 322.7 | 14.10 | 320.40 |
| 10-May-10 11:00:00 | 81.1 | 319.1 | 14.21 | 316.81 |
| 10-May-10 11:01:00 | 80.2 | 324.1 | 14.05 | 321.78 |
| 10-May-10 11:02:00 | 78.6 | 322.5 | 13.76 | 320.22 |
| 10-May-10 11:03:00 | 78.4 | 323.9 | 13.73 | 321.59 |
| 10-May-10 11:04:00 | 80.5 | 319.9 | 14.09 | 317.65 |
| 10-May-10 11:05:00 | 81.3 | 318.5 | 14.23 | 316.24 |
| 10-May-10 11:06:00 | 82.2 | 317.6 | 14.39 | 315.33 |
| 10-May-10 11:07:00 | 81.0 | 318.3 | 14.18 | 316.02 |
| 10-May-10 11:08:00 | 77.5 | 320.5 | 13.58 | 318.25 |
| 10-May-10 11:09:00 | 79.3 | 318.2 | 13.89 | 315.95 |
| 10-May-10 11:10:00 | 80.3 | 320.3 | 14.06 | 318.05 |
| 10-May-10 11:11:00 | 79.3 | 322.5 | 13.89 | 320.22 |
| 10-May-10 11:12:00 | 79.3 | 326.4 | 13.88 | 324.10 |
| 10-May-10 11:13:00 | 77.4 | 324.0 | 13.55 | 321.68 |
| 10-May-10 11:14:00 | 78.7 | 325.3 | 13.77 | 323.03 |
| 10-May-10 11:15:00 | 80.7 | 323.3 | 14.13 | 321.00 |
| 10-May-10 11:16:00 | 80.4 | 321.6 | 14.08 | 319.35 |
| 10-May-10 11:17:00 | 80.0 | 319.9 | 14.00 | 317.66 |
| 10-May-10 11:18:00 | 79.8 | 323.1 | 13.96 | 320.82 |
| 10-May-10 11:19:00 | 79.1 | 331.4 | 13.86 | 329.05 |
| 10-May-10 11:20:00 | 78.5 | 328.1 | 13.75 | 325.81 |
| 10-May-10 11:21:00 | 76.4 | 345.4 | 13.37 | 342.98 |
| 10-May-10 11:22:00 | 72.0 | 344.4 | 12.61 | 341.92 |
| 10-May-10 11:23:00 | 74.9 | 339.9 | 13.12 | 337.52 |
| 10-May-10 11:24:00 | 78.8 | 329.9 | 13.80 | 327.56 |
| 10-May-10 11:25:00 | 79.6 | 326.3 | 13.94 | 323.98 |
| 10-May-10 11:26:00 | 79.8 | 327.0 | 13.97 | 324.67 |
| 10-May-10 11:27:00 | 81.9 | 314.6 | 14.34 | 312.32 |
| 10-May-10 11:28:00 | 82.8 | 312.0 | 14.50 | 309.80 |
| 10-May-10 11:29:00 | 83.6 | 309.5 | 14.64 | 307.29 |
| 10-May-10 11:30:00 | 84.4 | 303.7 | 14.78 | 301.59 |
| 10-May-10 11:31:00 | 86.0 | 299.9 | 15.07 | 297.79 |

CHS, Inc.
Zone D H-1001 Reformer
Process Data

| Date and time | FI10124-D H1001 nat gas MSCFH | FI10109-D H1001 PSA tailgas MSCFH | LHV (Btu/SCF) 175 Natural Gas MMBtu/hr LHV | LHV (Btu/SCF) 993 PSA Tailgas MMBtu/hr LHV |
|---|---|---|---|---|
| 10-May-10 11:32:00 | 84.7 | 306.4 | 14.82 | 304.26 |
| 10-May-10 11:33:00 | 84.1 | 307.8 | 14.73 | 305.57 |
| 10-May-10 11:34:00 | 82.3 | 307.3 | 14.41 | 305.10 |
| 10-May-10 11:35:00 | 80.2 | 308.9 | 14.04 | 306.74 |
| 10-May-10 11:36:00 | 82.9 | 305.8 | 14.52 | 303.62 |
| 10-May-10 11:37:00 | 80.6 | 314.9 | 14.11 | 312.68 |
| 10-May-10 11:38:00 | 75.3 | 312.4 | 13.18 | 310.19 |
| 10-May-10 11:39:00 | 69.6 | 311.1 | 12.18 | 308.94 |
| 10-May-10 11:40:00 | 70.8 | 314.8 | 12.41 | 312.58 |
| 10-May-10 11:41:00 | 72.7 | 322.1 | 12.74 | 319.77 |
| 10-May-10 11:42:00 | 76.6 | 316.5 | 13.42 | 314.27 |
| 10-May-10 11:43:00 | 79.7 | 317.7 | 13.95 | 315.42 |
| 10-May-10 11:44:00 | 81.5 | 316.9 | 14.26 | 314.68 |
| 10-May-10 11:45:00 | 81.0 | 322.5 | 14.18 | 320.19 |
| 10-May-10 11:46:00 | 80.6 | 320.5 | 14.12 | 318.25 |
| 10-May-10 11:47:00 | 81.8 | 315.3 | 14.32 | 313.10 |
| 10-May-10 11:48:00 | 81.0 | 320.5 | 14.18 | 318.23 |
| 10-May-10 11:49:00 | 79.3 | 317.6 | 13.88 | 315.34 |
| 10-May-10 11:50:00 | 79.5 | 319.8 | 13.92 | 317.57 |
| 10-May-10 11:51:00 | 78.9 | 320.9 | 13.81 | 318.62 |
| 10-May-10 11:52:00 | 73.2 | 323.3 | 12.82 | 321.03 |
| 10-May-10 11:53:00 | 72.4 | 318.2 | 12.68 | 315.93 |
| 10-May-10 11:54:00 | 72.0 | 329.4 | 12.61 | 327.04 |
| 10-May-10 11:55:00 | 72.3 | 328.1 | 12.67 | 325.75 |
| 10-May-10 11:56:00 | 74.8 | 325.6 | 13.11 | 323.28 |
| 10-May-10 11:57:00 | 76.9 | 322.3 | 13.47 | 320.06 |
| 10-May-10 11:58:00 | 79.6 | 318.1 | 13.94 | 315.79 |
| 10-May-10 11:59:00 | 81.0 | 323.2 | 14.18 | 320.92 |
| 10-May-10 12:00:00 | 79.7 | 319.9 | 13.95 | 317.58 |
| 10-May-10 12:01:00 | 80.0 | 323.8 | 14.01 | 321.50 |
| 10-May-10 12:02:00 | 80.4 | 321.9 | 14.08 | 319.65 |
| 10-May-10 12:03:00 | 78.8 | 325.2 | 13.80 | 322.87 |
| 10-May-10 12:04:00 | 79.7 | 320.7 | 13.96 | 318.39 |
| 10-May-10 12:05:00 | 78.3 | 324.6 | 13.71 | 322.34 |
| 10-May-10 12:06:00 | 77.8 | 321.5 | 13.62 | 319.17 |
| 10-May-10 12:07:00 | 78.9 | 320.7 | 13.81 | 318.38 |
| 10-May-10 12:08:00 | 79.0 | 318.3 | 13.83 | 316.06 |
| 10-May-10 12:09:00 | 79.9 | 320.5 | 14.00 | 318.24 |
| 10-May-10 12:10:00 | 79.7 | 319.2 | 13.95 | 316.95 |
| 10-May-10 12:11:00 | 80.8 | 317.1 | 14.14 | 314.82 |
| 10-May-10 12:12:00 | 80.6 | 319.2 | 14.11 | 316.90 |
| 10-May-10 12:13:00 | 80.9 | 322.0 | 14.16 | 319.73 |
| 10-May-10 12:14:00 | 79.4 | 323.9 | 13.90 | 321.63 |
| 10-May-10 12:15:00 | 79.6 | 322.7 | 13.93 | 320.43 |
| 10-May-10 12:16:00 | 79.8 | 324.8 | 13.98 | 322.46 |
| 10-May-10 12:17:00 | 79.3 | 327.8 | 13.89 | 325.49 |
| 10-May-10 12:18:00 | 77.1 | 328.4 | 13.51 | 326.04 |
| 10-May-10 12:19:00 | 77.3 | 325.6 | 13.54 | 323.25 |
| 10-May-10 12:20:00 | 80.9 | 316.9 | 14.16 | 314.64 |
| 10-May-10 12:21:00 | 80.7 | 319.9 | 14.14 | 317.65 |
| 10-May-10 12:22:00 | 81.7 | 314.3 | 14.30 | 312.04 |
| 10-May-10 12:23:00 | 81.6 | 314.8 | 14.29 | 312.56 |
| 10-May-10 12:24:00 | 81.5 | 315.8 | 14.27 | 313.55 |
| 10-May-10 12:25:00 | 81.5 | 315.1 | 14.28 | 312.85 |
| 10-May-10 12:26:00 | 82.2 | 315.5 | 14.39 | 313.28 |
| 10-May-10 12:27:00 | 80.3 | 322.7 | 14.07 | 320.42 |
| 10-May-10 12:28:00 | 78.6 | 321.3 | 13.77 | 318.99 |
| 10-May-10 12:29:00 | 80.0 | 318.8 | 14.01 | 316.50 |
| 10-May-10 12:30:00 | 80.1 | 320.1 | 14.03 | 317.82 |
| 10-May-10 12:31:00 | 82.0 | 314.8 | 14.36 | 312.56 |
| 10-May-10 12:32:00 | 80.6 | 320.7 | 14.11 | 318.41 |
| 10-May-10 12:33:00 | 80.2 | 316.6 | 14.04 | 314.33 |
| 10-May-10 12:34:00 | 80.4 | 320.6 | 14.07 | 318.30 |
| 10-May-10 12:35:00 | 80.7 | 320.1 | 14.14 | 317.82 |
| 10-May-10 12:36:00 | 80.9 | 315.2 | 14.17 | 312.99 |
| 10-May-10 12:37:00 | 81.6 | 319.0 | 14.29 | 316.71 |
| 10-May-10 12:38:00 | 78.0 | 325.3 | 13.66 | 322.95 |
| 10-May-10 12:39:00 | 73.7 | 326.1 | 12.90 | 323.75 |
| 10-May-10 12:40:00 | 75.4 | 323.1 | 13.20 | 320.81 |
| 10-May-10 12:41:00 | 77.8 | 321.0 | 13.63 | 318.70 |
| 10-May-10 12:42:00 | 81.2 | 314.5 | 14.21 | 312.31 |
| 10-May-10 12:43:00 | 80.6 | 321.2 | 14.12 | 318.90 |
| 10-May-10 12:44:00 | 81.3 | 315.7 | 14.23 | 313.46 |
| 10-May-10 12:45:00 | 81.4 | 319.0 | 14.25 | 316.71 |
| 10-May-10 12:46:00 | 81.0 | 320.4 | 14.18 | 318.08 |
| 10-May-10 12:47:00 | 80.2 | 320.5 | 14.04 | 318.23 |
| 10-May-10 12:48:00 | 81.1 | 317.8 | 14.20 | 315.58 |

CHS, Inc.
Zone D H-1001 Reformer
Process Data

| Date and time | FI10124-D H1001 nat gas MSCFH | FI10109-D H1001 PSA tailgas MSCFH | LHV (Btu/SCF) 175 Natural Gas MMBtu/hr LHV | LHV (Btu/SCF) 993 PSA Tailgas MMBtu/hr LHV |
|---|---|---|---|---|
| 10-May-10 12:49:00 | 79.4 | 320.8 | 13.90 | 318.55 |
| 10-May-10 12:50:00 | 79.7 | 322.5 | 13.95 | 320.17 |
| 10-May-10 12:51:00 | 76.2 | 325.1 | 13.34 | 322.84 |
| 10-May-10 12:52:00 | 74.1 | 321.8 | 12.98 | 319.52 |
| 10-May-10 12:53:00 | 77.7 | 317.6 | 13.61 | 315.38 |
| 10-May-10 12:54:00 | 80.0 | 321.3 | 14.00 | 319.06 |
| 10-May-10 12:55:00 | 81.1 | 317.9 | 14.20 | 315.66 |
| 10-May-10 12:56:00 | 81.2 | 316.5 | 14.22 | 314.21 |
| 10-May-10 12:57:00 | 80.9 | 320.9 | 14.17 | 318.63 |
| 10-May-10 12:58:00 | 80.3 | 320.8 | 14.05 | 318.54 |
| 10-May-10 12:59:00 | 80.4 | 318.3 | 14.08 | 316.04 |
| 10-May-10 13:00:00 | 79.5 | 323.3 | 13.91 | 320.96 |
| 10-May-10 13:01:00 | 80.1 | 324.1 | 14.03 | 321.76 |
| 10-May-10 13:02:00 | 79.0 | 324.8 | 13.83 | 322.53 |
| 10-May-10 13:03:00 | 77.9 | 324.2 | 13.65 | 321.89 |
| 10-May-10 13:04:00 | 80.8 | 321.7 | 14.15 | 319.45 |
| 10-May-10 13:05:00 | 80.3 | 318.5 | 14.05 | 316.29 |
| 10-May-10 13:06:00 | 81.6 | 316.9 | 14.29 | 314.69 |
| 10-May-10 13:07:00 | 81.2 | 317.6 | 14.22 | 315.39 |
| 10-May-10 13:08:00 | 80.9 | 322.3 | 14.16 | 320.03 |
| 10-May-10 13:09:00 | 80.3 | 320.7 | 14.05 | 318.47 |
| 10-May-10 13:10:00 | 81.1 | 323.6 | 14.20 | 321.29 |
| 10-May-10 13:11:00 | 74.1 | 328.8 | 12.97 | 326.51 |
| 10-May-10 13:12:00 | 70.3 | 328.5 | 12.31 | 326.16 |
| 10-May-10 13:13:00 | 76.2 | 322.8 | 13.34 | 320.53 |
| 10-May-10 13:14:00 | 79.7 | 325.6 | 13.95 | 323.32 |
| 10-May-10 13:15:00 | 81.5 | 316.9 | 14.27 | 314.68 |
| 10-May-10 13:16:00 | 81.5 | 320.3 | 14.27 | 318.05 |
| 10-May-10 13:17:00 | 82.1 | 316.6 | 14.38 | 314.33 |
| 10-May-10 13:18:00 | 81.5 | 315.3 | 14.27 | 313.05 |
| 10-May-10 13:19:00 | 81.5 | 317.3 | 14.27 | 315.02 |
| 10-May-10 13:20:00 | 81.6 | 316.0 | 14.29 | 313.80 |
| 10-May-10 13:21:00 | 81.1 | 318.4 | 14.21 | 316.09 |
| 10-May-10 13:22:00 | 77.3 | 322.7 | 13.54 | 320.40 |
| 10-May-10 13:23:00 | 78.2 | 324.9 | 13.68 | 322.62 |
| 10-May-10 13:24:00 | 76.6 | 324.4 | 13.41 | 322.10 |
| 10-May-10 13:25:00 | 76.6 | 325.2 | 13.41 | 322.90 |
| 10-May-10 13:26:00 | 79.2 | 319.6 | 13.87 | 317.31 |
| 10-May-10 13:27:00 | 79.4 | 319.7 | 13.90 | 317.43 |
| 10-May-10 13:28:00 | 80.9 | 318.5 | 14.17 | 316.21 |
| 10-May-10 13:29:00 | 80.8 | 319.9 | 14.14 | 317.59 |
| 10-May-10 13:30:00 | 79.3 | 323.1 | 13.89 | 320.78 |
| 10-May-10 13:31:00 | 79.1 | 317.5 | 13.84 | 315.26 |
| 10-May-10 13:32:00 | 80.7 | 320.3 | 14.13 | 318.03 |
| 10-May-10 13:33:00 | 78.5 | 325.8 | 13.75 | 323.52 |
| 10-May-10 13:34:00 | 78.5 | 327.1 | 13.75 | 324.73 |
| 10-May-10 13:35:00 | 77.8 | 323.4 | 13.62 | 321.09 |
| 10-May-10 13:36:00 | 77.2 | 323.5 | 13.51 | 321.21 |
| 10-May-10 13:37:00 | 80.1 | 318.4 | 14.03 | 316.14 |
| 10-May-10 13:38:00 | 80.3 | 325.0 | 14.05 | 322.70 |
| 10-May-10 13:39:00 | 80.8 | 320.5 | 14.15 | 318.26 |
| 10-May-10 13:40:00 | 81.8 | 315.7 | 14.33 | 313.44 |
| 10-May-10 13:41:00 | 81.9 | 319.9 | 14.34 | 317.59 |
| 10-May-10 13:42:00 | 80.5 | 318.1 | 14.09 | 315.86 |
| 10-May-10 13:43:00 | 80.3 | 319.8 | 14.07 | 317.50 |
| 10-May-10 13:44:00 | 76.9 | 322.5 | 13.47 | 320.21 |
| 10-May-10 13:45:00 | 75.9 | 324.1 | 13.29 | 321.78 |
| 10-May-10 13:46:00 | 75.8 | 324.8 | 13.28 | 322.47 |
| 10-May-10 13:47:00 | 76.2 | 323.8 | 13.35 | 321.54 |
| 10-May-10 13:48:00 | 78.7 | 319.9 | 13.77 | 317.59 |
| 10-May-10 13:49:00 | 79.3 | 318.2 | 13.88 | 315.92 |
| 10-May-10 13:50:00 | 80.9 | 318.0 | 14.17 | 315.73 |
| 10-May-10 13:51:00 | 81.5 | 318.5 | 14.27 | 316.23 |
| 10-May-10 13:52:00 | 80.8 | 323.2 | 14.15 | 320.90 |
| 10-May-10 13:53:00 | 80.1 | 318.9 | 14.02 | 316.63 |
| 10-May-10 13:54:00 | 79.0 | 320.3 | 13.84 | 318.06 |
| 10-May-10 13:55:00 | 79.2 | 320.6 | 13.87 | 318.31 |
| 10-May-10 13:56:00 | 79.3 | 323.4 | 13.89 | 321.11 |
| 10-May-10 13:57:00 | 77.2 | 321.3 | 13.52 | 318.98 |
| 10-May-10 13:58:00 | 76.2 | 321.1 | 13.35 | 318.83 |
| Averages: | **79.44** | **318.23** | **13.91** | **315.97** |

CHS, Inc.
Zone D H-1001 Reformer
Process Data

| Unit Name | Code Name | Sample Date | Ideal Gross BTU | Ideal Net BTU |
|---|---|---|---|---|
| 1000 Unit GC all | PSA Tailgas | 5/11/2010 | 175.1 | 178.2 |

| Unit Name | Code Name | Sample Date | Ideal Gross BTU | Ideal Net BTU |
|---|---|---|---|---|
| 100U MkupH&psaTg | R1001 natural gas | 5/11/2010 | 992.9 | 1010.6 |

## CENTRAL FUEL GAS MIX DRUM

Start: 5/11/2010 0:00
End: 5/12/2010 0:00

Data calculated from on-line GC AN-84010
AI84037-D Central Fuel Mix Drum BTU/scf HHV
AI84038-D Central Fuel Mix Drum BTU/scf LHV

| | HHV btu/scf AI84037-D | LHV btu/scf AI84038-D |
|---|---|---|
| 11-May-10 00:00:00 | 1268.60 | 1153.79 |
| 11-May-10 01:00:00 | 1250.61 | 1136.93 |
| 11-May-10 02:00:00 | 1255.53 | 1141.45 |
| 11-May-10 03:00:00 | 1251.78 | 1138.17 |
| 11-May-10 04:00:00 | 1248.94 | 1135.23 |
| 11-May-10 05:00:00 | 1248.07 | 1134.44 |
| 11-May-10 06:00:00 | 1246.13 | 1132.59 |
| 11-May-10 07:00:00 | 1247.56 | 1133.91 |
| 11-May-10 08:00:00 | 1215.11 | 1103.27 |
| 11-May-10 09:00:00 | 1212.35 | 1100.79 |
| 11-May-10 10:00:00 | 1213.66 | 1102.08 |
| 11-May-10 11:00:00 | 1221.99 | 1109.90 |
| 11-May-10 12:00:00 | 1222.56 | 1110.61 |
| 11-May-10 13:00:00 | 1218.20 | 1106.54 |
| 11-May-10 14:00:00 | 1216.93 | 1105.41 |
| 11-May-10 15:00:00 | 1217.80 | 1106.25 |
| 11-May-10 16:00:00 | 1195.97 | 1085.81 |
| 11-May-10 17:00:00 | 1164.84 | 1056.97 |
| 11-May-10 18:00:00 | 1169.32 | 1061.18 |
| 11-May-10 19:00:00 | 1164.23 | 1056.26 |
| 11-May-10 20:00:00 | 1167.23 | 1059.19 |
| 11-May-10 21:00:00 | 1181.62 | 1072.81 |
| 11-May-10 22:00:00 | 1187.52 | 1078.32 |
| 11-May-10 23:00:00 | 1187.75 | 1078.58 |
| Averages: | 1215.60 | 1104.19 |

Zone D SRU

5/11/10 9:00
5/11/10 14:00

| Date and Time | FI4555-D<br>NAT GAS TO BR402/INC401<br>MSCFH |
|---|---|
| 11-May-10 09:00:00 | 5.03 |
| 11-May-10 09:01:00 | 2.30 |
| 11-May-10 09:02:00 | 5.06 |
| 11-May-10 09:03:00 | 2.25 |
| 11-May-10 09:04:00 | 5.17 |
| 11-May-10 09:05:00 | 2.28 |
| 11-May-10 09:06:00 | 5.16 |
| 11-May-10 09:07:00 | 2.27 |
| 11-May-10 09:08:00 | 5.17 |
| 11-May-10 09:09:00 | 2.28 |
| 11-May-10 09:10:00 | 5.04 |
| 11-May-10 09:11:00 | 2.27 |
| 11-May-10 09:12:00 | 5.28 |
| 11-May-10 09:13:00 | 2.35 |
| 11-May-10 09:14:00 | 5.19 |
| 11-May-10 09:15:00 | 2.28 |
| 11-May-10 09:16:00 | 5.18 |
| 11-May-10 09:17:00 | 2.30 |
| 11-May-10 09:18:00 | 5.16 |
| 11-May-10 09:19:00 | 2.27 |
| 11-May-10 09:20:00 | 5.11 |
| 11-May-10 09:21:00 | 2.27 |
| 11-May-10 09:22:00 | 5.12 |
| 11-May-10 09:23:00 | 2.31 |
| 11-May-10 09:24:00 | 5.02 |
| 11-May-10 09:25:00 | 2.29 |
| 11-May-10 09:26:00 | 5.14 |
| 11-May-10 09:27:00 | 2.28 |
| 11-May-10 09:28:00 | 5.06 |
| 11-May-10 09:29:00 | 2.31 |
| 11-May-10 09:30:00 | 5.09 |
| 11-May-10 09:31:00 | 2.36 |
| 11-May-10 09:32:00 | 5.11 |
| 11-May-10 09:33:00 | 2.39 |
| 11-May-10 09:34:00 | 5.18 |
| 11-May-10 09:35:00 | 2.40 |
| 11-May-10 09:36:00 | 5.10 |
| 11-May-10 09:37:00 | 2.43 |
| 11-May-10 09:38:00 | 4.94 |
| 11-May-10 09:39:00 | 2.41 |
| 11-May-10 09:40:00 | 5.04 |
| 11-May-10 09:41:00 | 2.49 |
| 11-May-10 09:42:00 | 4.96 |
| 11-May-10 09:43:00 | 2.53 |
| 11-May-10 09:44:00 | 4.99 |
| 11-May-10 09:45:00 | 2.71 |
| 11-May-10 09:46:00 | 4.75 |

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|---|---|
| 11-May-10 09:47:00 | 2.71 |
| 11-May-10 09:48:00 | 4.67 |
| 11-May-10 09:49:00 | 2.90 |
| 11-May-10 09:50:00 | 4.59 |
| 11-May-10 09:51:00 | 3.10 |
| 11-May-10 09:52:00 | 4.47 |
| 11-May-10 09:53:00 | 3.25 |
| 11-May-10 09:54:00 | 4.37 |
| 11-May-10 09:55:00 | 2.86 |
| 11-May-10 09:56:00 | 4.31 |
| 11-May-10 09:57:00 | 2.91 |
| 11-May-10 09:58:00 | 4.25 |
| 11-May-10 09:59:00 | 2.94 |
| 11-May-10 10:00:00 | 4.21 |
| 11-May-10 10:01:00 | 2.91 |
| 11-May-10 10:02:00 | 4.12 |
| 11-May-10 10:03:00 | 3.10 |
| 11-May-10 10:04:00 | 4.02 |
| 11-May-10 10:05:00 | 3.52 |
| 11-May-10 10:06:00 | 3.92 |
| 11-May-10 10:07:00 | 3.75 |
| 11-May-10 10:08:00 | 3.74 |
| 11-May-10 10:09:00 | 3.70 |
| 11-May-10 10:10:00 | 3.74 |
| 11-May-10 10:11:00 | 3.88 |
| 11-May-10 10:12:00 | 3.68 |
| 11-May-10 10:13:00 | 3.53 |
| 11-May-10 10:14:00 | 3.66 |
| 11-May-10 10:15:00 | 3.71 |
| 11-May-10 10:16:00 | 3.50 |
| 11-May-10 10:17:00 | 3.84 |
| 11-May-10 10:18:00 | 3.34 |
| 11-May-10 10:19:00 | 4.33 |
| 11-May-10 10:20:00 | 3.14 |
| 11-May-10 10:21:00 | 4.40 |
| 11-May-10 10:22:00 | 2.92 |
| 11-May-10 10:23:00 | 4.42 |
| 11-May-10 10:24:00 | 2.90 |
| 11-May-10 10:25:00 | 4.35 |
| 11-May-10 10:26:00 | 2.84 |
| 11-May-10 10:27:00 | 4.45 |
| 11-May-10 10:28:00 | 2.64 |
| 11-May-10 10:29:00 | 4.82 |
| 11-May-10 10:30:00 | 2.53 |
| 11-May-10 10:31:00 | 4.71 |
| 11-May-10 10:32:00 | 2.44 |
| 11-May-10 10:33:00 | 4.56 |
| 11-May-10 10:34:00 | 2.26 |
| 11-May-10 10:35:00 | 4.22 |
| 11-May-10 10:36:00 | 2.37 |
| 11-May-10 10:37:00 | 2.27 |
| 11-May-10 10:38:00 | 3.96 |

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|---|---|
| 11-May-10 10:39:00 | 2.24 |
| 11-May-10 10:40:00 | 2.41 |
| 11-May-10 10:41:00 | 4.00 |
| 11-May-10 10:42:00 | 2.22 |
| 11-May-10 10:43:00 | 2.22 |
| 11-May-10 10:44:00 | 2.54 |
| 11-May-10 10:45:00 | 3.68 |
| 11-May-10 10:46:00 | 2.22 |
| 11-May-10 10:47:00 | 2.91 |
| 11-May-10 10:48:00 | 3.53 |
| 11-May-10 10:49:00 | 2.22 |
| 11-May-10 10:50:00 | 3.00 |
| 11-May-10 10:51:00 | 3.25 |
| 11-May-10 10:52:00 | 2.25 |
| 11-May-10 10:53:00 | 3.04 |
| 11-May-10 10:54:00 | 3.12 |
| 11-May-10 10:55:00 | 2.25 |
| 11-May-10 10:56:00 | 3.82 |
| 11-May-10 10:57:00 | 2.51 |
| 11-May-10 10:58:00 | 2.20 |
| 11-May-10 10:59:00 | 3.90 |
| 11-May-10 11:00:00 | 2.55 |
| 11-May-10 11:01:00 | 2.21 |
| 11-May-10 11:02:00 | 4.03 |
| 11-May-10 11:03:00 | 2.49 |
| 11-May-10 11:04:00 | 2.40 |
| 11-May-10 11:05:00 | 4.16 |
| 11-May-10 11:06:00 | 2.21 |
| 11-May-10 11:07:00 | 3.51 |
| 11-May-10 11:08:00 | 3.08 |
| 11-May-10 11:09:00 | 2.39 |
| 11-May-10 11:10:00 | 4.34 |
| 11-May-10 11:11:00 | 2.50 |
| 11-May-10 11:12:00 | 4.76 |
| 11-May-10 11:13:00 | 2.50 |
| 11-May-10 11:14:00 | 4.84 |
| 11-May-10 11:15:00 | 2.49 |
| 11-May-10 11:16:00 | 4.83 |
| 11-May-10 11:17:00 | 2.47 |
| 11-May-10 11:18:00 | 4.90 |
| 11-May-10 11:19:00 | 2.39 |
| 11-May-10 11:20:00 | 4.91 |
| 11-May-10 11:21:00 | 2.43 |
| 11-May-10 11:22:00 | 5.09 |
| 11-May-10 11:23:00 | 2.42 |
| 11-May-10 11:24:00 | 5.08 |
| 11-May-10 11:25:00 | 2.41 |
| 11-May-10 11:26:00 | 5.08 |
| 11-May-10 11:27:00 | 2.42 |
| 11-May-10 11:28:00 | 5.09 |
| 11-May-10 11:29:00 | 2.43 |
| 11-May-10 11:30:00 | 5.12 |

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|---|---|
| 11-May-10 11:31:00 | 2.39 |
| 11-May-10 11:32:00 | 5.21 |
| 11-May-10 11:33:00 | 2.37 |
| 11-May-10 11:34:00 | 5.18 |
| 11-May-10 11:35:00 | 2.36 |
| 11-May-10 11:36:00 | 5.16 |
| 11-May-10 11:37:00 | 2.31 |
| 11-May-10 11:38:00 | 5.07 |
| 11-May-10 11:39:00 | 2.27 |
| 11-May-10 11:40:00 | 5.02 |
| 11-May-10 11:41:00 | 2.24 |
| 11-May-10 11:42:00 | 5.02 |
| 11-May-10 11:43:00 | 2.26 |
| 11-May-10 11:44:00 | 5.11 |
| 11-May-10 11:45:00 | 2.27 |
| 11-May-10 11:46:00 | 5.24 |
| 11-May-10 11:47:00 | 2.33 |
| 11-May-10 11:48:00 | 5.32 |
| 11-May-10 11:49:00 | 2.38 |
| 11-May-10 11:50:00 | 5.22 |
| 11-May-10 11:51:00 | 2.50 |
| 11-May-10 11:52:00 | 4.94 |
| 11-May-10 11:53:00 | 2.60 |
| 11-May-10 11:54:00 | 4.95 |
| 11-May-10 11:55:00 | 2.63 |
| 11-May-10 11:56:00 | 4.73 |
| 11-May-10 11:57:00 | 2.64 |
| 11-May-10 11:58:00 | 4.22 |
| 11-May-10 11:59:00 | 2.90 |
| 11-May-10 12:00:00 | 3.77 |
| 11-May-10 12:01:00 | 3.28 |
| 11-May-10 12:02:00 | 3.54 |
| 11-May-10 12:03:00 | 3.63 |
| 11-May-10 12:04:00 | 3.02 |
| 11-May-10 12:05:00 | 4.06 |
| 11-May-10 12:06:00 | 2.63 |
| 11-May-10 12:07:00 | 4.53 |
| 11-May-10 12:08:00 | 2.48 |
| 11-May-10 12:09:00 | 4.67 |
| 11-May-10 12:10:00 | 2.23 |
| 11-May-10 12:11:00 | 4.79 |
| 11-May-10 12:12:00 | 2.20 |
| 11-May-10 12:13:00 | 4.63 |
| 11-May-10 12:14:00 | 2.26 |
| 11-May-10 12:15:00 | 4.28 |
| 11-May-10 12:16:00 | 2.75 |
| 11-May-10 12:17:00 | 3.60 |
| 11-May-10 12:18:00 | 3.22 |
| 11-May-10 12:19:00 | 3.02 |
| 11-May-10 12:20:00 | 3.92 |
| 11-May-10 12:21:00 | 2.47 |
| 11-May-10 12:22:00 | 4.42 |

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|---|---|
| 11-May-10 12:23:00 | 2.25 |
| 11-May-10 12:24:00 | 4.68 |
| 11-May-10 12:25:00 | 2.22 |
| 11-May-10 12:26:00 | 4.80 |
| 11-May-10 12:27:00 | 2.29 |
| 11-May-10 12:28:00 | 4.59 |
| 11-May-10 12:29:00 | 2.38 |
| 11-May-10 12:30:00 | 4.77 |
| 11-May-10 12:31:00 | 2.61 |
| 11-May-10 12:32:00 | 4.58 |
| 11-May-10 12:33:00 | 2.71 |
| 11-May-10 12:34:00 | 4.42 |
| 11-May-10 12:35:00 | 2.89 |
| 11-May-10 12:36:00 | 4.25 |
| 11-May-10 12:37:00 | 3.04 |
| 11-May-10 12:38:00 | 4.30 |
| 11-May-10 12:39:00 | 3.14 |
| 11-May-10 12:40:00 | 3.89 |
| 11-May-10 12:41:00 | 3.32 |
| 11-May-10 12:42:00 | 3.72 |
| 11-May-10 12:43:00 | 3.43 |
| 11-May-10 12:44:00 | 3.13 |
| 11-May-10 12:45:00 | 4.00 |
| 11-May-10 12:46:00 | 2.97 |
| 11-May-10 12:47:00 | 4.10 |
| 11-May-10 12:48:00 | 2.41 |
| 11-May-10 12:49:00 | 4.46 |
| 11-May-10 12:50:00 | 2.31 |
| 11-May-10 12:51:00 | 4.81 |
| 11-May-10 12:52:00 | 2.23 |
| 11-May-10 12:53:00 | 4.84 |
| 11-May-10 12:54:00 | 2.24 |
| 11-May-10 12:55:00 | 4.97 |
| 11-May-10 12:56:00 | 2.26 |
| 11-May-10 12:57:00 | 5.07 |
| 11-May-10 12:58:00 | 2.28 |
| 11-May-10 12:59:00 | 5.09 |
| 11-May-10 13:00:00 | 2.31 |
| 11-May-10 13:01:00 | 4.90 |
| 11-May-10 13:02:00 | 2.30 |
| 11-May-10 13:03:00 | 4.83 |
| 11-May-10 13:04:00 | 2.36 |
| 11-May-10 13:05:00 | 4.68 |
| 11-May-10 13:06:00 | 2.59 |
| 11-May-10 13:07:00 | 4.45 |
| 11-May-10 13:08:00 | 2.78 |
| 11-May-10 13:09:00 | 4.27 |
| 11-May-10 13:10:00 | 3.08 |
| 11-May-10 13:11:00 | 4.18 |
| 11-May-10 13:12:00 | 3.20 |
| 11-May-10 13:13:00 | 3.92 |
| 11-May-10 13:14:00 | 3.41 |

| | |
|---|---|
| 11-May-10 13:15:00 | 3.71 |
| 11-May-10 13:16:00 | 3.58 |
| 11-May-10 13:17:00 | 3.62 |
| 11-May-10 13:18:00 | 3.88 |
| 11-May-10 13:19:00 | 3.39 |
| 11-May-10 13:20:00 | 4.28 |
| 11-May-10 13:21:00 | 3.14 |
| 11-May-10 13:22:00 | 4.42 |
| 11-May-10 13:23:00 | 3.01 |
| 11-May-10 13:24:00 | 4.49 |
| 11-May-10 13:25:00 | 2.71 |
| 11-May-10 13:26:00 | 4.42 |
| 11-May-10 13:27:00 | 2.23 |
| 11-May-10 13:28:00 | 4.54 |
| 11-May-10 13:29:00 | 2.24 |
| 11-May-10 13:30:00 | 4.04 |
| 11-May-10 13:31:00 | 2.71 |
| 11-May-10 13:32:00 | 3.05 |
| 11-May-10 13:33:00 | 3.73 |
| 11-May-10 13:34:00 | 2.54 |
| 11-May-10 13:35:00 | 4.42 |
| 11-May-10 13:36:00 | 2.34 |
| 11-May-10 13:37:00 | 4.87 |
| 11-May-10 13:38:00 | 2.22 |
| 11-May-10 13:39:00 | 4.82 |
| 11-May-10 13:40:00 | 2.34 |
| 11-May-10 13:41:00 | 4.64 |
| 11-May-10 13:42:00 | 2.61 |
| 11-May-10 13:43:00 | 4.25 |
| 11-May-10 13:44:00 | 2.98 |
| 11-May-10 13:45:00 | 3.67 |
| 11-May-10 13:46:00 | 3.45 |
| 11-May-10 13:47:00 | 3.04 |
| 11-May-10 13:48:00 | 3.96 |
| 11-May-10 13:49:00 | 2.53 |
| 11-May-10 13:50:00 | 4.41 |
| 11-May-10 13:51:00 | 2.24 |
| 11-May-10 13:52:00 | 4.58 |
| 11-May-10 13:53:00 | 2.25 |
| 11-May-10 13:54:00 | 4.44 |
| 11-May-10 13:55:00 | 2.48 |
| 11-May-10 13:56:00 | 3.51 |
| 11-May-10 13:57:00 | 3.22 |
| 11-May-10 13:58:00 | 2.55 |
| **Average:** | **3.52** |

## CHS, Inc. - Laurel Refinery

**CEMS Listing (June 2008) with revisions 6/3/09**

| Zone | Source | CEM Component | CEM Details | Required By |
|---|---|---|---|---|
| A | Refinery fuel gas | H2S analyzer | Applied Automation<br>Optichrom Advance Gas Chromatograph (GC)<br>Serial #: 202 904 0101<br>Extractive<br>Range: 0 - 300 ppmv H2S | SIP<br>Air Quality Permit<br>NSPS |
| A | Incinerator stack | SO2 analyzer | Ametek<br>4000 Photometric Analyzer<br>8000 Part #A.460000254<br>Extractive<br>Reranged in 2005: 0 - 500 ppm SO2 | Air Quality Permit<br>NSPS/MACT |
| A | Incinerator stack | Flow meter | EMRC<br>S-type Pitot Tube<br>Gas Flow Monitor<br>Range: 0-0.25² H2O | SIP<br>Air Quality Permit |
| A | Incinerator stack | O2 analyzer | ABB Advance<br>Optima Magnos 106<br>Range: 0 - 10% O2<br>Serial #: 3.242853.4 | Air Quality Permit<br>NSPS/MACT |
| C | Boiler 10 | CO/NOx | ABB Advance<br>URAS 14<br>ID # - AIT-08119A/B<br>Serial # 3.348968.6<br>0-500 ppm | NSPS Db<br>AQP<br>CO not required |
| C | Boiler 10 | O2 analyzer | ABB Advance<br>MAGNOS 106<br>ID # - AIT 08119C<br>Serial # - 3.348974.6<br>0-10% | NSPS Db<br>AQP |
| C | Boiler 11 | CO/NOx | ABB Advance<br>URAS 14<br>ID # AIT-08262/63<br>Serial # 3.348964.6<br>0-500 ppm | NSPS Db.<br>MACT |
| C | Boiler 11 | O2 analyzer | ABB Advance<br>MAGNOS 106<br>ID # - AIT 08264<br>Serial # - 3.348973.6<br>0-10% | NSPS Db.<br>MACT |

## CHS, Inc. - Laurel Refinery

**CEMS Listing (June 2008) with revisions 6/3/09**

| Zone | Source | CEM Component | CEM Details | Required By |
|---|---|---|---|---|
| C | Oil burning boilers<br>*Oil burning terminated 3-07* | Fuel oil flow meters | Krohne MFS 2000 800P<br>Range: 0-1,850 lb/min.<br>Serial #: 96204793, 96204799, and 96204800 | SIP |
| C | CO Boiler/FCC stack<br><br>*CEM Removed 9-06*<br>*CO Boiler Removed from Service* | SO2 analyzer | Monitor Labs<br>SM8160 SO2 Analyzer<br>Serial # 0662492R<br>Extractive<br>LS710 Controller<br>Range: 0-500 ppm SO2 | SIP<br>Air Quality Permit |
| C | FCC stack | Flow meter | EMRC<br>S-type Pitot Tube<br>Gas Flow Monitor<br>Range: 0-1" H2O | SIP<br>AQP |
| C | FCC stack | Opacity monitor | Durag<br>D-R 290<br>Serial No. 1203398<br>Range: 0 - 100% | MACT<br>Consent Decree<br>AQP |
| C | FCC stack | CO analyzer | Ametek-Western Research<br>Model 955<br>Extractive<br>0-1000 ppm CO<br>Serial #AY-914-9315-1 | NSPS<br>Air Quality Permit<br>Consent Decree |
| C | FCC stack | NOx analyzer | Ametek-Western Research<br>Model 922-CE<br>Extractive<br>0 - 500 ppm NOx<br>Serial #AE-922-10072-1 | Consent Decree<br>AQP |
| C | FCC stack | SO2 analyzer | Ametek-Western Research<br>Model 922-CE<br>Extractive<br>0 - 500 ppm SO2<br>Serial #AE-922-10072-1 | Consent Decree<br>SIP<br>AQP |
| C | FCC stack | O2 analyzer | Ametek<br>Thermox CEM/O2<br>In stack<br>Range 0-10% O2<br>Serial #10208411 | NSPS<br>Air Quality Permit<br>Consent Decree |

## CHS, Inc. - Laurel Refinery

**CEMS Listing (June 2008) with revisions 6/3/09**

| Zone | Source | CEM Component | CEM Details | Required By |
|---|---|---|---|---|
| D | Zone D refinery fuel gas | H2S analyzer | Applied Automation<br>Optichrom Advance Gas Chromatograph (GC)<br>Extractive<br>Range: 0 - 300 ppmv H2S<br>Serial # 12756711 | SIP<br>Air Quality Permit<br>NSPS |
| D | Zone D refinery fuel gas | Moisture analyzer | Panametrics<br>Moisture Monitor Series 3<br>Range: 0 - 20,000 ppmv H2O<br>Serial # 3-202 | SIP<br>Air Quality Permit<br>NSPS |
| D | SRU Incinerator Stack | SO2 analyzer | Hartman & Braun<br>RADAS 1G<br>Extractive<br>Range: 0-500 ppm SO2<br>Serial # 12756792 | SIP<br>Air Quality Permit<br>NSPS/MACT |
| D | SRU Incinerator Stack | O2 analyzer | Hartman & Braun<br>MAGNOS 6G<br>Extractive<br>Range: 0-10 mol% O2<br>Serial # 12756761 | SIP<br>Air Quality Permit<br>NSPS/MACT |
| D | SRU Incinerator Stack | Flow meter | EMRC<br>S-type Pitot Tube<br>Gas Flow Monitor<br>Range: 0-1² H2O<br>Serial # 0397 | SIP<br>Air Quality Permit |
| D | SRU Incinerator Stack | Moisture analyzer | Panametrics<br>Moisture Monitor Series 3<br>Range: 0 - 20,000 ppmv H2O<br>Serial # 3-201 | SIP<br>Air Quality Permit |
| D | H-1001 Stack | SO2 | Ametek-Western Research<br>Model 922-W<br>0 - 500 ppm SO2 | NSPS<br>AQP |
| D | H-1001 Stack | O2 | Ametek-Western Research<br>Model 922-W<br>0 - 10 % O2 | MACT<br>Air Quality Permit |
| D | H-1001 Stack | CO | Ametek-Western Research<br>Model 955<br>0-1000 ppm CO | MACT<br>Air Quality Permit |

## CHS, Inc. - Laurel Refinery

**CEMS Listing (June 2008) with revisions 6/3/09**

| Zone | Source | CEM Component | CEM Details | Required By |
|---|---|---|---|---|
| E | Zone E refinery fuel gas | H2S analyzer | ABB PGC 2000<br>ID# 77-AIT-202<br>Serial# 3.340497.07<br>0-200 ppm | SIP<br>Air Quality Permit<br>NSPS |
| E | Incinerator Stack | SO2 | ABB Limas 11<br>ID# 79-AIT-144BC<br>Serial# 3.340497.07<br>0-500 ppm, 0-3% | SIP<br>Air Quality Permit<br>NSPS/MACT |
| E | Incinerator Stack | O2 | ABB Magnos106<br>ID # 79-AIT-144A<br>Serial # 3.343041.7<br>0-10% | SIP<br>Air Quality Permit<br>NSPS/MACT |
| E | Incinerator Stack | Flow | EMRC DP-60/75 Mark 2<br>S-type Pitot Tube<br>Serial # 0985<br>0-10,000 scfm | SIP<br>Air Quality Permit |
| E | Coker Heater Stack | CO/O2 | California Analytics<br>Model 600 NDIR/O2<br>Serial # T11029/M<br>0-20% | MACT<br>Air Quality Permit |

## Zone C FCCU CEM RATAs

| NOTE: CEM Times have not been changed to DST | SO2 F.C.C. Uncorr ppm 1min Avg | O2 F.C.C. mole % 1min Avg | NOx F.C.C. Uncorr ppm 1min Avg | CO F.C.C. Uncorr ppm 1min Avg | Stack Flow 1 min SCFH Avg | | SO2 F.C.C. Uncorr ppm | O2 F.C.C. mole % | NOx F.C.C. Uncorr ppm | CO F.C.C. Uncorr ppm | Stack Flow 1 min |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/3/2010 8:05 | 7.63 | 2.43 | 35.89 | 32.95 | 1,708,547 | | | | | | |
| 5/3/2010 8:06 | 7.44 | 2.35 | 35.52 | 31.25 | 1,708,547 | | | | | | |
| 5/3/2010 8:07 | 7.87 | 2.22 | 34.54 | 35.38 | 1,708,547 | | | | | | |
| 5/3/2010 8:08 | 8.24 | 2.11 | 33.91 | 39.12 | 1,714,191 | | | | | | |
| 5/3/2010 8:09 | 8.38 | 2.05 | 33.88 | 40.10 | 1,777,047 | | | | | | |
| 5/3/2010 8:10 | 8.17 | 2.01 | 33.89 | 40.02 | 1,795,044 | RUN 1 | | | | | |
| 5/3/2010 8:11 | 8.01 | 2.02 | 34.10 | 35.32 | 1,965,249 | | | | | | |
| 5/3/2010 8:12 | 8.19 | 2.12 | 34.78 | 38.77 | 1,983,230 | | | | | | |
| 5/3/2010 8:13 | 7.92 | 2.18 | 35.38 | 36.69 | 1,964,430 | | | | | | |
| 5/3/2010 8:14 | 7.65 | 2.35 | 36.43 | 32.55 | 1,926,477 | | | | | | |
| 5/3/2010 8:15 | 7.97 | 2.26 | 36.04 | 34.19 | 1,926,730 | | | | | | |
| 5/3/2010 8:16 | 7.97 | 2.09 | 35.15 | 33.81 | 1,937,972 | | | | | | |
| 5/3/2010 8:17 | 7.77 | 2.17 | 35.19 | 32.07 | 1,943,714 | | | | | | |
| 5/3/2010 8:18 | 7.55 | 2.28 | 35.47 | 30.89 | 1,947,415 | | | | | | |
| 5/3/2010 8:19 | 7.32 | 2.21 | 34.98 | 34.88 | 1,965,543 | | | | | | |
| 5/3/2010 8:20 | 7.58 | 2.20 | 35.00 | 33.50 | 1,951,481 | | | | | | |
| 5/3/2010 8:21 | 7.42 | 2.27 | 35.70 | 34.45 | 1,976,958 | | | | | | |
| 5/3/2010 8:22 | 7.68 | 2.46 | 37.89 | 31.45 | 1,969,607 | | | | | | |
| 5/3/2010 8:23 | 7.74 | 2.43 | 37.93 | 30.31 | 1,916,105 | | | | | | |
| 5/3/2010 8:24 | 8.07 | 2.28 | 36.54 | 29.53 | 1,918,952 | | | | | | |
| 5/3/2010 8:25 | 8.34 | 2.14 | 36.08 | 30.55 | 1,933,985 | | | | | | |
| 5/3/2010 8:26 | 8.58 | 2.00 | 34.88 | 34.07 | 1,964,667 | | | | | | |
| 5/3/2010 8:27 | 8.54 | 1.99 | 34.51 | 35.66 | 1,965,197 | | | | | | |
| 5/3/2010 8:28 | 8.08 | 2.06 | 35.10 | 35.23 | 1,971,770 | | | | | | |
| 5/3/2010 8:29 | 8.16 | 2.09 | 35.35 | 34.36 | 1,877,022 | | | | | | |
| 5/3/2010 8:30 | 8.28 | 2.08 | 35.06 | 35.94 | 1,816,676 | | | | | | |
| 5/3/2010 8:31 | 8.19 | 2.06 | 35.11 | 35.99 | 1,825,288 | Averages | 7.96 | 2.17 | 35.48 | 34.10 | 1,929,251 |
| 5/3/2010 8:32 | 7.60 | 2.13 | 35.50 | 33.45 | 1,833,315 | | | | | | |
| 5/3/2010 8:33 | 7.04 | 2.30 | 36.19 | 32.59 | 1,813,511 | | | | | | |
| 5/3/2010 8:34 | 7.15 | 2.35 | 36.00 | 34.91 | 1,777,957 | | | | | | |
| 5/3/2010 8:35 | 7.23 | 2.41 | 35.72 | 34.63 | 1,802,171 | | | | | | |
| 5/3/2010 8:36 | 7.20 | 2.38 | 35.69 | 34.53 | 1,797,792 | | | | | | |
| 5/3/2010 8:37 | 7.11 | 2.46 | 35.48 | 32.66 | 1,798,806 | | | | | | |
| 5/3/2010 8:38 | 7.33 | 2.36 | 35.02 | 32.51 | 1,795,108 | | | | | | |
| 5/3/2010 8:39 | 7.37 | 2.26 | 34.68 | 34.37 | 1,803,738 | | | | | | |
| 5/3/2010 8:40 | 7.66 | 2.16 | 34.23 | 39.92 | 1,809,543 | | | | | | |
| 5/3/2010 8:41 | 7.65 | 2.24 | 34.65 | 36.78 | 1,844,485 | RUN 2 | | | | | |
| 5/3/2010 8:42 | 7.77 | 2.31 | 36.26 | 36.68 | 1,833,885 | | | | | | |
| 5/3/2010 8:43 | 7.43 | 2.41 | 36.07 | 35.16 | 1,815,469 | | | | | | |
| 5/3/2010 8:44 | 7.69 | 2.23 | 35.12 | 34.60 | 1,792,298 | | | | | | |
| 5/3/2010 8:45 | 7.78 | 2.22 | 34.92 | 29.99 | 1,791,626 | | | | | | |
| 5/3/2010 8:46 | 8.18 | 2.25 | 35.58 | 31.91 | 1,803,980 | | | | | | |
| 5/3/2010 8:47 | 8.41 | 2.03 | 34.23 | 36.06 | 1,805,572 | | | | | | |
| 5/3/2010 8:48 | 8.37 | 2.04 | 34.07 | 34.38 | 1,814,856 | | | | | | |
| 5/3/2010 8:49 | 8.13 | 2.01 | 34.26 | 34.70 | 1,820,138 | | | | | | |
| 5/3/2010 8:50 | 8.31 | 2.00 | 34.27 | 38.42 | 1,825,722 | | | | | | |
| 5/3/2010 8:51 | 8.34 | 1.98 | 34.19 | 40.61 | 1,827,375 | | | | | | |
| 5/3/2010 8:52 | 8.27 | 1.97 | 34.35 | 42.06 | 1,836,620 | | | | | | |
| 5/3/2010 8:53 | 8.28 | 2.05 | 34.85 | 37.33 | 1,839,182 | | | | | | |
| 5/3/2010 8:54 | 8.04 | 2.08 | 35.17 | 36.54 | 1,827,238 | | | | | | |
| 5/3/2010 8:55 | 7.59 | 2.15 | 35.52 | 35.64 | 1,840,979 | | | | | | |
| 5/3/2010 8:56 | 7.55 | 2.19 | 35.43 | 37.20 | 1,829,532 | | | | | | |
| 5/3/2010 8:57 | 7.42 | 2.28 | 35.64 | 34.09 | 1,826,661 | | | | | | |
| 5/3/2010 8:58 | 7.49 | 2.32 | 35.57 | 33.89 | 1,811,535 | | | | | | |
| 5/3/2010 8:59 | 7.42 | 2.36 | 35.49 | 32.85 | 1,789,736 | | | | | | |
| 5/3/2010 9:00 | 6.98 | 2.41 | 35.64 | 32.84 | 1,818,014 | | | | | | |
| 5/3/2010 9:01 | 7.40 | 2.38 | 35.51 | 32.02 | 1,850,455 | | | | | | |
| 5/3/2010 9:02 | 7.34 | 2.46 | 36.47 | 32.22 | 1,834,366 | Averages | 7.81 | 2.20 | 35.15 | 35.27 | 1,821,806 |
| 5/3/2010 9:03 | 6.17 | 4.97 | 33.13 | 30.42 | 1,783,453 | | | | | | |
| 5/3/2010 9:04 | 7.39 | 2.38 | 35.35 | 37.46 | 1,786,835 | | | | | | |
| 5/3/2010 9:05 | 7.87 | 2.22 | 34.35 | 35.25 | 1,792,465 | | | | | | |
| 5/3/2010 9:06 | 7.56 | 2.20 | 34.53 | 32.73 | 1,812,064 | | | | | | |
| 5/3/2010 9:07 | 7.67 | 2.26 | 35.00 | 32.09 | 1,814,861 | | | | | | |
| 5/3/2010 9:08 | 7.42 | 2.25 | 34.94 | 33.80 | 1,800,947 | | | | | | |
| 5/3/2010 9:09 | 7.24 | 2.30 | 35.26 | 34.11 | 1,803,774 | | | | | | |

# Zone C FCCU CEM RATAs

| *NOTE: CEM Times have not been changed to DST* | SO2 F.C.C. Uncorr ppm 1min Avg | O2 F.C.C. mole % 1min Avg | NOx F.C.C. Uncorr ppm 1min Avg | CO F.C.C. Uncorr ppm 1min Avg | Stack Flow 1 min SCFH Avg | | SO2 F.C.C. Uncorr ppm | O2 F.C.C. mole % | NOx F.C.C. Uncorr ppm | CO F.C.C. Uncorr ppm | Stack Flow 1 min |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/3/2010 9:10 | 7.51 | 2.38 | 36.28 | 27.00 | 1,799,284 | | | | | | |
| 5/3/2010 9:11 | 7.72 | 2.30 | 36.78 | 26.01 | 1,773,674 | | | | | | |
| 5/3/2010 9:12 | 7.91 | 2.32 | 36.88 | 24.87 | 1,794,119 | RUN 3 | | | | | |
| 5/3/2010 9:13 | 7.96 | 2.32 | 36.92 | 24.31 | 1,781,666 | | | | | | |
| 5/3/2010 9:14 | 8.10 | 2.29 | 37.04 | 24.37 | 1,794,520 | | | | | | |
| 5/3/2010 9:15 | 8.63 | 2.08 | 36.26 | 29.08 | 1,811,018 | | | | | | |
| 5/3/2010 9:16 | 9.12 | 1.81 | 34.05 | 43.20 | 1,819,022 | | | | | | |
| 5/3/2010 9:17 | 9.26 | 1.83 | 33.82 | 40.63 | 1,837,148 | | | | | | |
| 5/3/2010 9:18 | 9.01 | 1.85 | 34.55 | 33.41 | 1,841,839 | | | | | | |
| 5/3/2010 9:19 | 8.66 | 2.00 | 35.58 | 36.00 | 1,836,927 | | | | | | |
| 5/3/2010 9:20 | 8.20 | 2.12 | 36.18 | 34.13 | 1,693,058 | | | | | | |
| 5/3/2010 9:21 | 8.57 | 2.00 | 33.80 | 36.38 | 1,765,064 | | | | | | |
| 5/3/2010 9:22 | 9.78 | 2.03 | 34.17 | 29.69 | 1,907,913 | | | | | | |
| 5/3/2010 9:23 | 7.60 | 2.66 | 38.34 | 43.61 | 1,806,413 | | | | | | |
| 5/3/2010 9:24 | 9.75 | 1.90 | 33.65 | 63.78 | 1,818,862 | | | | | | |
| 5/3/2010 9:25 | 8.56 | 2.39 | 35.39 | 40.80 | 1,795,101 | | | | | | |
| 5/3/2010 9:26 | 8.60 | 2.29 | 35.42 | 38.07 | 1,812,507 | | | | | | |
| 5/3/2010 9:27 | 9.83 | 1.93 | 33.93 | 38.68 | 1,852,170 | | | | | | |
| 5/3/2010 9:28 | 10.14 | 1.97 | 34.22 | 36.89 | 1,842,577 | | | | | | |
| 5/3/2010 9:29 | 10.41 | 1.79 | 33.71 | 46.33 | 1,857,197 | | | | | | |
| 5/3/2010 9:30 | 10.13 | 1.70 | 33.02 | 46.30 | 1,869,922 | | | | | | |
| 5/3/2010 9:31 | 9.79 | 1.80 | 34.03 | 43.32 | 1,886,765 | | | | | | |
| 5/3/2010 9:32 | 8.98 | 1.99 | 35.12 | 41.91 | 1,879,237 | | | | | | |
| 5/3/2010 9:33 | 8.26 | 2.07 | 35.78 | 39.21 | 1,852,791 | Averages | 8.97 | 2.05 | 35.09 | 37.95 | 1,825,265 |
| 5/3/2010 9:34 | 7.86 | 2.25 | 36.47 | 38.92 | 1,824,200 | | | | | | |
| 5/3/2010 9:35 | 7.18 | 2.55 | 37.22 | 36.70 | 1,826,430 | | | | | | |
| 5/3/2010 9:36 | 6.92 | 2.60 | 36.95 | 34.54 | 1,815,414 | | | | | | |
| 5/3/2010 9:37 | 7.54 | 2.40 | 35.32 | 39.63 | 1,816,375 | | | | | | |
| 5/3/2010 9:38 | 7.42 | 2.43 | 35.69 | 29.53 | 1,818,876 | | | | | | |
| 5/3/2010 9:39 | 7.27 | 2.45 | 36.72 | 28.16 | 1,814,804 | | | | | | |
| 5/3/2010 9:40 | 7.04 | 2.38 | 36.38 | 28.98 | 1,813,536 | | | | | | |
| 5/3/2010 9:41 | 7.33 | 2.35 | 36.11 | 33.81 | 1,840,445 | | | | | | |
| 5/3/2010 9:42 | 7.27 | 2.46 | 36.95 | 33.11 | 1,829,815 | | | | | | |
| 5/3/2010 9:43 | 7.33 | 2.41 | 35.94 | 34.33 | 1,805,683 | RUN 4 | | | | | |
| 5/3/2010 9:44 | 7.62 | 2.35 | 36.35 | 29.69 | 1,803,699 | | | | | | |
| 5/3/2010 9:45 | 7.70 | 2.37 | 36.86 | 27.39 | 1,797,490 | | | | | | |
| 5/3/2010 9:46 | 7.66 | 2.43 | 37.37 | 26.53 | 1,797,927 | | | | | | |
| 5/3/2010 9:47 | 7.52 | 2.42 | 37.64 | 24.92 | 1,784,222 | | | | | | |
| 5/3/2010 9:48 | 7.86 | 2.41 | 37.47 | 24.60 | 1,786,317 | | | | | | |
| 5/3/2010 9:49 | 8.42 | 2.05 | 34.97 | 35.71 | 1,811,521 | | | | | | |
| 5/3/2010 9:50 | 8.61 | 1.94 | 34.00 | 33.34 | 1,830,046 | | | | | | |
| 5/3/2010 9:51 | 8.70 | 1.93 | 34.20 | 34.71 | 1,823,732 | | | | | | |
| 5/3/2010 9:52 | 8.67 | 1.98 | 34.69 | 34.89 | 1,825,535 | | | | | | |
| 5/3/2010 9:53 | 8.47 | 1.97 | 35.53 | 32.14 | 1,836,504 | | | | | | |
| 5/3/2010 9:54 | 8.08 | 2.23 | 37.08 | 28.81 | 1,845,114 | | | | | | |
| 5/3/2010 9:55 | 7.78 | 2.31 | 38.71 | 27.08 | 1,827,058 | | | | | | |
| 5/3/2010 9:56 | 7.74 | 2.27 | 38.36 | 35.81 | 1,831,478 | | | | | | |
| 5/3/2010 9:57 | 7.81 | 2.33 | 36.70 | 39.73 | 1,805,415 | | | | | | |
| 5/3/2010 9:58 | 7.49 | 2.44 | 36.86 | 34.87 | 1,778,282 | | | | | | |
| 5/3/2010 9:59 | 7.12 | 2.56 | 37.55 | 27.91 | 1,773,635 | | | | | | |
| 5/3/2010 10:00 | 7.08 | 2.64 | 38.39 | 25.93 | 1,751,349 | | | | | | |
| 5/3/2010 10:01 | 6.84 | 2.64 | 38.67 | 25.76 | 1,777,771 | | | | | | |
| 5/3/2010 10:02 | 7.11 | 2.70 | 40.15 | 26.14 | 1,776,345 | | | | | | |
| 5/3/2010 10:03 | 6.96 | 4.77 | 32.55 | 32.73 | 1,754,089 | | | | | | |
| 5/3/2010 10:04 | 8.59 | 2.02 | 33.46 | 37.78 | 1,751,631 | Averages | 7.78 | 2.42 | 36.52 | 30.95 | 1,798,857 |
| 5/3/2010 10:05 | 8.73 | 1.89 | 33.26 | 33.25 | 1,761,387 | | | | | | |
| 5/3/2010 10:06 | 9.08 | 1.93 | 33.76 | 28.23 | 1,751,018 | | | | | | |
| 5/3/2010 10:07 | 9.64 | 1.94 | 35.01 | 25.86 | 1,769,641 | | | | | | |
| 5/3/2010 10:08 | 9.90 | 1.95 | 34.94 | 25.83 | 1,752,746 | | | | | | |
| 5/3/2010 10:09 | 9.99 | 1.94 | 34.86 | 25.62 | 1,748,773 | | | | | | |
| 5/3/2010 10:10 | 10.35 | 1.83 | 34.77 | 28.53 | 1,764,644 | | | | | | |
| 5/3/2010 10:11 | 10.51 | 1.69 | 33.38 | 37.21 | 1,756,787 | | | | | | |
| 5/3/2010 10:12 | 10.31 | 1.61 | 32.34 | 36.08 | 1,771,132 | | | | | | |
| 5/3/2010 10:13 | 10.00 | 1.62 | 32.43 | 35.26 | 1,807,919 | | | | | | |
| 5/3/2010 10:14 | 9.99 | 1.60 | 32.99 | 34.26 | 1,824,462 | RUN 5 | | | | | |

## Zone C FCCU CEM RATAs

| NOTE: CEM Times have not been changed to DST | SO2 F.C.C. Uncorr ppm 1min Avg | O2 F.C.C. mole % 1min Avg | NOx F.C.C. Uncorr ppm 1min Avg | CO F.C.C. Uncorr ppm 1min Avg | Stack Flow 1 min SCFH Avg | | | SO2 F.C.C. Uncorr ppm | O2 F.C.C. mole % | NOx F.C.C. Uncorr ppm | CO F.C.C. Uncorr ppm | Stack Flow 1 min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/3/2010 10:15 | 9.88 | 1.70 | 33.75 | 37.35 | 1,832,756 | | | | | | | |
| 5/3/2010 10:16 | 9.57 | 1.70 | 34.09 | 36.32 | 1,828,758 | | | | | | | |
| 5/3/2010 10:17 | 9.24 | 1.82 | 34.83 | 35.38 | 1,832,958 | | | | | | | |
| 5/3/2010 10:18 | 8.82 | 1.96 | 35.50 | 38.09 | 1,830,797 | | | | | | | |
| 5/3/2010 10:19 | 8.01 | 2.26 | 37.03 | 30.56 | 1,808,512 | | | | | | | |
| 5/3/2010 10:20 | 7.59 | 2.48 | 38.57 | 27.22 | 1,806,684 | | | | | | | |
| 5/3/2010 10:21 | 7.35 | 2.50 | 39.12 | 27.43 | 1,785,737 | | | | | | | |
| 5/3/2010 10:22 | 7.28 | 2.45 | 37.83 | 33.70 | 1,780,878 | | | | | | | |
| 5/3/2010 10:23 | 7.10 | 2.46 | 36.54 | 30.86 | 1,785,686 | | | | | | | |
| 5/3/2010 10:24 | 7.85 | 2.28 | 35.27 | 34.29 | 1,770,412 | | | | | | | |
| 5/3/2010 10:25 | 8.39 | 2.12 | 34.29 | 35.44 | 1,782,428 | | | | | | | |
| 5/3/2010 10:26 | 8.38 | 2.06 | 33.99 | 34.07 | 1,808,608 | | | | | | | |
| 5/3/2010 10:27 | 8.13 | 2.03 | 34.23 | 34.27 | 1,804,813 | | | | | | | |
| 5/3/2010 10:28 | 8.22 | 2.03 | 34.32 | 37.08 | 1,804,712 | | | | | | | |
| 5/3/2010 10:29 | 8.10 | 2.06 | 34.60 | 36.84 | 1,816,771 | | | | | | | |
| 5/3/2010 10:30 | 7.96 | 2.05 | 34.83 | 34.79 | 1,813,646 | | | | | | | |
| 5/3/2010 10:31 | 8.01 | 2.09 | 34.72 | 33.69 | 1,808,991 | | | | | | | |
| 5/3/2010 10:32 | 7.79 | 2.26 | 36.17 | 28.55 | 1,801,608 | | | | | | | |
| 5/3/2010 10:33 | 8.01 | 2.26 | 36.88 | 28.00 | 1,806,217 | | | | | | | |
| 5/3/2010 10:34 | 8.15 | 2.15 | 35.88 | 34.75 | 1,795,718 | | | | | | | |
| 5/3/2010 10:35 | 7.93 | 2.13 | 34.99 | 38.20 | 1,794,483 | | Averages | 8.26 | 2.11 | 35.47 | 33.69 | 1,805,711 |
| 5/3/2010 10:36 | 7.80 | 2.18 | 34.92 | 36.41 | 1,804,963 | | | | | | | |
| 5/3/2010 10:37 | 7.61 | 2.22 | 35.13 | 32.76 | 1,804,363 | | | | | | | |
| 5/3/2010 10:38 | 7.48 | 2.27 | 35.39 | 35.08 | 1,800,889 | | | | | | | |
| 5/3/2010 10:39 | 7.35 | 2.43 | 36.25 | 29.87 | 1,784,652 | | | | | | | |
| 5/3/2010 10:40 | 7.40 | 2.43 | 36.79 | 29.95 | 1,763,999 | | | | | | | |
| 5/3/2010 10:41 | 7.77 | 2.21 | 35.39 | 30.93 | 1,805,590 | | | | | | | |
| 5/3/2010 10:42 | 7.71 | 2.28 | 35.75 | 33.08 | 1,807,679 | | | | | | | |
| 5/3/2010 10:43 | 7.71 | 2.28 | 35.41 | 35.16 | 1,790,786 | | | | | | | |
| 5/3/2010 10:44 | 7.90 | 2.08 | 34.22 | 39.00 | 1,788,849 | | | | | | | |
| 5/3/2010 10:45 | 8.35 | 1.96 | 33.63 | 42.65 | 1,804,186 | | RUN 6 | | | | | |
| 5/3/2010 10:46 | 7.98 | 1.99 | 33.77 | 35.77 | 1,796,237 | | | | | | | |
| 5/3/2010 10:47 | 7.89 | 2.17 | 34.53 | 36.29 | 1,806,260 | | | | | | | |
| 5/3/2010 10:48 | 7.84 | 2.17 | 34.57 | 32.50 | 1,818,520 | | | | | | | |
| 5/3/2010 10:49 | 7.65 | 2.23 | 34.87 | 32.83 | 1,805,585 | | | | | | | |
| 5/3/2010 10:50 | 7.68 | 2.20 | 35.21 | 34.70 | 1,801,465 | | | | | | | |
| 5/3/2010 10:51 | 7.58 | 2.22 | 35.10 | 33.53 | 1,799,414 | | | | | | | |
| 5/3/2010 10:52 | 7.58 | 2.18 | 34.93 | 34.43 | 1,787,758 | | | | | | | |
| 5/3/2010 10:53 | 7.82 | 2.17 | 34.48 | 37.92 | 1,798,124 | | | | | | | |
| 5/3/2010 10:54 | 7.97 | 2.14 | 34.09 | 36.06 | 1,804,210 | | | | | | | |
| 5/3/2010 10:55 | 7.68 | 2.27 | 34.95 | 32.24 | 1,795,800 | | | | | | | |
| 5/3/2010 10:56 | 7.84 | 2.16 | 34.09 | 34.60 | 1,805,490 | | | | | | | |
| 5/3/2010 10:57 | 8.03 | 2.23 | 34.62 | 33.93 | 1,815,420 | | | | | | | |
| 5/3/2010 10:58 | 8.04 | 2.22 | 35.54 | 29.62 | 1,812,725 | | | | | | | |
| 5/3/2010 10:59 | 8.32 | 2.18 | 36.17 | 28.09 | 1,801,246 | | | | | | | |
| 5/3/2010 11:00 | 8.42 | 2.17 | 36.19 | 30.08 | 1,807,106 | | | | | | | |
| 5/3/2010 11:01 | 8.42 | 2.09 | 35.64 | 33.47 | 1,850,607 | | | | | | | |
| 5/3/2010 11:02 | 8.45 | 2.21 | 36.62 | 33.90 | 1,835,765 | | | | | | | |
| 5/3/2010 11:03 | 7.33 | 4.64 | 32.51 | 40.09 | 1,820,605 | | | | | | | |
| 5/3/2010 11:04 | 7.97 | 2.15 | 36.18 | 37.02 | 1,815,179 | | | | | | | |
| 5/3/2010 11:05 | 8.24 | 2.14 | 35.92 | 38.45 | 1,809,765 | | | | | | | |
| 5/3/2010 11:06 | 7.49 | 2.45 | 36.51 | 32.79 | 1,803,669 | | Averages | 7.93 | 2.29 | 35.01 | 34.59 | 1,808,870 |
| 5/3/2010 11:07 | 6.98 | 2.54 | 37.51 | 31.96 | 1,799,047 | | | | | | | |
| 5/3/2010 11:08 | 7.39 | 2.24 | 35.14 | 40.33 | 1,778,441 | | | | | | | |
| 5/3/2010 11:09 | 7.84 | 2.17 | 34.31 | 35.14 | 1,803,681 | | | | | | | |
| 5/3/2010 11:10 | 7.93 | 2.03 | 33.60 | 36.02 | 1,802,151 | | | | | | | |
| 5/3/2010 11:11 | 7.81 | 2.06 | 33.53 | 34.99 | 1,816,551 | | | | | | | |
| 5/3/2010 11:12 | 7.74 | 2.08 | 33.99 | 32.13 | 1,812,944 | | | | | | | |
| 5/3/2010 11:13 | 7.50 | 2.15 | 34.60 | 38.66 | 1,823,205 | | | | | | | |
| 5/3/2010 11:14 | 7.68 | 2.23 | 34.84 | 38.70 | 1,805,349 | | | | | | | |
| 5/3/2010 11:15 | 7.60 | 2.21 | 34.54 | 36.70 | 1,802,782 | | | | | | | |
| 5/3/2010 11:16 | 7.60 | 2.33 | 35.56 | 29.21 | 1,802,179 | | RUN 7 | | | | | |
| 5/3/2010 11:17 | 7.63 | 2.31 | 36.67 | 27.16 | 1,786,196 | | | | | | | |
| 5/3/2010 11:18 | 7.89 | 2.32 | 36.57 | 26.65 | 1,786,642 | | | | | | | |
| 5/3/2010 11:19 | 8.20 | 2.29 | 36.80 | 25.87 | 1,768,247 | | | | | | | |

| NOTE: CEM Times have not been changed to DST | SO2 F.C.C. Uncorr ppm 1min Avg | O2 F.C.C. mole % 1min Avg | NOx F.C.C. Uncorr ppm 1min Avg | CO F.C.C. Uncorr ppm 1min Avg | Stack Flow 1 min SCFH Avg | | SO2 F.C.C. Uncorr ppm | O2 F.C.C. mole % | NOx F.C.C. Uncorr ppm | CO F.C.C. Uncorr ppm | Stack Flow 1 min |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/3/2010 11:20 | 8.34 | 2.25 | 36.61 | 25.77 | 1,799,187 | | | | | | |
| 5/3/2010 11:21 | 8.12 | 2.22 | 37.65 | 24.95 | 1,834,273 | | | | | | |
| 5/3/2010 11:22 | 8.24 | 2.33 | 40.00 | 25.23 | 1,823,716 | | | | | | |
| 5/3/2010 11:23 | 8.46 | 2.22 | 38.15 | 27.32 | 1,800,761 | | | | | | |
| 5/3/2010 11:24 | 9.30 | 1.91 | 36.48 | 32.53 | 1,783,498 | | | | | | |
| 5/3/2010 11:25 | 9.28 | 1.82 | 35.33 | 33.69 | 1,818,463 | | | | | | |
| 5/3/2010 11:26 | 8.67 | 1.86 | 34.98 | 33.22 | 1,823,215 | | | | | | |
| 5/3/2010 11:27 | 8.30 | 2.07 | 35.70 | 36.59 | 1,823,292 | | | | | | |
| 5/3/2010 11:28 | 8.06 | 2.14 | 36.08 | 36.05 | 1,821,273 | | | | | | |
| 5/3/2010 11:29 | 7.59 | 2.19 | 36.01 | 34.93 | 1,829,828 | | | | | | |
| 5/3/2010 11:30 | 7.65 | 2.21 | 36.01 | 35.01 | 1,806,445 | | | | | | |
| 5/3/2010 11:31 | 7.57 | 2.19 | 35.77 | 34.52 | 1,817,666 | | | | | | |
| 5/3/2010 11:32 | 7.41 | 2.23 | 35.64 | 35.16 | 1,815,152 | | | | | | |
| 5/3/2010 11:33 | 7.08 | 2.37 | 37.21 | 33.32 | 1,793,912 | | | | | | |
| 5/3/2010 11:34 | 6.93 | 2.47 | 37.35 | 33.18 | 1,783,169 | | | | | | |
| 5/3/2010 11:35 | 7.13 | 2.52 | 38.11 | 26.61 | 1,761,559 | | | | | | |
| 5/3/2010 11:36 | 7.06 | 2.53 | 38.46 | 25.93 | 1,764,789 | | | | | | |
| 5/3/2010 11:37 | 7.14 | 2.46 | 38.09 | 25.30 | 1,767,948 | | Averages | 7.89 | 2.24 | 36.78 | 30.37 | 1,800,51 |
| 5/3/2010 11:38 | 7.70 | 2.18 | 37.25 | 30.10 | 1,798,161 | | | | | | |
| 5/3/2010 11:39 | 8.34 | 2.05 | 35.62 | 37.99 | 1,807,602 | | | | | | |
| 5/3/2010 11:40 | 8.47 | 1.96 | 35.03 | 34.40 | 1,825,693 | | | | | | |
| 5/3/2010 11:41 | 8.47 | 1.86 | 35.47 | 38.54 | 1,859,246 | | | | | | |
| 5/3/2010 11:42 | 8.91 | 1.89 | 37.06 | 39.11 | 1,850,820 | | | | | | |
| 5/3/2010 11:43 | 8.56 | 2.07 | 36.58 | 41.22 | 1,833,149 | | | | | | |
| 5/3/2010 11:44 | 8.43 | 2.15 | 38.15 | 29.76 | 1,804,558 | | | | | | |
| 5/3/2010 11:45 | 8.11 | 2.32 | 39.53 | 27.73 | 1,800,805 | | | | | | |
| 5/3/2010 11:46 | 7.84 | 2.38 | 39.26 | 27.27 | 1,790,367 | | | | | | |
| 5/3/2010 11:47 | 7.87 | 2.22 | 38.17 | 33.33 | 1,797,919 | | RUN 8 | | | | |
| 5/3/2010 11:48 | 8.07 | 2.17 | 36.74 | 34.22 | 1,803,895 | | | | | | |
| 5/3/2010 11:49 | 7.94 | 2.12 | 36.38 | 32.19 | 1,810,767 | | | | | | |
| 5/3/2010 11:50 | 7.93 | 2.10 | 36.11 | 34.24 | 1,810,781 | | | | | | |
| 5/3/2010 11:51 | 7.76 | 2.24 | 37.21 | 29.52 | 1,807,761 | | | | | | |
| 5/3/2010 11:52 | 8.04 | 2.22 | 38.15 | 28.22 | 1,809,876 | | | | | | |
| 5/3/2010 11:53 | 8.22 | 2.18 | 38.17 | 29.84 | 1,808,005 | | | | | | |
| 5/3/2010 11:54 | 8.14 | 2.06 | 37.14 | 35.08 | 1,807,606 | | | | | | |
| 5/3/2010 11:55 | 7.87 | 2.14 | 36.61 | 32.99 | 1,808,600 | | | | | | |
| 5/3/2010 11:56 | 7.58 | 2.15 | 36.56 | 35.16 | 1,827,305 | | | | | | |
| 5/3/2010 11:57 | 7.61 | 2.15 | 36.58 | 35.28 | 1,830,868 | | | | | | |
| 5/3/2010 11:58 | 7.44 | 2.18 | 36.65 | 35.62 | 1,825,078 | | | | | | |
| 5/3/2010 11:59 | 7.73 | 2.17 | 36.62 | 35.34 | 1,811,704 | | | | | | |
| 5/3/2010 12:00 | 7.85 | 2.06 | 36.34 | 36.67 | 1,820,036 | | | | | | |
| 5/3/2010 12:01 | 7.67 | 2.11 | 36.53 | 32.90 | 1,833,460 | | | | | | |
| 5/3/2010 12:02 | 7.72 | 2.26 | 38.31 | 33.46 | 1,838,473 | | | | | | |
| 5/3/2010 12:03 | 6.80 | 4.88 | 34.78 | 28.64 | 1,784,384 | | | | | | |
| 5/3/2010 12:04 | 7.46 | 2.43 | 39.29 | 27.94 | 1,784,544 | | | | | | |
| 5/3/2010 12:05 | 7.60 | 2.26 | 37.98 | 30.74 | 1,779,482 | | | | | | |
| 5/3/2010 12:06 | 7.25 | 2.33 | 37.02 | 29.63 | 1,787,972 | | | | | | |
| 5/3/2010 12:07 | 7.25 | 2.30 | 36.66 | 34.39 | 1,811,521 | | | | | | |
| 5/3/2010 12:08 | 7.46 | 2.21 | 35.79 | 34.73 | 1,814,313 | | Averages | 7.69 | 2.32 | 36.99 | 32.73 | 1,809,7 |
| 5/3/2010 12:09 | 7.80 | 2.12 | 35.44 | 40.54 | 1,832,290 | | | | | | |
| 5/3/2010 12:10 | 7.96 | 2.04 | 35.32 | 36.64 | 1,820,669 | | | | | | |
| 5/3/2010 12:11 | 7.88 | 2.12 | 35.60 | 37.13 | 1,823,640 | | | | | | |
| 5/3/2010 12:12 | 7.60 | 2.18 | 35.92 | 38.43 | 1,808,828 | | | | | | |
| 5/3/2010 12:13 | 7.19 | 2.25 | 36.54 | 35.49 | 1,802,696 | | | | | | |
| 5/3/2010 12:14 | 7.12 | 2.24 | 36.11 | 35.52 | 1,806,429 | | | | | | |
| 5/3/2010 12:15 | 6.90 | 2.34 | 36.41 | 32.29 | 1,790,322 | | | | | | |
| 5/3/2010 12:16 | 6.87 | 2.35 | 36.35 | 33.07 | 1,791,121 | | | | | | |
| 5/3/2010 12:17 | 7.23 | 2.36 | 36.13 | 30.60 | 1,783,736 | | | | | | |
| 5/3/2010 12:18 | 7.13 | 2.47 | 37.66 | 26.67 | 1,772,139 | | RUN 9 | | | | |
| 5/3/2010 12:19 | 7.48 | 2.43 | 37.34 | 26.47 | 1,779,337 | | | | | | |
| 5/3/2010 12:20 | 7.94 | 2.20 | 36.35 | 27.90 | 1,794,536 | | | | | | |
| 5/3/2010 12:21 | 8.63 | 2.08 | 35.98 | 29.22 | 1,823,925 | | | | | | |
| 5/3/2010 12:22 | 8.60 | 1.97 | 36.08 | 38.31 | 1,845,559 | | | | | | |
| 5/3/2010 12:23 | 8.58 | 2.06 | 35.81 | 38.59 | 1,826,406 | | | | | | |
| 5/3/2010 12:24 | 8.59 | 1.95 | 35.49 | 37.18 | 1,829,298 | | | | | | |

## Zone C FCCU CEM RATAs

| *NOTE: CEM Times have not been changed to DST* | SO2 F.C.C. Uncorr ppm 1min Avg | O2 F.C.C. mole % 1min Avg | NOx F.C.C. Uncorr ppm 1min Avg | CO F.C.C. Uncorr ppm 1min Avg | Stack Flow 1 min SCFH Avg |
|---|---|---|---|---|---|
| 5/3/2010 12:25 | 8.46 | 2.01 | 35.75 | 37.64 | 1,809,600 |
| 5/3/2010 12:26 | 7.76 | 2.16 | 36.51 | 35.86 | 1,807,868 |
| 5/3/2010 12:27 | 7.53 | 2.27 | 36.43 | 34.05 | 1,798,058 |
| 5/3/2010 12:28 | 7.20 | 2.35 | 36.26 | 31.70 | 1,807,697 |
| 5/3/2010 12:29 | 7.29 | 2.31 | 35.96 | 32.95 | 1,785,401 |
| 5/3/2010 12:30 | 7.30 | 2.19 | 35.52 | 32.27 | 1,800,024 |
| 5/3/2010 12:31 | 7.33 | 2.19 | 35.41 | 34.16 | 1,800,020 |
| 5/3/2010 12:32 | 7.34 | 2.18 | 35.49 | 35.92 | 1,811,589 |
| 5/3/2010 12:33 | 7.28 | 2.24 | 35.56 | 34.61 | 1,806,826 |
| 5/3/2010 12:34 | 7.35 | 2.25 | 35.60 | 38.34 | 1,801,859 |
| 5/3/2010 12:35 | 7.66 | 2.20 | 35.41 | 33.46 | 1,856,869 |
| 5/3/2010 12:36 | 7.47 | 2.21 | 35.39 | 33.31 | 1,930,447 |
| 5/3/2010 12:37 | 7.51 | 2.18 | 35.15 | 33.63 | 1,933,193 |
| 5/3/2010 12:38 | 7.64 | 2.16 | 34.80 | 36.60 | 1,926,629 |
| 5/3/2010 12:39 | 7.69 | 2.14 | 34.88 | 33.01 | 1,930,124 |
| 5/3/2010 12:40 | 7.41 | 2.15 | 35.13 | 32.16 | 1,940,901 |
| 5/3/2010 12:41 | 7.54 | 2.28 | 36.23 | 33.32 | 1,963,027 |
| 5/3/2010 12:42 | 7.34 | 2.34 | 36.99 | 35.23 | 1,954,753 |
| 5/3/2010 12:43 | 7.45 | 2.33 | 36.51 | 36.68 | 1,912,892 |
| 5/3/2010 12:44 | 7.81 | 2.30 | 35.50 | 32.92 | 1,797,009 |
| 5/3/2010 12:45 | 7.89 | 2.27 | 35.99 | 26.63 | 1,762,644 |

| | SO2 F.C.C. Uncorr ppm | O2 F.C.C. mole % | NOx F.C.C. Uncorr ppm | CO F.C.C. Uncorr ppm | Stack Flow 1 min |
|---|---|---|---|---|---|
| **Averages** | **7.72** | **2.19** | **35.86** | **33.72** | **1,830,791** |

## Boiler 10 CEM Data

*NOTE: CEM Times have not been changed to DST*

| Date / Time | 1 - Boiler 10 NOx ppm - 1 Minute Average | 2 - Boiler 10 CO ppm - 1 Minute Average | 3 - Boiler 10 O2 % - 1 Minute Average | | | | |
|---|---|---|---|---|---|---|---|
| 5/4/2010 7:55 | 33.50 | 72.03 | 6.06 | | | | |
| 5/4/2010 7:56 | 33.57 | 70.51 | 6.08 | | | | |
| 5/4/2010 7:57 | 33.35 | 71.8 | 6.09 | | | | |
| 5/4/2010 7:58 | 33.43 | 72.9 | 6.05 | | | | |
| 5/4/2010 7:59 | 33.37 | 71.37 | 6.11 | | | | |
| 5/4/2010 8:00 | 33.37 | 70.16 | 6.1 | **RUN 1** | | | |
| 5/4/2010 8:01 | 33.68 | 71.01 | 6.09 | | | | |
| 5/4/2010 8:02 | 33.65 | 70.63 | 6.12 | | | | |
| 5/4/2010 8:03 | 33.82 | 70.52 | 6.13 | | | | |
| 5/4/2010 8:04 | 33.66 | 72.12 | 6.1 | | | | |
| 5/4/2010 8:05 | 33.86 | 70.48 | 6.05 | | | | |
| 5/4/2010 8:06 | 33.92 | 72.14 | 6.06 | | | | |
| 5/4/2010 8:07 | 33.49 | 73.73 | 6.03 | | | | |
| 5/4/2010 8:08 | 33.41 | 74.15 | 6 | | | | |
| 5/4/2010 8:09 | 33.80 | 72.94 | 6.01 | | | | |
| 5/4/2010 8:10 | 33.70 | 73.54 | 5.99 | | | | |
| 5/4/2010 8:11 | 33.60 | 75.1 | 6.01 | | | | |
| 5/4/2010 8:12 | 33.70 | 75.16 | 5.98 | | | | |
| 5/4/2010 8:13 | 33.74 | 75.12 | 5.98 | | | | |
| 5/4/2010 8:14 | 33.72 | 73.97 | 6.01 | | | | |
| 5/4/2010 8:15 | 33.91 | 75.33 | 5.97 | | | | |
| 5/4/2010 8:16 | 33.84 | 74.63 | 6 | | | | |
| 5/4/2010 8:17 | 33.97 | 75.32 | 5.99 | | | | |
| 5/4/2010 8:18 | 34.34 | 76.23 | 5.94 | | | | |
| 5/4/2010 8:19 | 33.97 | 76.66 | 5.95 | | | | |
| 5/4/2010 8:20 | 34.11 | 76.34 | 5.95 | | | | |
| 5/4/2010 8:21 | 34.14 | 76.13 | 5.94 | **Averages:** | **33.79** | **73.70** | **6.02** |
| 5/4/2010 8:22 | 33.74 | 76.58 | 5.87 | | | | |
| 5/4/2010 8:23 | 34.03 | 76.99 | 5.91 | | | | |
| 5/4/2010 8:24 | 34.05 | 78.36 | 5.89 | | | | |
| 5/4/2010 8:25 | 33.85 | 76.56 | 5.91 | | | | |
| 5/4/2010 8:26 | 34.15 | 76.08 | 5.96 | | | | |
| 5/4/2010 8:27 | 34.01 | 75.93 | 5.95 | | | | |
| 5/4/2010 8:28 | 34.14 | 75.86 | 5.97 | | | | |
| 5/4/2010 8:29 | 34.16 | 76.74 | 5.91 | | | | |
| 5/4/2010 8:30 | 33.90 | 77.11 | 5.89 | **RUN 2** | | | |
| 5/4/2010 8:31 | 34.06 | 78.34 | 5.88 | | | | |
| 5/4/2010 8:32 | 34.47 | 78.18 | 5.89 | | | | |
| 5/4/2010 8:33 | 34.04 | 78.19 | 5.84 | | | | |
| 5/4/2010 8:34 | 34.15 | 77.97 | 5.92 | | | | |
| 5/4/2010 8:35 | 34.19 | 76.23 | 5.95 | | | | |
| 5/4/2010 8:36 | 33.96 | 76.86 | 5.91 | | | | |
| 5/4/2010 8:37 | 34.05 | 74.62 | 5.89 | | | | |
| 5/4/2010 8:38 | 34.19 | 76.66 | 5.92 | | | | |
| 5/4/2010 8:39 | 34.52 | 76.89 | 5.9 | | | | |
| 5/4/2010 8:40 | 34.15 | 76.66 | 5.95 | | | | |
| 5/4/2010 8:41 | 34.24 | 77.6 | 5.9 | | | | |
| 5/4/2010 8:42 | 34.19 | 77.77 | 5.86 | | | | |
| 5/4/2010 8:43 | 34.30 | 76.69 | 5.91 | | | | |
| 5/4/2010 8:44 | 34.11 | 78.27 | 5.89 | | | | |
| 5/4/2010 8:45 | 34.55 | 77.03 | 5.87 | | | | |
| 5/4/2010 8:46 | 34.37 | 77.4 | 5.92 | | | | |
| 5/4/2010 8:47 | 34.18 | 77.12 | 5.89 | | | | |
| 5/4/2010 8:48 | 34.12 | 77.9 | 5.87 | | | | |
| 5/4/2010 8:49 | 34.20 | 76.93 | 5.89 | | | | |
| 5/4/2010 8:50 | 34.27 | 77.84 | 5.91 | | | | |
| 5/4/2010 8:51 | 34.47 | 77.25 | 5.89 | **Averages:** | **34.21** | **77.25** | **5.90** |
| 5/4/2010 8:52 | 34.22 | 77.75 | 5.91 | | | | |
| 5/4/2010 8:53 | 34.26 | 76.96 | 5.88 | | | | |
| 5/4/2010 8:54 | 33.80 | 78.51 | 5.84 | | | | |
| 5/4/2010 8:55 | 34.02 | 78.97 | 5.9 | | | | |
| 5/4/2010 8:56 | 34.11 | 79.48 | 5.82 | | | | |
| 5/4/2010 8:57 | 34.31 | 77.97 | 5.79 | | | | |
| 5/4/2010 8:58 | 34.24 | 78.77 | 5.85 | | | | |
| 5/4/2010 8:59 | 34.27 | 77.89 | 5.84 | | | | |
| 5/4/2010 9:00 | 34.08 | 78.73 | 5.81 | **RUN 3** | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5/4/2010 9:01 | 34.51 | 77.74 | 5.88 | | | | |
| 5/4/2010 9:02 | 33.92 | 76.86 | 5.81 | | | | |
| 5/4/2010 9:03 | 34.35 | 76.81 | 5.86 | | | | |
| 5/4/2010 9:04 | 34.40 | 76.99 | 5.89 | | | | |
| 5/4/2010 9:05 | 34.07 | 76.55 | 5.89 | | | | |
| 5/4/2010 9:06 | 34.20 | 75.73 | 5.88 | | | | |
| 5/4/2010 9:07 | 33.82 | 77.8 | 5.88 | | | | |
| 5/4/2010 9:08 | 33.81 | 78.7 | 5.84 | | | | |
| 5/4/2010 9:09 | 34.14 | 78.85 | 5.81 | | | | |
| 5/4/2010 9:10 | 34.07 | 79.67 | 5.83 | | | | |
| 5/4/2010 9:11 | 34.03 | 79.46 | 5.78 | | | | |
| 5/4/2010 9:12 | 34.32 | 78.7 | 5.83 | | | | |
| 5/4/2010 9:13 | 34.44 | 78.71 | 5.84 | | | | |
| 5/4/2010 9:14 | 34.16 | 77.32 | 5.85 | | | | |
| 5/4/2010 9:15 | 34.20 | 76.9 | 5.89 | | | | |
| 5/4/2010 9:16 | 34.34 | 77.78 | 5.88 | | | | |
| 5/4/2010 9:17 | 34.15 | 77.59 | 5.85 | | | | |
| 5/4/2010 9:18 | 34.08 | 77.66 | 5.87 | | | | |
| 5/4/2010 9:19 | 34.32 | 79.91 | 5.81 | | | | |
| 5/4/2010 9:20 | 33.81 | 78.87 | 5.79 | | | | |
| 5/4/2010 9:21 | 33.95 | 80.86 | 5.8 | **Averages:** | **34.14** | **78.10** | **5.84** |
| 5/4/2010 9:22 | 34.28 | 80.86 | 5.81 | | | | |
| 5/4/2010 9:23 | 34.15 | 80.44 | 5.75 | | | | |
| 5/4/2010 9:24 | 33.97 | 78.79 | 5.83 | | | | |
| 5/4/2010 9:25 | 34.15 | 80.21 | 5.77 | | | | |
| 5/4/2010 9:26 | 34.11 | 80.14 | 5.8 | | | | |
| 5/4/2010 9:27 | 34.26 | 78.47 | 5.86 | | | | |
| 5/4/2010 9:28 | 34.36 | 78.61 | 5.83 | | | | |
| 5/4/2010 9:29 | 34.28 | 76.58 | 5.85 | | | | |
| 5/4/2010 9:30 | 34.46 | 76.88 | 5.87 | **RUN 4** | | | |
| 5/4/2010 9:31 | 34.20 | 77.95 | 5.87 | | | | |
| 5/4/2010 9:32 | 34.17 | 77.35 | 5.94 | | | | |
| 5/4/2010 9:33 | 34.00 | 74.42 | 5.94 | | | | |
| 5/4/2010 9:34 | 33.95 | 75.65 | 5.92 | | | | |
| 5/4/2010 9:35 | 34.02 | 76.5 | 5.88 | | | | |
| 5/4/2010 9:36 | 34.17 | 76.61 | 5.87 | | | | |
| 5/4/2010 9:37 | 34.24 | 76.78 | 5.93 | | | | |
| 5/4/2010 9:38 | 33.85 | 76.74 | 5.85 | | | | |
| 5/4/2010 9:39 | 33.93 | 77.31 | 5.87 | | | | |
| 5/4/2010 9:40 | 34.72 | 77.27 | 5.86 | | | | |
| 5/4/2010 9:41 | 34.52 | 75.92 | 5.9 | | | | |
| 5/4/2010 9:42 | 34.34 | 77.79 | 5.83 | | | | |
| 5/4/2010 9:43 | 34.22 | 77.08 | 5.8 | | | | |
| 5/4/2010 9:44 | 34.52 | 75.79 | 5.85 | | | | |
| 5/4/2010 9:45 | 34.53 | 78.37 | 5.84 | | | | |
| 5/4/2010 9:46 | 34.16 | 76.95 | 5.86 | | | | |
| 5/4/2010 9:47 | 34.07 | 77.18 | 5.82 | | | | |
| 5/4/2010 9:48 | 34.10 | 77.4 | 5.84 | | | | |
| 5/4/2010 9:49 | 34.28 | 77.47 | 5.83 | | | | |
| 5/4/2010 9:50 | 34.06 | 77.65 | 5.9 | | | | |
| 5/4/2010 9:51 | 34.22 | 77.85 | 5.89 | **Averages:** | **34.22** | **76.95** | **5.87** |
| 5/4/2010 9:52 | 34.14 | 77.07 | 5.91 | | | | |
| 5/4/2010 9:53 | 34.19 | 76.27 | 5.88 | | | | |
| 5/4/2010 9:54 | 34.08 | 77.95 | 5.85 | | | | |
| 5/4/2010 9:55 | 34.02 | 78.26 | 5.78 | | | | |
| 5/4/2010 9:56 | 34.46 | 79.1 | 5.81 | | | | |
| 5/4/2010 9:57 | 34.61 | 78.95 | 5.81 | | | | |
| 5/4/2010 9:58 | 34.64 | 79.86 | 5.81 | | | | |
| 5/4/2010 9:59 | 34.69 | 79.93 | 5.79 | | | | |
| 5/4/2010 10:00 | 34.67 | 80.27 | 5.81 | **RUN 5** | | | |
| 5/4/2010 10:01 | 34.32 | 76.94 | 5.84 | | | | |
| 5/4/2010 10:02 | 34.43 | 76.69 | 5.85 | | | | |
| 5/4/2010 10:03 | 34.28 | 78.45 | 5.8 | | | | |
| 5/4/2010 10:04 | 34.30 | 77.86 | 5.81 | | | | |
| 5/4/2010 10:05 | 34.15 | 77.58 | 5.83 | | | | |
| 5/4/2010 10:06 | 34.27 | 79.07 | 5.77 | | | | |
| 5/4/2010 10:07 | 34.13 | 80.3 | 5.76 | | | | |
| 5/4/2010 10:08 | 34.51 | 81.19 | 5.77 | | | | |
| 5/4/2010 10:09 | 34.31 | 78.67 | 5.78 | | | | |
| 5/4/2010 10:10 | 34.68 | 79.81 | 5.81 | | | | |
| 5/4/2010 10:11 | 34.46 | 79.62 | 5.79 | | | | |

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|---|---|---|---|---|---|---|---|
| 5/4/2010 10:12 | 34.31 | 79.78 | 5.77 | | | | |
| 5/4/2010 10:13 | 34.57 | 79.06 | 5.79 | | | | |
| 5/4/2010 10:14 | 34.65 | 80.23 | 5.76 | | | | |
| 5/4/2010 10:15 | 34.46 | 80.12 | 5.74 | | | | |
| 5/4/2010 10:16 | 34.80 | 80.49 | 5.73 | | | | |
| 5/4/2010 10:17 | 34.54 | 81.89 | 5.71 | | | | |
| 5/4/2010 10:18 | 34.49 | 82.43 | 5.65 | | | | |
| 5/4/2010 10:19 | 34.45 | 81.11 | 5.74 | | | | |
| 5/4/2010 10:20 | 34.17 | 82.54 | 5.74 | | | | |
| 5/4/2010 10:21 | 34.09 | 81.5 | 5.69 | **Averages:** | **34.41** | **79.80** | **5.77** |
| 5/4/2010 10:22 | 34.48 | 78.95 | 5.81 | | | | |
| 5/4/2010 10:23 | 34.56 | 79.97 | 5.82 | | | | |
| 5/4/2010 10:24 | 34.45 | 78.36 | 5.83 | | | | |
| 5/4/2010 10:25 | 34.59 | 77.54 | 5.86 | | | | |
| 5/4/2010 10:26 | 34.41 | 76.24 | 5.84 | | | | |
| 5/4/2010 10:27 | 34.46 | 77.88 | 5.86 | | | | |
| 5/4/2010 10:28 | 34.56 | 78.52 | 5.85 | | | | |
| 5/4/2010 10:29 | 34.46 | 78.2 | 5.82 | | | | |
| 5/4/2010 10:30 | 34.21 | 77.54 | 5.84 | **RUN 6** | | | |
| 5/4/2010 10:31 | 34.30 | 76.88 | 5.86 | | | | |
| 5/4/2010 10:32 | 34.24 | 77.64 | 5.85 | | | | |
| 5/4/2010 10:33 | 34.07 | 76.12 | 5.89 | | | | |
| 5/4/2010 10:34 | 34.00 | 78.68 | 5.85 | | | | |
| 5/4/2010 10:35 | 34.75 | 78.61 | 5.83 | | | | |
| 5/4/2010 10:36 | 35.45 | 78.78 | 5.83 | | | | |
| 5/4/2010 10:37 | 34.89 | 79.24 | 5.83 | | | | |
| 5/4/2010 10:38 | 34.32 | 76.83 | 5.84 | | | | |
| 5/4/2010 10:39 | 34.28 | 77.74 | 5.86 | | | | |
| 5/4/2010 10:40 | 34.18 | 77.09 | 5.87 | | | | |
| 5/4/2010 10:41 | 34.24 | 76.32 | 5.89 | | | | |
| 5/4/2010 10:42 | 34.14 | 77.65 | 5.84 | | | | |
| 5/4/2010 10:43 | 34.32 | 76.41 | 5.85 | | | | |
| 5/4/2010 10:44 | 33.91 | 77.23 | 5.84 | | | | |
| 5/4/2010 10:45 | 34.24 | 76.78 | 5.88 | | | | |
| 5/4/2010 10:46 | 34.44 | 78.19 | 5.88 | | | | |
| 5/4/2010 10:47 | 34.14 | 77.17 | 5.82 | | | | |
| 5/4/2010 10:48 | 33.82 | 77.04 | 5.79 | | | | |
| 5/4/2010 10:49 | 34.10 | 78.14 | 5.77 | | | | |
| 5/4/2010 10:50 | 34.24 | 79.03 | 5.75 | | | | |
| 5/4/2010 10:51 | 34.53 | 79.24 | 5.78 | **Averages:** | **34.31** | **77.65** | **5.84** |
| 5/4/2010 10:52 | 34.63 | 79.41 | 5.78 | | | | |
| 5/4/2010 10:53 | 34.65 | 78.37 | 5.85 | | | | |
| 5/4/2010 10:54 | 34.46 | 77.94 | 5.83 | | | | |
| 5/4/2010 10:55 | 34.21 | 75.79 | 5.87 | | | | |
| 5/4/2010 10:56 | 34.28 | 77.48 | 5.87 | | | | |
| 5/4/2010 10:57 | 34.23 | 78.02 | 5.83 | | | | |
| 5/4/2010 10:58 | 34.07 | 78.42 | 5.81 | | | | |
| 5/4/2010 10:59 | 34.36 | 78.29 | 5.79 | | | | |
| 5/4/2010 11:00 | 34.49 | 77.76 | 5.82 | **RUN 7** | | | |
| 5/4/2010 11:01 | 34.38 | 76.18 | 5.85 | | | | |
| 5/4/2010 11:02 | 34.65 | 77.45 | 5.85 | | | | |
| 5/4/2010 11:03 | 34.28 | 78.26 | 5.81 | | | | |
| 5/4/2010 11:04 | 34.53 | 78.93 | 5.85 | | | | |
| 5/4/2010 11:05 | 34.44 | 76.18 | 5.88 | | | | |
| 5/4/2010 11:06 | 34.59 | 77.66 | 5.86 | | | | |
| 5/4/2010 11:07 | 34.40 | 76.88 | 5.84 | | | | |
| 5/4/2010 11:08 | 34.46 | 75.32 | 5.94 | | | | |
| 5/4/2010 11:09 | 34.43 | 76.61 | 5.88 | | | | |
| 5/4/2010 11:10 | 34.25 | 76.32 | 5.91 | | | | |
| 5/4/2010 11:11 | 34.18 | 75.7 | 5.93 | | | | |
| 5/4/2010 11:12 | 34.22 | 76.82 | 5.9 | | | | |
| 5/4/2010 11:13 | 34.42 | 77.43 | 5.84 | | | | |
| 5/4/2010 11:14 | 34.40 | 78.41 | 5.84 | | | | |
| 5/4/2010 11:15 | 34.60 | 77.56 | 5.87 | | | | |
| 5/4/2010 11:16 | 34.33 | 74.85 | 5.86 | | | | |
| 5/4/2010 11:17 | 34.43 | 76.24 | 5.91 | | | | |
| 5/4/2010 11:18 | 34.23 | 76.02 | 5.9 | | | | |
| 5/4/2010 11:19 | 34.24 | 75.07 | 5.88 | | | | |
| 5/4/2010 11:20 | 34.40 | 76.27 | 5.88 | | | | |
| 5/4/2010 11:21 | 34.53 | 77.71 | 5.83 | **Averages:** | **34.40** | **76.80** | **5.87** |
| 5/4/2010 11:22 | 34.19 | 77.93 | 5.82 | | | | |

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|---|---|---|---|---|---|---|---|
| 5/4/2010 11:23 | 34.34 | 75.47 | 5.9 | | | | |
| 5/4/2010 11:24 | 34.19 | 77.78 | 5.84 | | | | |
| 5/4/2010 11:25 | 34.39 | 77.17 | 5.89 | | | | |
| 5/4/2010 11:26 | 34.89 | 76.99 | 5.87 | | | | |
| 5/4/2010 11:27 | 34.75 | 77.76 | 5.88 | | | | |
| 5/4/2010 11:28 | 34.57 | 77.68 | 5.84 | | | | |
| 5/4/2010 11:29 | 34.25 | 75.59 | 5.91 | | | | |
| 5/4/2010 11:30 | 34.34 | 75.87 | 5.94 | **RUN 8** | | | |
| 5/4/2010 11:31 | 33.92 | 76.8 | 5.86 | | | | |
| 5/4/2010 11:32 | 33.98 | 75.83 | 5.94 | | | | |
| 5/4/2010 11:33 | 33.98 | 75.64 | 5.91 | | | | |
| 5/4/2010 11:34 | 34.17 | 75.1 | 5.93 | | | | |
| 5/4/2010 11:35 | 34.05 | 74.31 | 5.92 | | | | |
| 5/4/2010 11:36 | 34.32 | 75.03 | 5.9 | | | | |
| 5/4/2010 11:37 | 34.60 | 74.68 | 5.91 | | | | |
| 5/4/2010 11:38 | 34.39 | 77.49 | 5.87 | | | | |
| 5/4/2010 11:39 | 34.09 | 76.77 | 5.81 | | | | |
| 5/4/2010 11:40 | 34.44 | 75.37 | 5.86 | | | | |
| 5/4/2010 11:41 | 34.43 | 77.94 | 5.84 | | | | |
| 5/4/2010 11:42 | 34.42 | 78.2 | 5.8 | | | | |
| 5/4/2010 11:43 | 34.53 | 78.16 | 5.78 | | | | |
| 5/4/2010 11:44 | 34.22 | 79.5 | 5.77 | | | | |
| 5/4/2010 11:45 | 34.39 | 78.96 | 5.81 | | | | |
| 5/4/2010 11:46 | 34.60 | 79.99 | 5.76 | | | | |
| 5/4/2010 11:47 | 34.60 | 79.86 | 5.75 | | | | |
| 5/4/2010 11:48 | 34.51 | 79.92 | 5.71 | | | | |
| 5/4/2010 11:49 | 34.98 | 79.6 | 5.78 | | | | |
| 5/4/2010 11:50 | 34.72 | 80.41 | 5.71 | | | | |
| 5/4/2010 11:51 | 34.59 | 79.68 | 5.73 | **Averages:** | **34.38** | **77.51** | **5.83** |
| 5/4/2010 11:52 | 34.64 | 79.54 | 5.72 | | | | |
| 5/4/2010 11:53 | 34.91 | 81.01 | 5.75 | | | | |
| 5/4/2010 11:54 | 34.62 | 80.89 | 5.69 | | | | |
| 5/4/2010 11:55 | 34.49 | 79.4 | 5.73 | | | | |
| 5/4/2010 11:56 | 34.64 | 79.07 | 5.79 | | | | |
| 5/4/2010 11:57 | 34.43 | 78.25 | 5.8 | | | | |
| 5/4/2010 11:58 | 34.25 | 77.52 | 5.83 | | | | |
| 5/4/2010 11:59 | 34.25 | 78.04 | 5.79 | | | | |
| 5/4/2010 12:00 | 34.35 | 76.72 | 5.79 | **RUN 9** | | | |
| 5/4/2010 12:01 | 34.73 | 78.57 | 5.82 | | | | |
| 5/4/2010 12:02 | 34.28 | 77.1 | 5.82 | | | | |
| 5/4/2010 12:03 | 34.20 | 78.72 | 5.82 | | | | |
| 5/4/2010 12:04 | 34.49 | 77.89 | 5.8 | | | | |
| 5/4/2010 12:05 | 34.36 | 79.22 | 5.77 | | | | |
| 5/4/2010 12:06 | 34.63 | 77.23 | 5.81 | | | | |
| 5/4/2010 12:07 | 34.70 | 78.25 | 5.81 | | | | |
| 5/4/2010 12:08 | 34.53 | 78.17 | 5.8 | | | | |
| 5/4/2010 12:09 | 34.62 | 77.71 | 5.81 | | | | |
| 5/4/2010 12:10 | 34.30 | 77.61 | 5.8 | | | | |
| 5/4/2010 12:11 | 34.46 | 76.52 | 5.81 | | | | |
| 5/4/2010 12:12 | 35.24 | 76.89 | 5.86 | | | | |
| 5/4/2010 12:13 | 34.58 | 79.97 | 5.75 | | | | |
| 5/4/2010 12:14 | 34.88 | 79.09 | 5.79 | | | | |
| 5/4/2010 12:15 | 34.96 | 78.07 | 5.79 | | | | |
| 5/4/2010 12:16 | 34.73 | 78.29 | 5.78 | | | | |
| 5/4/2010 12:17 | 34.64 | 78.07 | 5.76 | | | | |
| 5/4/2010 12:18 | 34.58 | 77.79 | 5.85 | | | | |
| 5/4/2010 12:19 | 34.50 | 76.06 | 5.85 | | | | |
| 5/4/2010 12:20 | 34.79 | 76.95 | 5.8 | | | | |
| 5/4/2010 12:21 | 34.53 | 76.79 | 5.83 | **Averages:** | **34.59** | **77.80** | **5.81** |
| 5/4/2010 12:22 | 34.57 | 77.53 | 5.82 | | | | |
| 5/4/2010 12:23 | 34.42 | 77.44 | 5.8 | | | | |
| 5/4/2010 12:24 | 34.38 | 77.6 | 5.79 | | | | |
| 5/4/2010 12:25 | 34.78 | 77.67 | 5.83 | | | | |
| 5/4/2010 12:26 | 34.58 | 77.76 | 5.83 | | | | |
| 5/4/2010 12:27 | 34.51 | 76.25 | 5.84 | | | | |
| 5/4/2010 12:28 | 34.53 | 77.48 | 5.81 | | | | |
| 5/4/2010 12:29 | 34.44 | 77.5 | 5.8 | | | | |
| 5/4/2010 12:30 | 34.67 | 78.46 | 5.78 | | | | |
| **Averages** | **34.54** | **77.45** | **5.81** | | | | |

oiler #12 CEMS Data

| ate / Time | 15 - B12: NOx ppm - 1 Minute Avg | 24 - B12: NOx lbs/hr - 1 Minute Avg | 19 - B12: NOx lbs/MMbtu - 1 Minute Avg | 23 - B12: Stack Flow MMDSCFH - 1 Minute Avg | 16 - B12: CO ppm - 1 Minute Avg | 20 - B12: CO ppm @ 3% O2 - 1 Minute Avg | 25 - B12: CO lbs/hr - 1 Minute Avg | 17 - B12: O2 % - 1 Minute Avg | | 15 - B12: NOx ppm - 1 Minute Avg | 24 - B12: NOx lbs/hr - 1 Minute Avg | 19 - B12: NOx lbs/MMbtu - 1 Minute Avg | 23 - B12: Stack Flow MMDSCFH - 1 Minute Avg | 16 - B12: CO ppm - 1 Minute Avg | 20 - B12: CO ppm @ 3% O2 - 1 Minute Avg | 25 - B12: CO lbs/hr - 1 Minute Avg | 17 - B12: O2 - 1 Minute Av |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/2010 9:10 | 19.02 | 3.87 | 0.02 | 1.71 | 0.89 | 0.88 | 0.11 | 2.83 | | | | | | | | | |
| 5/2010 9:11 | 17.89 | 3.63 | 0.02 | 1.70 | 0.82 | 0.82 | 0.10 | 2.92 | | | | | | | | | |
| 5/2010 9:12 | 18.96 | 3.82 | 0.02 | 1.69 | 0.67 | 0.68 | 0.08 | 3.14 | | | | | | | | | |
| 5/2010 9:13 | 19.25 | 3.87 | 0.02 | 1.68 | 0.85 | 0.84 | 0.10 | 2.85 | | | | | | | | | |
| 5/2010 9:14 | 18.44 | 3.71 | 0.02 | 1.69 | 0.89 | 0.88 | 0.11 | 2.80 | | | | | | | | | |
| 5/2010 9:15 | 18.00 | 3.63 | 0.02 | 1.69 | 0.90 | 0.89 | 0.11 | 2.82 | RUN 1 | | | | | | | | |
| 5/2010 9:16 | 19.33 | 3.91 | 0.02 | 1.69 | 0.91 | 0.90 | 0.11 | 2.77 | | | | | | | | | |
| 5/2010 9:17 | 18.25 | 3.71 | 0.02 | 1.70 | 0.91 | 0.90 | 0.11 | 2.83 | | | | | | | | | |
| 5/2010 9:18 | 17.08 | 3.52 | 0.02 | 1.72 | 0.97 | 0.96 | 0.12 | 2.84 | | | | | | | | | |
| 5/2010 9:19 | 17.75 | 3.70 | 0.02 | 1.75 | 1.02 | 1.00 | 0.13 | 2.80 | | | | | | | | | |
| 5/2010 9:20 | 19.93 | 4.16 | 0.02 | 1.75 | 1.19 | 1.17 | 0.15 | 2.58 | | | | | | | | | |
| 5/2010 9:21 | 20.22 | 4.24 | 0.02 | 1.76 | 1.08 | 1.06 | 0.14 | 2.70 | | | | | | | | | |
| 5/2010 9:22 | 20.02 | 4.20 | 0.02 | 1.76 | 1.13 | 1.11 | 0.14 | 2.66 | | | | | | | | | |
| 5/2010 9:23 | 19.64 | 4.10 | 0.02 | 1.75 | 1.12 | 1.10 | 0.14 | 2.65 | | | | | | | | | |
| 5/2010 9:24 | 19.48 | 4.05 | 0.02 | 1.74 | 1.06 | 1.05 | 0.13 | 2.73 | | | | | | | | | |
| 5/2010 9:25 | 19.46 | 4.00 | 0.02 | 1.72 | 1.06 | 1.04 | 0.13 | 2.66 | | | | | | | | | |
| 5/2010 9:26 | 17.49 | 3.60 | 0.02 | 1.72 | 0.99 | 0.98 | 0.12 | 2.80 | | | | | | | | | |
| 5/2010 9:27 | 18.94 | 3.85 | 0.02 | 1.70 | 0.83 | 0.82 | 0.10 | 2.94 | | | | | | | | | |
| 5/2010 9:28 | 18.89 | 3.82 | 0.02 | 1.70 | 0.82 | 0.81 | 0.10 | 2.87 | | | | | | | | | |
| 5/2010 9:29 | 18.02 | 3.63 | 0.02 | 1.69 | 0.83 | 0.83 | 0.10 | 2.87 | | | | | | | | | |
| 5/2010 9:30 | 18.83 | 3.69 | 0.02 | 1.64 | 0.68 | 0.69 | 0.08 | 3.09 | | | | | | | | | |
| 5/2010 9:31 | 19.66 | 3.84 | 0.02 | 1.63 | 0.87 | 0.86 | 0.10 | 2.72 | | | | | | | | | |
| 5/2010 9:32 | 19.09 | 3.73 | 0.02 | 1.64 | 0.87 | 0.86 | 0.10 | 2.74 | | | | | | | | | |
| 5/2010 9:33 | 18.93 | 3.65 | 0.02 | 1.62 | 0.70 | 0.70 | 0.08 | 3.02 | | | | | | | | | |
| 5/2010 9:34 | 19.07 | 3.66 | 0.02 | 1.61 | 0.79 | 0.78 | 0.09 | 2.82 | | | | | | | | | |
| 5/2010 9:35 | 19.12 | 3.64 | 0.02 | 1.59 | 0.73 | 0.72 | 0.08 | 2.91 | | | | | | | | | |
| 5/2010 9:36 | 18.81 | 3.53 | 0.02 | 1.57 | 0.71 | 0.70 | 0.08 | 2.90 | Averages | 18.91 | 3.81 | 0.02 | 1.69 | 0.92 | 0.91 | 0.11 | 2.81 |
| 5/2010 9:37 | 18.74 | 3.47 | 0.02 | 1.55 | 0.69 | 0.69 | 0.08 | 2.85 | | | | | | | | | |
| 5/2010 9:38 | 18.49 | 3.38 | 0.02 | 1.53 | 0.71 | 0.71 | 0.08 | 2.82 | | | | | | | | | |
| 5/2010 9:39 | 18.46 | 3.34 | 0.02 | 1.51 | 0.70 | 0.69 | 0.08 | 2.82 | | | | | | | | | |
| 5/2010 9:40 | 18.37 | 3.28 | 0.02 | 1.49 | 0.71 | 0.70 | 0.08 | 2.75 | | | | | | | | | |
| 5/2010 9:41 | 18.57 | 3.27 | 0.02 | 1.48 | 0.72 | 0.70 | 0.08 | 2.73 | | | | | | | | | |
| 5/2010 9:42 | 18.09 | 3.19 | 0.02 | 1.48 | 0.71 | 0.70 | 0.08 | 2.70 | | | | | | | | | |
| 5/2010 9:43 | 17.97 | 3.25 | 0.02 | 1.51 | 0.63 | 0.62 | 0.07 | 2.81 | | | | | | | | | |
| 5/2010 9:44 | 17.95 | 3.30 | 0.02 | 1.54 | 0.67 | 0.66 | 0.07 | 2.80 | | | | | | | | | |
| 5/2010 9:45 | 18.67 | 3.45 | 0.02 | 1.55 | 0.73 | 0.72 | 0.08 | 2.72 | RUN 2 | | | | | | | | |
| 5/2010 9:46 | 18.83 | 3.49 | 0.02 | 1.55 | 0.78 | 0.76 | 0.09 | 2.73 | | | | | | | | | |
| 5/2010 9:47 | 18.92 | 3.51 | 0.02 | 1.55 | 0.85 | 0.83 | 0.10 | 2.64 | | | | | | | | | |
| 5/2010 9:48 | 18.77 | 3.56 | 0.02 | 1.59 | 0.72 | 0.71 | 0.08 | 2.87 | | | | | | | | | |
| 5/2010 9:49 | 19.00 | 3.62 | 0.02 | 1.60 | 0.82 | 0.81 | 0.09 | 2.76 | | | | | | | | | |
| 5/2010 9:50 | 19.10 | 3.66 | 0.02 | 1.60 | 0.82 | 0.81 | 0.10 | 2.74 | | | | | | | | | |
| 5/2010 9:51 | 19.10 | 3.70 | 0.02 | 1.62 | 0.79 | 0.78 | 0.09 | 2.83 | | | | | | | | | |
| 5/2010 9:52 | 19.23 | 3.75 | 0.02 | 1.63 | 0.89 | 0.88 | 0.11 | 2.69 | | | | | | | | | |
| 5/2010 9:53 | 18.98 | 3.76 | 0.02 | 1.66 | 0.85 | 0.84 | 0.10 | 2.77 | | | | | | | | | |
| 5/2010 9:54 | 19.20 | 3.83 | 0.02 | 1.67 | 0.87 | 0.86 | 0.11 | 2.78 | | | | | | | | | |
| 5/2010 9:55 | 19.32 | 3.86 | 0.02 | 1.67 | 0.96 | 0.94 | 0.12 | 2.68 | | | | | | | | | |
| 5/2010 9:56 | 18.36 | 3.68 | 0.02 | 1.68 | 1.04 | 1.03 | 0.13 | 2.68 | | | | | | | | | |
| 5/2010 9:57 | 19.54 | 3.98 | 0.02 | 1.71 | 0.92 | 0.91 | 0.11 | 2.78 | | | | | | | | | |
| 5/2010 9:58 | 19.60 | 3.95 | 0.02 | 1.69 | 0.91 | 0.90 | 0.11 | 2.79 | | | | | | | | | |
| 5/2010 9:59 | 19.65 | 3.93 | 0.02 | 1.68 | 0.75 | 0.75 | 0.09 | 3.01 | | | | | | | | | |
| 5/2010 10:00 | 18.03 | 3.62 | 0.02 | 1.68 | 1.01 | 0.99 | 0.12 | 2.76 | | | | | | | | | |
| 5/2010 10:01 | 19.39 | 3.87 | 0.02 | 1.67 | 1.04 | 1.02 | 0.13 | 2.61 | | | | | | | | | |
| 5/2010 10:02 | 18.38 | 3.69 | 0.02 | 1.68 | 0.98 | 0.97 | 0.12 | 2.73 | | | | | | | | | |
| 5/2010 10:03 | 17.87 | 3.61 | 0.02 | 1.69 | 1.04 | 1.03 | 0.13 | 2.72 | | | | | | | | | |
| 5/2010 10:04 | 18.48 | 3.74 | 0.02 | 1.69 | 0.94 | 0.93 | 0.12 | 2.77 | | | | | | | | | |
| 5/2010 10:05 | 19.68 | 3.96 | 0.02 | 1.68 | 0.81 | 0.81 | 0.10 | 2.92 | | | | | | | | | |
| 5/2010 10:06 | 19.83 | 3.98 | 0.02 | 1.68 | 0.98 | 0.97 | 0.12 | 2.68 | Averages | 19.00 | 3.74 | 0.02 | 1.65 | 0.89 | 0.88 | 0.11 | 2.76 |
| 5/2010 10:07 | 19.29 | 3.87 | 0.02 | 1.68 | 1.00 | 0.98 | 0.12 | 2.63 | | | | | | | | | |
| 5/2010 10:08 | 19.55 | 3.93 | 0.02 | 1.69 | 0.99 | 0.97 | 0.12 | 2.66 | | | | | | | | | |
| 5/2010 10:09 | 19.60 | 3.94 | 0.02 | 1.69 | 0.98 | 0.96 | 0.12 | 2.65 | | | | | | | | | |
| 5/2010 10:10 | 19.44 | 3.91 | 0.02 | 1.69 | 1.10 | 1.08 | 0.13 | 2.60 | | | | | | | | | |
| 5/2010 10:11 | 19.80 | 4.00 | 0.02 | 1.69 | 0.96 | 0.94 | 0.12 | 2.71 | | | | | | | | | |
| 5/2010 10:12 | 19.74 | 3.96 | 0.02 | 1.68 | 0.95 | 0.93 | 0.12 | 2.73 | | | | | | | | | |
| 5/2010 10:13 | 19.44 | 3.89 | 0.02 | 1.68 | 0.99 | 0.97 | 0.12 | 2.68 | | | | | | | | | |

oiler #12 CEMS Data

| ate / Time | 15 - B12: NOx ppm - 1 Minute Avg | 24 - B12: NOx lbs/hr - 1 Minute Avg | 19 - B12: NOx lbs/MMbtu - 1 Minute Avg | 23 - B12: Stack Flow MMDSCFH - 1 Minute Avg | 16 - B12: CO ppm - 1 Minute Avg | 20 - B12: CO ppm @ 3% O2 - 1 Minute Avg | 25 - B12: CO lbs/hr - 1 Minute Avg | 17 - B12: O2 % - 1 Minute Avg | | 15 - B12: NOx ppm - 1 Minute Avg | 24 - B12: NOx lbs/hr - 1 Minute Avg | 19 - B12: NOx lbs/MMbtu - 1 Minute Avg | 23 - B12: Stack Flow MMDSCFH - 1 Minute Avg | 16 - B12: CO ppm - 1 Minute Avg | 20 - B12: CO ppm @ 3% O2 - 1 Minute Avg | 25 - B12: CO lbs/hr - 1 Minute Avg | 17 - B12: O2 - 1 Minute Av |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/2010 10:14 | 18.90 | 3.77 | 0.02 | 1.67 | 0.90 | 0.89 | 0.11 | 2.80 | | | | | | | | | |
| 5/2010 10:15 | 19.65 | 3.92 | 0.02 | 1.67 | 1.08 | 1.06 | 0.13 | 2.60 | RUN 3 | | | | | | | | |
| 5/2010 10:16 | 19.16 | 3.84 | 0.02 | 1.68 | 1.05 | 1.03 | 0.13 | 2.62 | | | | | | | | | |
| 5/2010 10:17 | 18.72 | 3.77 | 0.02 | 1.69 | 1.00 | 0.98 | 0.12 | 2.70 | | | | | | | | | |
| 5/2010 10:18 | 19.19 | 3.86 | 0.02 | 1.68 | 0.94 | 0.92 | 0.11 | 2.73 | | | | | | | | | |
| 5/2010 10:19 | 18.23 | 3.67 | 0.02 | 1.69 | 0.84 | 0.84 | 0.10 | 2.88 | | | | | | | | | |
| 5/2010 10:20 | 19.70 | 3.95 | 0.02 | 1.68 | 0.85 | 0.84 | 0.10 | 2.84 | | | | | | | | | |
| 5/2010 10:21 | 19.60 | 3.91 | 0.02 | 1.67 | 1.05 | 1.03 | 0.13 | 2.59 | | | | | | | | | |
| 5/2010 10:22 | 19.72 | 3.92 | 0.02 | 1.66 | 0.96 | 0.94 | 0.12 | 2.69 | | | | | | | | | |
| 5/2010 10:23 | 19.49 | 3.87 | 0.02 | 1.66 | 1.00 | 0.98 | 0.12 | 2.60 | | | | | | | | | |
| 5/2010 10:24 | 19.03 | 3.82 | 0.02 | 1.68 | 0.95 | 0.94 | 0.12 | 2.70 | | | | | | | | | |
| 5/2010 10:25 | 17.76 | 3.56 | 0.02 | 1.68 | 1.03 | 1.01 | 0.13 | 2.69 | | | | | | | | | |
| 5/2010 10:26 | 19.62 | 3.94 | 0.02 | 1.68 | 1.02 | 1.00 | 0.12 | 2.63 | | | | | | | | | |
| 5/2010 10:27 | 19.67 | 3.94 | 0.02 | 1.68 | 0.98 | 0.96 | 0.12 | 2.70 | | | | | | | | | |
| 5/2010 10:28 | 20.08 | 3.96 | 0.02 | 1.65 | 0.86 | 0.85 | 0.10 | 2.81 | | | | | | | | | |
| 5/2010 10:29 | 19.63 | 3.88 | 0.02 | 1.65 | 2.74 | 2.68 | 0.33 | 2.56 | | | | | | | | | |
| 5/2010 10:30 | 19.08 | 3.84 | 0.02 | 1.69 | 0.95 | 0.94 | 0.12 | 2.68 | | | | | | | | | |
| 5/2010 10:31 | 18.18 | 3.67 | 0.02 | 1.69 | 0.98 | 0.97 | 0.12 | 2.72 | | | | | | | | | |
| 5/2010 10:32 | 18.77 | 3.77 | 0.02 | 1.68 | 0.88 | 0.87 | 0.11 | 2.81 | | | | | | | | | |
| 5/2010 10:33 | 19.49 | 3.91 | 0.02 | 1.68 | 1.04 | 1.02 | 0.13 | 2.63 | | | | | | | | | |
| 5/2010 10:34 | 19.93 | 3.94 | 0.02 | 1.66 | 0.89 | 0.88 | 0.11 | 2.76 | | | | | | | | | |
| 5/2010 10:35 | 19.95 | 3.96 | 0.02 | 1.66 | 1.01 | 0.99 | 0.12 | 2.61 | | | | | | | | | |
| 5/2010 10:36 | 19.15 | 3.84 | 0.02 | 1.68 | 0.89 | 0.88 | 0.11 | 2.76 | Averages | 19.26 | 3.85 | 0.02 | 1.67 | 1.05 | 1.03 | 0.13 | 2.70 |
| 5/2010 10:37 | 18.86 | 3.80 | 0.02 | 1.69 | 0.94 | 0.93 | 0.12 | 2.72 | | | | | | | | | |
| 5/2010 10:38 | 19.26 | 3.89 | 0.02 | 1.69 | 0.86 | 0.85 | 0.11 | 2.83 | | | | | | | | | |
| 5/2010 10:39 | 19.32 | 3.87 | 0.02 | 1.68 | 0.94 | 0.93 | 0.12 | 2.75 | | | | | | | | | |
| 5/2010 10:40 | 18.28 | 3.67 | 0.02 | 1.68 | 0.94 | 0.93 | 0.11 | 2.77 | | | | | | | | | |
| 5/2010 10:41 | 19.33 | 3.89 | 0.02 | 1.69 | 0.95 | 0.93 | 0.12 | 2.68 | | | | | | | | | |
| 5/2010 10:42 | 17.97 | 3.61 | 0.02 | 1.68 | 1.00 | 0.98 | 0.12 | 2.73 | | | | | | | | | |
| 5/2010 10:43 | 19.31 | 3.88 | 0.02 | 1.68 | 1.00 | 0.98 | 0.12 | 2.64 | | | | | | | | | |
| 5/2010 10:44 | 19.12 | 3.83 | 0.02 | 1.68 | 1.02 | 1.00 | 0.12 | 2.64 | | | | | | | | | |
| 5/2010 10:45 | 19.14 | 3.86 | 0.02 | 1.69 | 1.01 | 0.99 | 0.12 | 2.66 | RUN 4 | | | | | | | | |
| 5/2010 10:46 | 18.61 | 3.75 | 0.02 | 1.69 | 1.01 | 0.99 | 0.12 | 2.69 | | | | | | | | | |
| 5/2010 10:47 | 19.31 | 3.89 | 0.02 | 1.69 | 0.90 | 0.89 | 0.11 | 2.75 | | | | | | | | | |
| 5/2010 10:48 | 19.34 | 3.89 | 0.02 | 1.69 | 0.95 | 0.93 | 0.12 | 2.73 | | | | | | | | | |
| 5/2010 10:49 | 19.19 | 3.86 | 0.02 | 1.68 | 0.95 | 0.94 | 0.12 | 2.73 | | | | | | | | | |
| 5/2010 10:50 | 18.87 | 3.79 | 0.02 | 1.68 | 0.94 | 0.92 | 0.11 | 2.73 | | | | | | | | | |
| 5/2010 10:51 | 17.56 | 3.52 | 0.02 | 1.68 | 1.02 | 1.00 | 0.12 | 2.75 | | | | | | | | | |
| 5/2010 10:52 | 18.86 | 3.79 | 0.02 | 1.68 | 1.04 | 1.01 | 0.13 | 2.64 | | | | | | | | | |
| 5/2010 10:53 | 18.18 | 3.67 | 0.02 | 1.69 | 1.00 | 0.99 | 0.12 | 2.74 | | | | | | | | | |
| 5/2010 10:54 | 19.03 | 3.82 | 0.02 | 1.68 | 0.86 | 0.86 | 0.11 | 2.83 | | | | | | | | | |
| 5/2010 10:55 | 19.69 | 3.95 | 0.02 | 1.68 | 0.96 | 0.94 | 0.12 | 2.69 | | | | | | | | | |
| 5/2010 10:56 | 18.66 | 3.74 | 0.02 | 1.68 | 0.93 | 0.91 | 0.11 | 2.75 | | | | | | | | | |
| 5/2010 10:57 | 18.46 | 3.70 | 0.02 | 1.68 | 1.04 | 1.02 | 0.13 | 2.66 | | | | | | | | | |
| 5/2010 10:58 | 19.66 | 3.94 | 0.02 | 1.68 | 1.00 | 0.99 | 0.12 | 2.69 | | | | | | | | | |
| 5/2010 10:59 | 17.62 | 3.55 | 0.02 | 1.69 | 1.00 | 0.99 | 0.12 | 2.75 | | | | | | | | | |
| 5/2010 11:00 | 17.67 | 3.58 | 0.02 | 1.70 | 1.02 | 1.01 | 0.13 | 2.75 | | | | | | | | | |
| 5/2010 11:01 | 19.41 | 3.91 | 0.02 | 1.69 | 0.91 | 0.90 | 0.11 | 2.80 | | | | | | | | | |
| 5/2010 11:02 | 19.47 | 3.91 | 0.02 | 1.68 | 0.99 | 0.97 | 0.12 | 2.67 | | | | | | | | | |
| 5/2010 11:03 | 17.97 | 3.60 | 0.02 | 1.68 | 0.88 | 0.87 | 0.11 | 2.81 | | | | | | | | | |
| 5/2010 11:04 | 18.36 | 3.66 | 0.02 | 1.67 | 0.85 | 0.84 | 0.10 | 2.81 | | | | | | | | | |
| 5/2010 11:05 | 19.87 | 3.98 | 0.02 | 1.68 | 1.02 | 1.00 | 0.12 | 2.63 | | | | | | | | | |
| 5/2010 11:06 | 19.50 | 3.91 | 0.02 | 1.68 | 1.02 | 1.00 | 0.12 | 2.64 | Averages | 18.84 | 3.79 | 0.02 | 1.68 | 0.97 | 0.95 | 0.12 | 2.72 |
| 5/2010 11:07 | 18.02 | 3.62 | 0.02 | 1.68 | 1.03 | 1.01 | 0.13 | 2.66 | | | | | | | | | |
| 5/2010 11:08 | 17.99 | 3.61 | 0.02 | 1.68 | 1.01 | 0.99 | 0.12 | 2.67 | | | | | | | | | |
| 5/2010 11:09 | 19.47 | 3.93 | 0.02 | 1.69 | 1.03 | 1.01 | 0.13 | 2.61 | | | | | | | | | |
| 5/2010 11:10 | 19.40 | 3.91 | 0.02 | 1.69 | 1.10 | 1.08 | 0.13 | 2.77 | | | | | | | | | |
| 5/2010 11:11 | 19.01 | 3.81 | 0.02 | 1.68 | 1.00 | 0.98 | 0.12 | 2.76 | | | | | | | | | |
| 5/2010 11:12 | 17.87 | 3.58 | 0.02 | 1.68 | 0.96 | 0.95 | 0.12 | 2.79 | | | | | | | | | |
| 5/2010 11:13 | 19.60 | 3.94 | 0.02 | 1.69 | 0.98 | 0.96 | 0.12 | 2.71 | | | | | | | | | |
| 5/2010 11:14 | 19.37 | 3.90 | 0.02 | 1.69 | 0.99 | 0.98 | 0.12 | 2.67 | | | | | | | | | |
| 5/2010 11:15 | 18.88 | 3.80 | 0.02 | 1.69 | 0.94 | 0.92 | 0.11 | 2.76 | RUN 5 | | | | | | | | |
| 5/2010 11:16 | 18.35 | 3.70 | 0.02 | 1.69 | 0.94 | 0.93 | 0.12 | 2.78 | | | | | | | | | |
| 5/2010 11:17 | 19.70 | 3.96 | 0.02 | 1.69 | 0.99 | 0.98 | 0.12 | 2.68 | | | | | | | | | |

oiler #12 CEMS Data

| ate / Time | 15 - B12: NOx ppm - 1 Minute Avg | 24 - B12: NOx lbs/hr - 1 Minute Avg | 19 - B12: NOx lbs/MMbtu - 1 Minute Avg | 23 - B12: Stack Flow MMDSCFH - 1 Minute Avg | 16 - B12: CO ppm - 1 Minute Avg | 20 - B12: CO ppm @ 3% O2 - 1 Minute Avg | 25 - B12: CO lbs/hr - 1 Minute Avg | 17 - B12: O2 % - 1 Minute Avg | | 15 - B12: NOx ppm - 1 Minute Avg | 24 - B12: NOx lbs/hr - 1 Minute Avg | 19 - B12: NOx lbs/MMbtu - 1 Minute Avg | 23 - B12: Stack Flow MMDSCFH - 1 Minute Avg | 16 - B12: CO ppm - 1 Minute Avg | 20 - B12: CO ppm @ 3% O2 - 1 Minute Avg | 25 - B12: CO lbs/hr - 1 Minute Avg | 17 - B12: O2 - 1 Minute Av |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/2010 11:18 | 19.59 | 3.92 | 0.02 | 1.68 | 0.82 | 0.81 | 0.10 | 2.90 | | | | | | | | | |
| 5/2010 11:19 | 19.80 | 3.96 | 0.02 | 1.68 | 0.94 | 0.92 | 0.11 | 2.71 | | | | | | | | | |
| 5/2010 11:20 | 17.82 | 3.58 | 0.02 | 1.68 | 0.94 | 0.92 | 0.11 | 2.77 | | | | | | | | | |
| 5/2010 11:21 | 19.26 | 3.87 | 0.02 | 1.68 | 0.99 | 0.97 | 0.12 | 2.66 | | | | | | | | | |
| 5/2010 11:22 | 18.23 | 3.67 | 0.02 | 1.69 | 0.96 | 0.94 | 0.12 | 2.74 | | | | | | | | | |
| 5/2010 11:23 | 19.47 | 3.92 | 0.02 | 1.69 | 0.86 | 0.85 | 0.11 | 2.85 | | | | | | | | | |
| 5/2010 11:24 | 19.63 | 3.93 | 0.02 | 1.68 | 2.18 | 2.15 | 0.27 | 2.83 | | | | | | | | | |
| 5/2010 11:25 | 19.18 | 3.84 | 0.02 | 1.68 | 1.07 | 1.05 | 0.13 | 2.71 | | | | | | | | | |
| 5/2010 11:26 | 19.52 | 3.91 | 0.02 | 1.68 | 0.93 | 0.92 | 0.11 | 2.74 | | | | | | | | | |
| 5/2010 11:27 | 18.80 | 3.76 | 0.02 | 1.68 | 0.92 | 0.91 | 0.11 | 2.75 | | | | | | | | | |
| 5/2010 11:28 | 18.58 | 3.71 | 0.02 | 1.67 | 0.97 | 0.96 | 0.12 | 2.73 | | | | | | | | | |
| 5/2010 11:29 | 19.21 | 3.84 | 0.02 | 1.68 | 0.93 | 0.92 | 0.11 | 2.73 | | | | | | | | | |
| 5/2010 11:30 | 18.33 | 3.70 | 0.02 | 1.69 | 0.94 | 0.93 | 0.12 | 2.79 | | | | | | | | | |
| 5/2010 11:31 | 18.72 | 3.77 | 0.02 | 1.69 | 0.89 | 0.88 | 0.11 | 2.81 | | | | | | | | | |
| 5/2010 11:32 | 19.65 | 3.97 | 0.02 | 1.69 | 0.97 | 0.95 | 0.12 | 2.72 | | | | | | | | | |
| 5/2010 11:33 | 19.25 | 3.88 | 0.02 | 1.69 | 0.88 | 0.88 | 0.11 | 2.84 | | | | | | | | | |
| 5/2010 11:34 | 18.91 | 3.81 | 0.02 | 1.69 | 0.94 | 0.93 | 0.12 | 2.77 | | | | | | | | | |
| 5/2010 11:35 | 17.65 | 3.54 | 0.02 | 1.68 | 1.06 | 1.05 | 0.13 | 2.73 | | | | | | | | | |
| 5/2010 11:36 | 18.31 | 3.66 | 0.02 | 1.68 | 0.94 | 0.93 | 0.11 | 2.71 | Averages | 18.95 | 3.80 | 0.02 | 1.68 | 1.00 | 0.99 | 0.12 | 2.76 |
| 5/2010 11:37 | 19.67 | 3.94 | 0.02 | 1.68 | 1.00 | 0.98 | 0.12 | 2.61 | | | | | | | | | |
| 5/2010 11:38 | 19.05 | 3.82 | 0.02 | 1.68 | 0.98 | 0.96 | 0.12 | 2.65 | | | | | | | | | |
| 5/2010 11:39 | 18.13 | 3.65 | 0.02 | 1.69 | 0.89 | 0.88 | 0.11 | 2.79 | | | | | | | | | |
| 5/2010 11:40 | 19.44 | 3.89 | 0.02 | 1.68 | 0.96 | 0.95 | 0.12 | 2.70 | | | | | | | | | |
| 5/2010 11:41 | 18.42 | 3.69 | 0.02 | 1.68 | 0.90 | 0.89 | 0.11 | 2.82 | | | | | | | | | |
| 5/2010 11:42 | 18.78 | 3.76 | 0.02 | 1.68 | 1.02 | 1.00 | 0.12 | 2.67 | | | | | | | | | |
| 5/2010 11:43 | 19.33 | 3.88 | 0.02 | 1.68 | 0.99 | 0.97 | 0.12 | 2.65 | | | | | | | | | |
| 5/2010 11:44 | 18.80 | 3.78 | 0.02 | 1.68 | 0.96 | 0.94 | 0.12 | 2.72 | | | | | | | | | |
| 5/2010 11:45 | 18.18 | 3.65 | 0.02 | 1.68 | 0.99 | 0.98 | 0.12 | 2.69 | RUN 6 | | | | | | | | |
| 5/2010 11:46 | 18.67 | 3.76 | 0.02 | 1.69 | 0.96 | 0.95 | 0.12 | 2.74 | | | | | | | | | |
| 5/2010 11:47 | 17.55 | 3.53 | 0.02 | 1.68 | 0.89 | 0.89 | 0.11 | 2.92 | | | | | | | | | |
| 5/2010 11:48 | 19.28 | 3.88 | 0.02 | 1.68 | 0.87 | 0.86 | 0.11 | 2.79 | | | | | | | | | |
| 5/2010 11:49 | 17.44 | 3.50 | 0.02 | 1.68 | 1.11 | 1.09 | 0.14 | 2.73 | | | | | | | | | |
| 5/2010 11:50 | 19.13 | 3.82 | 0.02 | 1.67 | 1.12 | 1.10 | 0.14 | 2.53 | | | | | | | | | |
| 5/2010 11:51 | 19.45 | 3.90 | 0.02 | 1.68 | 1.01 | 0.99 | 0.12 | 2.62 | | | | | | | | | |
| 5/2010 11:52 | 18.69 | 3.77 | 0.02 | 1.69 | 1.00 | 0.98 | 0.12 | 2.69 | | | | | | | | | |
| 5/2010 11:53 | 18.07 | 3.64 | 0.02 | 1.69 | 1.22 | 1.20 | 0.15 | 2.65 | | | | | | | | | |
| 5/2010 11:54 | 18.82 | 3.78 | 0.02 | 1.68 | 0.83 | 0.83 | 0.10 | 2.85 | | | | | | | | | |
| 5/2010 11:55 | 19.48 | 3.91 | 0.02 | 1.68 | 1.00 | 0.98 | 0.12 | 2.65 | | | | | | | | | |
| 5/2010 11:56 | 18.85 | 3.78 | 0.02 | 1.68 | 0.96 | 0.94 | 0.12 | 2.69 | | | | | | | | | |
| 5/2010 11:57 | 17.98 | 3.62 | 0.02 | 1.69 | 0.92 | 0.90 | 0.11 | 2.77 | | | | | | | | | |
| 5/2010 11:58 | 18.48 | 3.71 | 0.02 | 1.68 | 0.98 | 0.97 | 0.12 | 2.71 | | | | | | | | | |
| 5/2010 11:59 | 18.48 | 3.69 | 0.02 | 1.67 | 0.86 | 0.86 | 0.11 | 2.88 | | | | | | | | | |
| 5/2010 12:00 | 17.62 | 3.52 | 0.02 | 1.67 | 0.87 | 0.86 | 0.11 | 2.83 | | | | | | | | | |
| 5/2010 12:01 | 19.69 | 3.93 | 0.02 | 1.67 | 1.13 | 1.10 | 0.14 | 2.49 | | | | | | | | | |
| 5/2010 12:02 | 18.72 | 3.77 | 0.02 | 1.69 | 0.97 | 0.96 | 0.12 | 2.70 | | | | | | | | | |
| 5/2010 12:03 | 17.32 | 3.50 | 0.02 | 1.69 | 0.93 | 0.92 | 0.11 | 2.85 | | | | | | | | | |
| 5/2010 12:04 | 17.83 | 3.61 | 0.02 | 1.69 | 0.95 | 0.94 | 0.12 | 2.77 | | | | | | | | | |
| 5/2010 12:05 | 19.52 | 3.93 | 0.02 | 1.69 | 0.88 | 0.87 | 0.11 | 2.84 | | | | | | | | | |
| 5/2010 12:06 | 19.82 | 3.97 | 0.02 | 1.68 | 0.88 | 0.87 | 0.11 | 2.80 | Averages | 18.59 | 3.74 | 0.02 | 1.68 | 0.97 | 0.96 | 0.12 | 2.74 |
| 5/2010 12:07 | 19.82 | 3.95 | 0.02 | 1.67 | 0.99 | 0.97 | 0.12 | 2.65 | | | | | | | | | |
| 5/2010 12:08 | 19.36 | 3.85 | 0.02 | 1.67 | 0.92 | 0.91 | 0.11 | 2.71 | | | | | | | | | |
| 5/2010 12:09 | 18.93 | 3.79 | 0.02 | 1.68 | 0.92 | 0.90 | 0.11 | 2.75 | | | | | | | | | |
| 5/2010 12:10 | 17.70 | 3.55 | 0.02 | 1.68 | 1.13 | 1.11 | 0.14 | 2.64 | | | | | | | | | |
| 5/2010 12:11 | 19.20 | 3.85 | 0.02 | 1.68 | 0.96 | 0.95 | 0.12 | 2.72 | | | | | | | | | |
| 5/2010 12:12 | 19.16 | 3.85 | 0.02 | 1.68 | 0.95 | 0.94 | 0.12 | 2.69 | | | | | | | | | |
| 5/2010 12:13 | 18.67 | 3.74 | 0.02 | 1.68 | 1.04 | 1.02 | 0.13 | 2.65 | | | | | | | | | |
| 5/2010 12:14 | 19.26 | 3.86 | 0.02 | 1.68 | 0.99 | 0.97 | 0.12 | 2.67 | | | | | | | | | |
| 5/2010 12:15 | 18.99 | 3.83 | 0.02 | 1.69 | 0.91 | 0.90 | 0.11 | 2.79 | RUN 7 | | | | | | | | |
| 5/2010 12:16 | 17.96 | 3.63 | 0.02 | 1.69 | 1.04 | 1.02 | 0.13 | 2.69 | | | | | | | | | |
| 5/2010 12:17 | 19.03 | 3.84 | 0.02 | 1.69 | 1.00 | 0.99 | 0.12 | 2.70 | | | | | | | | | |
| 5/2010 12:18 | 18.40 | 3.70 | 0.02 | 1.68 | 0.93 | 0.92 | 0.11 | 2.76 | | | | | | | | | |
| 5/2010 12:19 | 17.42 | 3.51 | 0.02 | 1.69 | 0.91 | 0.90 | 0.11 | 2.85 | | | | | | | | | |
| 5/2010 12:20 | 18.03 | 3.62 | 0.02 | 1.68 | 0.89 | 0.88 | 0.11 | 2.79 | | | | | | | | | |
| 5/2010 12:21 | 19.76 | 3.97 | 0.02 | 1.68 | 1.07 | 1.05 | 0.13 | 2.59 | | | | | | | | | |

## Boiler #12 CEMS Data

| Date / Time | 15 - B12: NOx ppm - 1 Minute Avg | 24 - B12: NOx lbs/hr - 1 Minute Avg | 19 - B12: NOx lbs/MMbtu - 1 Minute Avg | 23 - B12: Stack Flow MMDSCFH - 1 Minute Avg | 16 - B12: CO ppm - 1 Minute Avg | 20 - B12: CO ppm @ 3% O2 - 1 Minute Avg | 25 - B12: CO lbs/hr - 1 Minute Avg | 17 - B12: O2 % - 1 Minute Avg | | 15 - B12: NOx ppm - 1 Minute Avg | 24 - B12: NOx lbs/hr - 1 Minute Avg | 19 - B12: NOx lbs/MMbtu - 1 Minute Avg | 23 - B12: Stack Flow MMDSCFH - 1 Minute Avg | 16 - B12: CO ppm - 1 Minute Avg | 20 - B12: CO ppm @ 3% O2 - 1 Minute Avg | 25 - B12: CO lbs/hr - 1 Minute Avg | 17 - B12: O2 - 1 Minute A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| /5/2010 12:22 | 19.49 | 3.94 | 0.02 | 1.69 | 0.99 | 0.98 | 0.12 | 2.66 | | | | | | | | | |
| /5/2010 12:23 | 19.24 | 3.87 | 0.02 | 1.68 | 0.92 | 0.91 | 0.11 | 2.74 | | | | | | | | | |
| /5/2010 12:24 | 18.80 | 3.78 | 0.02 | 1.69 | 0.81 | 0.80 | 0.10 | 2.92 | | | | | | | | | |
| /5/2010 12:25 | 18.43 | 3.71 | 0.02 | 1.69 | 0.91 | 0.89 | 0.11 | 2.78 | | | | | | | | | |
| /5/2010 12:26 | 18.55 | 3.72 | 0.02 | 1.68 | 0.90 | 0.89 | 0.11 | 2.80 | | | | | | | | | |
| /5/2010 12:27 | 18.98 | 3.80 | 0.02 | 1.68 | 0.99 | 0.97 | 0.12 | 2.66 | | | | | | | | | |
| /5/2010 12:28 | 17.32 | 3.49 | 0.02 | 1.69 | 0.99 | 0.97 | 0.12 | 2.74 | | | | | | | | | |
| /5/2010 12:29 | 18.53 | 3.73 | 0.02 | 1.68 | 1.02 | 1.00 | 0.12 | 2.69 | | | | | | | | | |
| /5/2010 12:30 | 19.63 | 3.95 | 0.02 | 1.69 | 1.05 | 1.03 | 0.13 | 2.60 | | | | | | | | | |
| /5/2010 12:31 | 19.52 | 3.91 | 0.02 | 1.68 | 0.93 | 0.91 | 0.11 | 2.72 | | | | | | | | | |
| /5/2010 12:32 | 17.93 | 3.60 | 0.02 | 1.68 | 0.87 | 0.86 | 0.11 | 2.82 | | | | | | | | | |
| /5/2010 12:33 | 19.13 | 3.84 | 0.02 | 1.68 | 1.01 | 0.99 | 0.12 | 2.65 | | | | | | | | | |
| /5/2010 12:34 | 18.20 | 3.65 | 0.02 | 1.68 | 1.00 | 0.99 | 0.12 | 2.72 | | | | | | | | | |
| /5/2010 12:35 | 19.27 | 3.88 | 0.02 | 1.69 | 1.02 | 1.00 | 0.12 | 2.63 | | | | | | | | | |
| /5/2010 12:36 | 19.24 | 3.88 | 0.02 | 1.69 | 1.01 | 0.99 | 0.12 | 2.63 | Averages | 18.72 | 3.77 | 0.02 | 1.68 | 0.96 | 0.95 | 0.12 | 2.72 |
| /5/2010 12:37 | 18.99 | 3.80 | 0.02 | 1.68 | 0.81 | 0.81 | 0.10 | 2.90 | | | | | | | | | |
| /5/2010 12:38 | 17.94 | 3.58 | 0.02 | 1.67 | 0.97 | 0.95 | 0.12 | 2.68 | | | | | | | | | |
| /5/2010 12:39 | 18.93 | 3.81 | 0.02 | 1.68 | 0.96 | 0.94 | 0.12 | 2.69 | | | | | | | | | |
| /5/2010 12:40 | 17.05 | 3.46 | 0.02 | 1.70 | 0.92 | 0.91 | 0.11 | 2.83 | | | | | | | | | |
| /5/2010 12:41 | 17.94 | 3.65 | 0.02 | 1.71 | 1.12 | 1.10 | 0.14 | 2.71 | | | | | | | | | |
| /5/2010 12:42 | 19.31 | 3.83 | 0.02 | 1.66 | 0.73 | 0.73 | 0.09 | 3.06 | | | | | | | | | |
| /5/2010 12:43 | 19.37 | 3.83 | 0.02 | 1.66 | 0.97 | 0.96 | 0.12 | 2.65 | | | | | | | | | |
| /5/2010 12:44 | 17.60 | 3.52 | 0.02 | 1.67 | 0.97 | 0.96 | 0.12 | 2.70 | | | | | | | | | |
| /5/2010 12:45 | 17.38 | 3.50 | 0.02 | 1.69 | 1.06 | 1.04 | 0.13 | 2.68 | RUN 8 | | | | | | | | |
| /5/2010 12:46 | 19.07 | 3.87 | 0.02 | 1.70 | 0.96 | 0.95 | 0.12 | 2.72 | | | | | | | | | |
| /5/2010 12:47 | 19.35 | 3.92 | 0.02 | 1.70 | 0.87 | 0.87 | 0.11 | 2.84 | | | | | | | | | |
| /5/2010 12:48 | 19.26 | 3.88 | 0.02 | 1.69 | 0.98 | 0.96 | 0.12 | 2.68 | | | | | | | | | |
| /5/2010 12:49 | 19.03 | 3.86 | 0.02 | 1.70 | 0.90 | 0.89 | 0.11 | 2.78 | | | | | | | | | |
| /5/2010 12:50 | 17.15 | 3.50 | 0.02 | 1.71 | 0.83 | 0.82 | 0.10 | 2.94 | | | | | | | | | |
| /5/2010 12:51 | 16.95 | 3.45 | 0.02 | 1.70 | 0.97 | 0.96 | 0.12 | 2.90 | | | | | | | | | |
| /5/2010 12:52 | 18.55 | 3.67 | 0.02 | 1.66 | 0.59 | 0.60 | 0.07 | 3.28 | | | | | | | | | |
| 5/5/2010 12:53 | 19.19 | 3.83 | 0.02 | 1.67 | 0.91 | 0.90 | 0.11 | 2.70 | | | | | | | | | |
| 5/5/2010 12:54 | 19.03 | 3.82 | 0.02 | 1.68 | 1.00 | 0.98 | 0.12 | 2.63 | | | | | | | | | |
| 5/5/2010 12:55 | 19.18 | 3.89 | 0.02 | 1.70 | 0.98 | 0.97 | 0.12 | 2.73 | | | | | | | | | |
| 5/5/2010 12:56 | 19.26 | 3.91 | 0.02 | 1.70 | 0.95 | 0.93 | 0.12 | 2.74 | | | | | | | | | |
| 5/5/2010 12:57 | 18.01 | 3.63 | 0.02 | 1.69 | 1.15 | 1.13 | 0.14 | 2.77 | | | | | | | | | |
| 5/5/2010 12:58 | 17.77 | 3.53 | 0.02 | 1.66 | 0.62 | 0.63 | 0.08 | 3.20 | | | | | | | | | |
| 5/5/2010 12:59 | 19.40 | 3.82 | 0.02 | 1.65 | 1.02 | 1.00 | 0.12 | 2.58 | | | | | | | | | |
| 5/5/2010 13:00 | 17.66 | 3.57 | 0.02 | 1.69 | 0.87 | 0.86 | 0.11 | 2.86 | | | | | | | | | |
| 5/5/2010 13:01 | 16.92 | 3.45 | 0.02 | 1.71 | 0.96 | 0.95 | 0.12 | 2.82 | | | | | | | | | |
| 5/5/2010 13:02 | 19.52 | 3.99 | 0.02 | 1.71 | 0.97 | 0.96 | 0.12 | 2.75 | | | | | | | | | |
| 5/5/2010 13:03 | 19.72 | 3.93 | 0.02 | 1.67 | 0.82 | 0.82 | 0.10 | 2.93 | | | | | | | | | |
| 5/5/2010 13:04 | 19.97 | 3.93 | 0.02 | 1.65 | 0.84 | 0.83 | 0.10 | 2.81 | | | | | | | | | |
| 5/5/2010 13:05 | 18.89 | 3.80 | 0.02 | 1.68 | 0.90 | 0.89 | 0.11 | 2.73 | | | | | | | | | |
| 5/5/2010 13:06 | 18.97 | 3.86 | 0.02 | 1.70 | 0.97 | 0.95 | 0.12 | 2.68 | Averages | 18.65 | 3.76 | 0.02 | 1.69 | 0.91 | 0.90 | 0.11 | 2.81 |
| 5/5/2010 13:07 | 18.02 | 3.68 | 0.02 | 1.71 | 0.85 | 0.84 | 0.11 | 2.90 | | | | | | | | | |
| 5/5/2010 13:08 | 17.73 | 3.57 | 0.02 | 1.69 | 0.81 | 0.81 | 0.10 | 2.97 | | | | | | | | | |
| 5/5/2010 13:09 | 19.58 | 3.88 | 0.02 | 1.66 | 0.92 | 0.91 | 0.11 | 2.83 | | | | | | | | | |
| 5/5/2010 13:10 | 19.27 | 3.85 | 0.02 | 1.67 | 0.90 | 0.89 | 0.11 | 2.76 | | | | | | | | | |
| 5/5/2010 13:11 | 17.92 | 3.63 | 0.02 | 1.69 | 1.00 | 0.99 | 0.12 | 2.76 | | | | | | | | | |
| 5/5/2010 13:12 | 17.88 | 3.61 | 0.02 | 1.69 | 0.98 | 0.96 | 0.12 | 2.78 | | | | | | | | | |
| 5/5/2010 13:13 | 19.67 | 3.96 | 0.02 | 1.69 | 0.86 | 0.86 | 0.11 | 2.86 | | | | | | | | | |
| 5/5/2010 13:14 | 19.37 | 3.89 | 0.02 | 1.68 | 1.00 | 0.98 | 0.12 | 2.67 | | | | | | | | | |
| 5/5/2010 13:15 | 19.22 | 3.85 | 0.02 | 1.68 | 1.05 | 1.02 | 0.13 | 2.63 | RUN 9 | | | | | | | | |
| 5/5/2010 13:16 | 18.25 | 3.66 | 0.02 | 1.68 | 0.95 | 0.94 | 0.12 | 2.76 | | | | | | | | | |
| 5/5/2010 13:17 | 17.17 | 3.44 | 0.02 | 1.68 | 1.11 | 1.09 | 0.14 | 2.69 | | | | | | | | | |
| 5/5/2010 13:18 | 18.15 | 3.65 | 0.02 | 1.68 | 1.08 | 1.06 | 0.13 | 2.70 | | | | | | | | | |
| 5/5/2010 13:19 | 19.32 | 3.88 | 0.02 | 1.68 | 1.01 | 0.99 | 0.12 | 2.65 | | | | | | | | | |
| 5/5/2010 13:20 | 19.19 | 3.86 | 0.02 | 1.69 | 0.99 | 0.98 | 0.12 | 2.68 | | | | | | | | | |
| 5/5/2010 13:21 | 19.22 | 3.86 | 0.02 | 1.68 | 0.94 | 0.92 | 0.11 | 2.71 | | | | | | | | | |
| 5/5/2010 13:22 | 19.19 | 3.87 | 0.02 | 1.69 | 0.99 | 0.97 | 0.12 | 2.68 | | | | | | | | | |
| 5/5/2010 13:23 | 18.86 | 3.79 | 0.02 | 1.68 | 1.02 | 1.00 | 0.12 | 2.68 | | | | | | | | | |
| 5/5/2010 13:24 | 17.37 | 3.48 | 0.02 | 1.68 | 0.84 | 0.84 | 0.10 | 2.88 | | | | | | | | | |
| 5/5/2010 13:25 | 18.00 | 3.58 | 0.02 | 1.66 | 0.91 | 0.90 | 0.11 | 2.80 | | | | | | | | | |

oiler #12 CEMS Data

| ıte / Time | 15 - B12: NOx ppm - 1 Minute Avg | 24 - B12: NOx lbs/hr - 1 Minute Avg | 19 - B12: NOx lbs/MMbtu - 1 Minute Avg | 23 - B12: Stack Flow MMDSCFH - 1 Minute Avg | 16 - B12: CO ppm - 1 Minute Avg | 20 - B12: CO ppm @ 3% O2 - 1 Minute Avg | 25 - B12: CO lbs/hr - 1 Minute Avg | 17 - B12: O2 % - 1 Minute Avg |
|---|---|---|---|---|---|---|---|---|
| 5/2010 13:26 | 19.60 | 3.90 | 0.02 | 1.67 | 1.06 | 1.03 | 0.13 | 2.59 |
| 5/2010 13:27 | 19.04 | 3.80 | 0.02 | 1.67 | 1.08 | 1.05 | 0.13 | 2.59 |
| 5/2010 13:28 | 19.02 | 3.78 | 0.02 | 1.66 | 1.03 | 1.01 | 0.12 | 2.64 |
| 5/2010 13:29 | 17.29 | 3.44 | 0.02 | 1.67 | 0.91 | 0.90 | 0.11 | 2.80 |
| 5/2010 13:30 | 18.82 | 3.76 | 0.02 | 1.67 | 1.02 | 1.00 | 0.12 | 2.66 |
| 5/2010 13:31 | 19.71 | 3.95 | 0.02 | 1.68 | 1.00 | 0.99 | 0.12 | 2.67 |
| 5/2010 13:32 | 19.54 | 3.90 | 0.02 | 1.67 | 0.95 | 0.94 | 0.12 | 2.73 |
| 5/2010 13:33 | 19.46 | 3.86 | 0.02 | 1.66 | 0.85 | 0.84 | 0.10 | 2.83 |
| 5/2010 13:34 | 17.88 | 3.53 | 0.02 | 1.65 | 1.00 | 0.99 | 0.12 | 2.70 |
| 5/2010 13:35 | 19.01 | 3.75 | 0.02 | 1.65 | 1.06 | 1.03 | 0.13 | 2.56 |
| 5/2010 13:36 | 18.42 | 3.67 | 0.02 | 1.67 | 1.02 | 1.00 | 0.12 | 2.64 |
| 5/2010 13:37 | 17.91 | 3.58 | 0.02 | 1.67 | 1.08 | 1.06 | 0.13 | 2.65 |
| 5/2010 13:38 | 19.24 | 3.83 | 0.02 | 1.67 | 1.03 | 1.01 | 0.12 | 2.63 |
| 5/2010 13:39 | 18.71 | 3.72 | 0.02 | 1.67 | 0.80 | 0.80 | 0.10 | 2.91 |
| 5/2010 13:40 | 17.31 | 3.45 | 0.02 | 1.67 | 0.85 | 0.84 | 0.10 | 2.88 |
| 5/2010 13:41 | 18.97 | 3.78 | 0.02 | 1.67 | 1.03 | 1.01 | 0.12 | 2.67 |
| 5/2010 13:42 | 19.28 | 3.83 | 0.02 | 1.67 | 0.99 | 0.97 | 0.12 | 2.67 |
| 5/2010 13:43 | 18.14 | 3.61 | 0.02 | 1.67 | 1.03 | 1.01 | 0.12 | 2.64 |
| 5/2010 13:44 | 18.92 | 3.77 | 0.02 | 1.67 | 1.03 | 1.01 | 0.13 | 2.62 |
| 5/2010 13:45 | 17.67 | 3.51 | 0.02 | 1.67 | 0.89 | 0.88 | 0.11 | 2.81 |

| | 15 - B12: NOx ppm - 1 Minute Avg | 24 - B12: NOx lbs/hr - 1 Minute Avg | 19 - B12: NOx lbs/MMbtu - 1 Minute Avg | 23 - B12: Stack Flow MMDSCFH - 1 Minute Avg | 16 - B12: CO ppm - 1 Minute Avg | 20 - B12: CO ppm @ 3% O2 - 1 Minute Avg | 25 - B12: CO lbs/hr - 1 Minute Avg | 17 - B12: O2 - 1 Minute Av |
|---|---|---|---|---|---|---|---|---|
| Averages | 18.72 | 3.74 | 0.02 | 1.67 | 0.99 | 0.98 | 0.12 | 2.69 |

## Boiler #11 CEMS Data

| Date / Time | B11: NOx ppm - 1 Minute Avg | B11: CO ppm - 1 Minute Avg | B11: O2 % - 1 Minute Avg | | B11: NOx ppm - 1 Minute Avg | B11: CO ppm - 1 Minute Avg | B11: O2 % - 1 Minute Avg |
|---|---|---|---|---|---|---|---|
| 5/6/2010 7:55 | 20.53 | 0.78 | 2.96 | | | | |
| 5/6/2010 7:56 | 20.32 | 0.79 | 2.90 | | | | |
| 5/6/2010 7:57 | 20.31 | 0.69 | 2.94 | | | | |
| 5/6/2010 7:58 | 20.30 | 0.81 | 2.86 | | | | |
| 5/6/2010 7:59 | 20.14 | 0.78 | 2.93 | | | | |
| 5/6/2010 8:00 | 20.07 | 0.91 | 2.91 | RUN 1 | | | |
| 5/6/2010 8:01 | 20.19 | 0.82 | 2.95 | | | | |
| 5/6/2010 8:02 | 20.13 | 0.77 | 2.92 | | | | |
| 5/6/2010 8:03 | 20.07 | 0.77 | 2.93 | | | | |
| 5/6/2010 8:04 | 19.99 | 0.83 | 2.92 | | | | |
| 5/6/2010 8:05 | 19.90 | 0.78 | 2.97 | | | | |
| 5/6/2010 8:06 | 19.93 | 0.88 | 2.95 | | | | |
| 5/6/2010 8:07 | 19.90 | 0.93 | 2.84 | | | | |
| 5/6/2010 8:08 | 20.00 | 0.84 | 2.87 | | | | |
| 5/6/2010 8:09 | 19.87 | 1.19 | 2.88 | | | | |
| 5/6/2010 8:10 | 19.71 | 0.96 | 2.85 | | | | |
| 5/6/2010 8:11 | 19.85 | 0.83 | 2.96 | | | | |
| 5/6/2010 8:12 | 19.71 | 1.06 | 2.97 | | | | |
| 5/6/2010 8:13 | 19.71 | 0.99 | 2.95 | | | | |
| 5/6/2010 8:14 | 19.55 | 1.05 | 2.91 | | | | |
| 5/6/2010 8:15 | 19.80 | 1.07 | 2.96 | | | | |
| 5/6/2010 8:16 | 19.93 | 1.16 | 2.94 | | | | |
| 5/6/2010 8:17 | 19.84 | 1.10 | 2.89 | | | | |
| 5/6/2010 8:18 | 19.82 | 1.19 | 2.89 | | | | |
| 5/6/2010 8:19 | 19.73 | 1.03 | 2.89 | | | | |
| 5/6/2010 8:20 | 19.37 | 1.04 | 2.89 | | | | |
| 5/6/2010 8:21 | 19.52 | 1.28 | 2.86 | Averages | 19.85 | 0.98 | 2.91 |
| 5/6/2010 8:22 | 19.50 | 1.15 | 2.86 | | | | |
| 5/6/2010 8:23 | 19.40 | 1.21 | 2.87 | | | | |
| 5/6/2010 8:24 | 19.51 | 1.13 | 2.87 | | | | |
| 5/6/2010 8:25 | 19.53 | 1.19 | 2.88 | | | | |
| 5/6/2010 8:26 | 19.56 | 1.34 | 2.89 | | | | |
| 5/6/2010 8:27 | 19.49 | 1.32 | 2.82 | | | | |
| 5/6/2010 8:28 | 19.77 | 1.28 | 2.82 | | | | |
| 5/6/2010 8:29 | 19.81 | 1.29 | 2.78 | | | | |
| 5/6/2010 8:30 | 20.04 | 1.20 | 2.81 | RUN 2 | | | |
| 5/6/2010 8:31 | 20.07 | 1.09 | 2.74 | | | | |
| 5/6/2010 8:32 | 19.86 | 0.90 | 2.83 | | | | |
| 5/6/2010 8:33 | 19.85 | 1.07 | 2.79 | | | | |
| 5/6/2010 8:34 | 19.66 | 1.07 | 2.84 | | | | |
| 5/6/2010 8:35 | 19.97 | 0.82 | 2.91 | | | | |
| 5/6/2010 8:36 | 20.26 | 0.72 | 2.93 | | | | |
| 5/6/2010 8:37 | 20.30 | 0.73 | 2.81 | | | | |
| 5/6/2010 8:38 | 19.98 | 0.67 | 2.83 | | | | |
| 5/6/2010 8:39 | 20.11 | 1.00 | 2.72 | | | | |
| 5/6/2010 8:40 | 19.97 | 0.82 | 2.91 | | | | |
| 5/6/2010 8:41 | 20.10 | 0.88 | 2.86 | | | | |
| 5/6/2010 8:42 | 20.04 | 0.79 | 2.87 | | | | |
| 5/6/2010 8:43 | 19.98 | 0.89 | 2.79 | | | | |
| 5/6/2010 8:44 | 20.33 | 0.92 | 2.89 | | | | |
| 5/6/2010 8:45 | 20.34 | 1.01 | 2.70 | | | | |
| 5/6/2010 8:46 | 19.87 | 0.84 | 2.76 | | | | |
| 5/6/2010 8:47 | 19.70 | 0.87 | 2.79 | | | | |
| 5/6/2010 8:48 | 19.96 | 0.94 | 2.75 | | | | |
| 5/6/2010 8:49 | 19.98 | 1.08 | 2.78 | | | | |
| 5/6/2010 8:50 | 19.79 | 1.00 | 2.81 | | | | |
| 5/6/2010 8:51 | 19.93 | 0.92 | 2.81 | Averages | 20.00 | 0.92 | 2.82 |
| 5/6/2010 8:52 | 19.88 | 0.96 | 2.88 | | | | |
| 5/6/2010 8:53 | 19.87 | 0.94 | 2.83 | | | | |
| 5/6/2010 8:54 | 20.00 | 1.13 | 2.80 | | | | |
| 5/6/2010 8:55 | 19.88 | 0.94 | 2.86 | | | | |
| 5/6/2010 8:56 | 20.07 | 1.10 | 2.77 | | | | |
| 5/6/2010 8:57 | 19.97 | 1.05 | 2.79 | | | | |
| 5/6/2010 8:58 | 20.10 | 1.10 | 2.74 | | | | |
| 5/6/2010 8:59 | 20.16 | 1.18 | 2.73 | | | | |
| 5/6/2010 9:00 | 20.30 | 1.45 | 2.73 | RUN 3 | | | |
| 5/6/2010 9:01 | 20.04 | 1.12 | 2.77 | | | | |
| 5/6/2010 9:02 | 19.88 | 1.14 | 2.72 | | | | |
| 5/6/2010 9:03 | 19.86 | 1.06 | 2.79 | | | | |
| 5/6/2010 9:04 | 19.99 | 1.09 | 2.78 | | | | |

## Boiler #11 CEMS Data

| Date / Time | B11: NOx ppm - 1 Minute Avg | B11: CO ppm - 1 Minute Avg | B11: O2 % - 1 Minute Avg | | B11: NOx ppm - 1 Minute Avg | B11: CO ppm - 1 Minute Avg | B11: O2 % - 1 Minute Avg |
|---|---|---|---|---|---|---|---|
| 5/6/2010 9:05 | 19.77 | 1.11 | 2.81 | | | | |
| 5/6/2010 9:06 | 19.89 | 1.06 | 2.84 | | | | |
| 5/6/2010 9:07 | 19.88 | 1.19 | 2.78 | | | | |
| 5/6/2010 9:08 | 20.00 | 1.12 | 2.73 | | | | |
| 5/6/2010 9:09 | 19.90 | 1.18 | 2.69 | | | | |
| 5/6/2010 9:10 | 19.89 | 1.77 | 2.65 | | | | |
| 5/6/2010 9:11 | 20.13 | 2.48 | 2.63 | | | | |
| 5/6/2010 9:12 | 19.89 | 1.36 | 2.69 | | | | |
| 5/6/2010 9:13 | 19.90 | 1.61 | 2.71 | | | | |
| 5/6/2010 9:14 | 19.96 | 1.32 | 2.65 | | | | |
| 5/6/2010 9:15 | 19.83 | 1.09 | 2.70 | | | | |
| 5/6/2010 9:16 | 19.91 | 1.08 | 2.69 | | | | |
| 5/6/2010 9:17 | 19.96 | 1.15 | 2.73 | | | | |
| 5/6/2010 9:18 | 19.86 | 1.22 | 2.79 | | | | |
| 5/6/2010 9:19 | 19.95 | 0.97 | 2.84 | | | | |
| 5/6/2010 9:20 | 20.10 | 1.04 | 2.73 | | | | |
| 5/6/2010 9:21 | 19.87 | 0.90 | 2.83 | **Averages** | **19.94** | **1.25** | **2.74** |
| 5/6/2010 9:22 | 19.89 | 0.87 | 2.86 | | | | |
| 5/6/2010 9:23 | 20.11 | 0.85 | 2.86 | | | | |
| 5/6/2010 9:24 | 20.04 | 0.91 | 2.75 | | | | |
| 5/6/2010 9:25 | 20.23 | 1.00 | 2.65 | | | | |
| 5/6/2010 9:26 | 20.22 | 0.89 | 2.76 | | | | |
| 5/6/2010 9:27 | 20.20 | 0.84 | 2.77 | | | | |
| 5/6/2010 9:28 | 20.11 | 1.35 | 2.68 | | | | |
| 5/6/2010 9:29 | 19.93 | 1.11 | 2.69 | | | | |
| 5/6/2010 9:30 | 19.91 | 1.15 | 2.68 | **RUN 4** | | | |
| 5/6/2010 9:31 | 19.98 | 1.06 | 2.65 | | | | |
| 5/6/2010 9:32 | 20.32 | 1.31 | 2.73 | | | | |
| 5/6/2010 9:33 | 20.19 | 1.45 | 2.68 | | | | |
| 5/6/2010 9:34 | 20.22 | 1.13 | 2.74 | | | | |
| 5/6/2010 9:35 | 20.19 | 1.45 | 2.68 | | | | |
| 5/6/2010 9:36 | 20.21 | 1.27 | 2.77 | | | | |
| 5/6/2010 9:37 | 19.96 | 1.35 | 2.73 | | | | |
| 5/6/2010 9:38 | 19.96 | 1.13 | 2.82 | | | | |
| 5/6/2010 9:39 | 19.87 | 1.11 | 2.80 | | | | |
| 5/6/2010 9:40 | 19.95 | 1.05 | 2.74 | | | | |
| 5/6/2010 9:41 | 20.10 | 1.65 | 2.71 | | | | |
| 5/6/2010 9:42 | 20.38 | 1.64 | 2.65 | | | | |
| 5/6/2010 9:43 | 20.00 | 1.05 | 2.77 | | | | |
| 5/6/2010 9:44 | 19.84 | 1.00 | 2.84 | | | | |
| 5/6/2010 9:45 | 19.88 | 1.17 | 2.71 | | | | |
| 5/6/2010 9:46 | 19.92 | 1.08 | 2.73 | | | | |
| 5/6/2010 9:47 | 19.86 | 1.12 | 2.72 | | | | |
| 5/6/2010 9:48 | 20.09 | 1.22 | 2.72 | | | | |
| 5/6/2010 9:49 | 20.01 | 1.20 | 2.61 | | | | |
| 5/6/2010 9:50 | 19.85 | 1.07 | 2.77 | | | | |
| 5/6/2010 9:51 | 20.15 | 1.13 | 2.80 | **Averages** | **20.04** | **1.22** | **2.73** |
| 5/6/2010 9:52 | 20.20 | 1.08 | 2.84 | | | | |
| 5/6/2010 9:53 | 20.28 | 1.07 | 2.82 | | | | |
| 5/6/2010 9:54 | 20.26 | 1.21 | 2.76 | | | | |
| 5/6/2010 9:55 | 19.91 | 1.14 | 2.79 | | | | |
| 5/6/2010 9:56 | 20.00 | 1.08 | 2.81 | | | | |
| 5/6/2010 9:57 | 20.21 | 1.12 | 2.76 | | | | |
| 5/6/2010 9:58 | 20.05 | 1.13 | 2.78 | | | | |
| 5/6/2010 9:59 | 20.12 | 1.23 | 2.72 | | | | |
| 5/6/2010 10:00 | 19.95 | 1.31 | 2.82 | **RUN 5** | | | |
| 5/6/2010 10:01 | 20.07 | 1.18 | 2.77 | | | | |
| 5/6/2010 10:02 | 20.00 | 1.13 | 2.81 | | | | |
| 5/6/2010 10:03 | 20.22 | 1.17 | 2.74 | | | | |
| 5/6/2010 10:04 | 20.20 | 1.11 | 2.77 | | | | |
| 5/6/2010 10:05 | 20.43 | 1.21 | 2.65 | | | | |
| 5/6/2010 10:06 | 20.50 | 0.99 | 2.73 | | | | |
| 5/6/2010 10:07 | 20.23 | 1.00 | 2.72 | | | | |
| 5/6/2010 10:08 | 20.14 | 1.02 | 2.73 | | | | |
| 5/6/2010 10:09 | 20.30 | 0.83 | 2.75 | | | | |
| 5/6/2010 10:10 | 20.39 | 0.90 | 2.73 | | | | |
| 5/6/2010 10:11 | 20.29 | 0.72 | 2.85 | | | | |
| 5/6/2010 10:12 | 20.51 | 0.80 | 2.77 | | | | |
| 5/6/2010 10:13 | 20.47 | 0.73 | 2.78 | | | | |
| 5/6/2010 10:14 | 20.75 | 0.81 | 2.69 | | | | |

## Boiler #11 CEMS Data

| Date / Time | B11: NOx ppm - 1 Minute Avg | B11: CO ppm - 1 Minute Avg | B11: O2 % - 1 Minute Avg | | B11: NOx ppm - 1 Minute Avg | B11: CO ppm - 1 Minute Avg | B11: O2 % - 1 Minute Avg |
|---|---|---|---|---|---|---|---|
| 5/6/2010 10:15 | 20.65 | 0.80 | 2.81 | | | | |
| 5/6/2010 10:16 | 20.59 | 0.74 | 2.81 | | | | |
| 5/6/2010 10:17 | 20.59 | 0.75 | 2.80 | | | | |
| 5/6/2010 10:18 | 20.52 | 0.83 | 2.83 | | | | |
| 5/6/2010 10:19 | 20.35 | 0.85 | 2.83 | | | | |
| 5/6/2010 10:20 | 20.47 | 0.86 | 2.69 | | | | |
| 5/6/2010 10:21 | 20.37 | 0.88 | 2.67 | **Averages** | **20.36** | **0.94** | **2.76** |
| 5/6/2010 10:22 | 20.38 | 0.87 | 2.66 | | | | |
| 5/6/2010 10:23 | 20.42 | 1.00 | 2.65 | | | | |
| 5/6/2010 10:24 | 20.37 | 0.97 | 2.67 | | | | |
| 5/6/2010 10:25 | 20.28 | 0.95 | 2.71 | | | | |
| 5/6/2010 10:26 | 20.27 | 1.00 | 2.64 | | | | |
| 5/6/2010 10:27 | 20.21 | 0.91 | 2.75 | | | | |
| 5/6/2010 10:28 | 20.29 | 0.94 | 2.75 | | | | |
| 5/6/2010 10:29 | 20.19 | 1.34 | 2.76 | | | | |
| 5/6/2010 10:30 | 20.05 | 0.84 | 2.91 | **RUN 6** | | | |
| 5/6/2010 10:31 | 20.44 | 0.96 | 2.82 | | | | |
| 5/6/2010 10:32 | 20.41 | 1.04 | 2.72 | | | | |
| 5/6/2010 10:33 | 20.30 | 1.18 | 2.76 | | | | |
| 5/6/2010 10:34 | 20.22 | 1.08 | 2.75 | | | | |
| 5/6/2010 10:35 | 20.34 | 1.07 | 2.75 | | | | |
| 5/6/2010 10:36 | 20.15 | 1.05 | 2.74 | | | | |
| 5/6/2010 10:37 | 20.34 | 1.15 | 2.77 | | | | |
| 5/6/2010 10:38 | 20.18 | 0.97 | 2.89 | | | | |
| 5/6/2010 10:39 | 20.18 | 0.97 | 2.95 | | | | |
| 5/6/2010 10:40 | 20.22 | 1.03 | 2.86 | | | | |
| 5/6/2010 10:41 | 20.38 | 1.04 | 2.80 | | | | |
| 5/6/2010 10:42 | 20.32 | 1.00 | 2.91 | | | | |
| 5/6/2010 10:43 | 20.19 | 1.00 | 2.91 | | | | |
| 5/6/2010 10:44 | 20.30 | 1.01 | 2.88 | | | | |
| 5/6/2010 10:45 | 20.29 | 1.01 | 2.89 | | | | |
| 5/6/2010 10:46 | 20.45 | 1.04 | 2.89 | | | | |
| 5/6/2010 10:47 | 20.45 | 1.02 | 2.88 | | | | |
| 5/6/2010 10:48 | 20.35 | 1.08 | 2.88 | | | | |
| 5/6/2010 10:49 | 20.45 | 1.06 | 2.82 | | | | |
| 5/6/2010 10:50 | 20.52 | 1.06 | 2.83 | | | | |
| 5/6/2010 10:51 | 20.42 | 0.99 | 2.87 | **Averages** | **20.32** | **1.03** | **2.84** |
| 5/6/2010 10:52 | 20.53 | 0.95 | 2.87 | | | | |
| 5/6/2010 10:53 | 20.39 | 0.86 | 2.96 | | | | |
| 5/6/2010 10:54 | 20.51 | 0.78 | 2.94 | | | | |
| 5/6/2010 10:55 | 20.74 | 0.81 | 2.85 | | | | |
| 5/6/2010 10:56 | 20.44 | 0.69 | 2.92 | | | | |
| 5/6/2010 10:57 | 20.70 | 0.73 | 2.88 | | | | |
| 5/6/2010 10:58 | 20.63 | 0.70 | 2.90 | | | | |
| 5/6/2010 10:59 | 20.75 | 0.85 | 2.91 | | | | |
| 5/6/2010 11:00 | 20.92 | 0.69 | 2.86 | **RUN 7** | | | |
| 5/6/2010 11:01 | 20.98 | 0.63 | 2.90 | | | | |
| 5/6/2010 11:02 | 20.89 | 0.61 | 2.90 | | | | |
| 5/6/2010 11:03 | 20.81 | 0.60 | 2.86 | | | | |
| 5/6/2010 11:04 | 20.94 | 0.69 | 2.87 | | | | |
| 5/6/2010 11:05 | 20.84 | 0.59 | 2.95 | | | | |
| 5/6/2010 11:06 | 20.94 | 0.65 | 2.91 | | | | |
| 5/6/2010 11:07 | 20.81 | 0.66 | 2.88 | | | | |
| 5/6/2010 11:08 | 20.68 | 0.67 | 2.89 | | | | |
| 5/6/2010 11:09 | 20.63 | 0.68 | 2.90 | | | | |
| 5/6/2010 11:10 | 20.74 | 0.71 | 2.90 | | | | |
| 5/6/2010 11:11 | 20.67 | 0.73 | 2.93 | | | | |
| 5/6/2010 11:12 | 20.75 | 0.78 | 2.87 | | | | |
| 5/6/2010 11:13 | 20.52 | 0.81 | 2.84 | | | | |
| 5/6/2010 11:14 | 20.82 | 0.81 | 2.82 | | | | |
| 5/6/2010 11:15 | 20.86 | 0.85 | 2.82 | | | | |
| 5/6/2010 11:16 | 20.84 | 0.92 | 2.76 | | | | |
| 5/6/2010 11:17 | 20.64 | 0.86 | 2.83 | | | | |
| 5/6/2010 11:18 | 20.58 | 0.85 | 2.88 | | | | |
| 5/6/2010 11:19 | 20.81 | 0.87 | 2.93 | | | | |
| 5/6/2010 11:20 | 20.56 | 0.89 | 2.93 | | | | |
| 5/6/2010 11:21 | 20.65 | 0.90 | 2.90 | **Averages** | **20.77** | **0.75** | **2.88** |
| 5/6/2010 11:22 | 20.56 | 0.88 | 2.90 | | | | |
| 5/6/2010 11:23 | 20.43 | 0.89 | 2.90 | | | | |
| 5/6/2010 11:24 | 20.52 | 1.03 | 2.75 | | | | |

## Boiler #11 CEMS Data

| Date / Time | B11: NOx ppm - 1 Minute Avg | B11: CO ppm - 1 Minute Avg | B11: O2 % - 1 Minute Avg | | B11: NOx ppm - 1 Minute Avg | B11: CO ppm - 1 Minute Avg | B11: O2 % - 1 Minute Avg |
|---|---|---|---|---|---|---|---|
| 5/6/2010 11:25 | 20.38 | 1.01 | 2.80 | | | | |
| 5/6/2010 11:26 | 20.43 | 1.00 | 2.83 | | | | |
| 5/6/2010 11:27 | 20.68 | 1.00 | 2.85 | | | | |
| 5/6/2010 11:28 | 20.48 | 0.99 | 2.82 | | | | |
| 5/6/2010 11:29 | 20.46 | 0.98 | 2.87 | | | | |
| 5/6/2010 11:30 | 20.49 | 0.98 | 2.81 | **RUN 8** | | | |
| 5/6/2010 11:31 | 20.20 | 1.11 | 2.94 | | | | |
| 5/6/2010 11:32 | 20.29 | 0.99 | 2.96 | | | | |
| 5/6/2010 11:33 | 20.46 | 1.01 | 2.87 | | | | |
| 5/6/2010 11:34 | 20.59 | 0.96 | 2.84 | | | | |
| 5/6/2010 11:35 | 20.92 | 0.96 | 2.83 | | | | |
| 5/6/2010 11:36 | 20.73 | 1.00 | 2.75 | | | | |
| 5/6/2010 11:37 | 20.66 | 0.84 | 2.82 | | | | |
| 5/6/2010 11:38 | 20.68 | 0.74 | 2.90 | | | | |
| 5/6/2010 11:39 | 20.88 | 0.79 | 2.85 | | | | |
| 5/6/2010 11:40 | 20.67 | 0.69 | 2.89 | | | | |
| 5/6/2010 11:41 | 20.67 | 0.76 | 2.86 | | | | |
| 5/6/2010 11:42 | 20.90 | 0.72 | 2.84 | | | | |
| 5/6/2010 11:43 | 20.82 | 0.67 | 2.91 | | | | |
| 5/6/2010 11:44 | 20.86 | 0.72 | 2.77 | | | | |
| 5/6/2010 11:45 | 20.99 | 0.71 | 2.79 | | | | |
| 5/6/2010 11:46 | 20.82 | 0.61 | 2.88 | | | | |
| 5/6/2010 11:47 | 21.03 | 0.61 | 2.86 | | | | |
| 5/6/2010 11:48 | 21.02 | 0.66 | 2.82 | | | | |
| 5/6/2010 11:49 | 21.04 | 0.72 | 2.76 | | | | |
| 5/6/2010 11:50 | 21.18 | 0.70 | 2.78 | | | | |
| 5/6/2010 11:51 | 21.04 | 0.67 | 2.78 | **Averages** | **20.77** | **0.80** | **2.84** |
| 5/6/2010 11:52 | 20.94 | 0.74 | 2.84 | | | | |
| 5/6/2010 11:53 | 21.04 | 0.74 | 2.83 | | | | |
| 5/6/2010 11:54 | 20.84 | 0.73 | 2.90 | | | | |
| 5/6/2010 11:55 | 20.99 | 0.76 | 2.89 | | | | |
| 5/6/2010 11:56 | 20.67 | 0.74 | 2.94 | | | | |
| 5/6/2010 11:57 | 20.88 | 0.80 | 2.85 | | | | |
| 5/6/2010 11:58 | 20.83 | 0.79 | 2.90 | | | | |
| 5/6/2010 11:59 | 20.54 | 0.72 | 2.97 | | | | |
| 5/6/2010 12:00 | 20.81 | 0.77 | 2.97 | **RUN 9** | | | |
| 5/6/2010 12:01 | 20.71 | 0.90 | 2.85 | | | | |
| 5/6/2010 12:02 | 20.73 | 0.93 | 2.77 | | | | |
| 5/6/2010 12:03 | 20.74 | 0.98 | 2.80 | | | | |
| 5/6/2010 12:04 | 20.82 | 0.91 | 2.85 | | | | |
| 5/6/2010 12:05 | 20.86 | 0.95 | 2.83 | | | | |
| 5/6/2010 12:06 | 20.76 | 0.97 | 2.87 | | | | |
| 5/6/2010 12:07 | 20.70 | 0.93 | 2.83 | | | | |
| 5/6/2010 12:08 | 20.59 | 0.94 | 2.81 | | | | |
| 5/6/2010 12:09 | 20.44 | 0.98 | 2.86 | | | | |
| 5/6/2010 12:10 | 20.47 | 0.96 | 2.86 | | | | |
| 5/6/2010 12:11 | 20.44 | 1.09 | 2.81 | | | | |
| 5/6/2010 12:12 | 20.58 | 1.19 | 2.71 | | | | |
| 5/6/2010 12:13 | 20.59 | 1.15 | 2.73 | | | | |
| 5/6/2010 12:14 | 20.63 | 1.40 | 2.64 | | | | |
| 5/6/2010 12:15 | 20.55 | 1.07 | 2.82 | | | | |
| 5/6/2010 12:16 | 20.75 | 1.16 | 2.74 | | | | |
| 5/6/2010 12:17 | 20.37 | 1.19 | 2.69 | | | | |
| 5/6/2010 12:18 | 20.60 | 1.08 | 2.83 | | | | |
| 5/6/2010 12:19 | 20.66 | 1.02 | 2.78 | | | | |
| 5/6/2010 12:20 | 20.51 | 1.04 | 2.78 | | | | |
| 5/6/2010 12:21 | 20.63 | 0.94 | 2.80 | **Averages** | **20.63** | **1.03** | **2.80** |
| 5/6/2010 12:22 | 20.81 | 0.93 | 2.76 | | | | |
| 5/6/2010 12:23 | 20.70 | 0.90 | 2.73 | | | | |
| 5/6/2010 12:24 | 20.83 | 0.82 | 2.82 | | | | |
| 5/6/2010 12:25 | 20.92 | 0.77 | 2.81 | | | | |
| 5/6/2010 12:26 | 20.87 | 0.80 | 2.81 | | | | |
| 5/6/2010 12:27 | 20.82 | 0.75 | 2.84 | | | | |
| 5/6/2010 12:28 | 21.02 | 0.84 | 2.78 | | | | |
| 5/6/2010 12:29 | 21.16 | 0.70 | 2.85 | | | | |
| 5/6/2010 12:30 | 21.04 | 0.72 | 2.80 | | | | |

## CHS, Inc. - Laurel Refinery
## Zone D H-1001 RATA CEM Data

| *NOTE: CEM Times have not been changed to DST* Date/Time | H1001 SO2 0% O2 corr 1 min Avg | H1001 O2 1 min Avg | H1001 CO 3% O2 corr 1 min Avg | | H1001 SO2 0% O2 corr 1 min | H1001 O2 1 min | H1001 CO 3% O2 corr 1 min |
|---|---|---|---|---|---|---|---|
| 5/10/10 8:25 | 0.00 | 3.02 | 3.77 | | | | |
| 5/10/10 8:26 | 0.00 | 3.01 | 3.33 | | | | |
| 5/10/10 8:27 | 0.00 | 3.47 | 3.59 | | | | |
| 5/10/10 8:28 | 0.00 | 3.42 | 3.44 | | | | |
| 5/10/10 8:29 | 0.00 | 3.27 | 3.80 | | | | |
| 5/10/10 8:30 | 0.00 | 3.28 | 3.24 | **Run 1** | | | |
| 5/10/10 8:31 | 0.00 | 3.07 | 3.55 | | | | |
| 5/10/10 8:32 | 0.00 | 2.95 | 3.97 | | | | |
| 5/10/10 8:33 | 0.00 | 3.10 | 3.63 | | | | |
| 5/10/10 8:34 | 0.00 | 2.95 | 3.78 | | | | |
| 5/10/10 8:35 | 0.00 | 2.70 | 3.82 | | | | |
| 5/10/10 8:36 | 0.00 | 3.11 | 4.27 | | | | |
| 5/10/10 8:37 | 0.00 | 2.86 | 3.32 | | | | |
| 5/10/10 8:38 | 0.00 | 2.87 | 4.06 | | | | |
| 5/10/10 8:39 | 0.00 | 2.83 | 4.14 | | | | |
| 5/10/10 8:40 | 0.00 | 2.91 | 3.91 | | | | |
| 5/10/10 8:41 | 0.00 | 2.91 | 3.48 | | | | |
| 5/10/10 8:42 | 0.00 | 2.87 | 4.05 | | | | |
| 5/10/10 8:43 | 0.00 | 2.74 | 3.63 | | | | |
| 5/10/10 8:44 | 0.00 | 2.79 | 4.00 | | | | |
| 5/10/10 8:45 | 0.00 | 2.79 | 3.40 | | | | |
| 5/10/10 8:46 | 0.00 | 2.79 | 3.35 | | | | |
| 5/10/10 8:47 | 0.00 | 3.12 | 3.81 | | | | |
| 5/10/10 8:48 | 0.00 | 2.92 | 3.55 | | | | |
| 5/10/10 8:49 | 0.00 | 2.90 | 4.39 | | | | |
| 5/10/10 8:50 | 0.00 | 3.00 | 3.82 | | | | |
| 5/10/10 8:51 | 0.00 | 2.80 | 4.01 | **Averages:** | **0.00** | **2.92** | **3.78** |
| 5/10/10 8:52 | 0.00 | 2.60 | 4.14 | | | | |
| 5/10/10 8:53 | 0.00 | 2.61 | 4.21 | | | | |
| 5/10/10 8:54 | 0.00 | 2.45 | 3.94 | | | | |
| 5/10/10 8:55 | 0.00 | 2.60 | 4.42 | | | | |
| 5/10/10 8:56 | 0.00 | 2.64 | 3.74 | | | | |
| 5/10/10 8:57 | 0.00 | 2.49 | 3.70 | | | | |
| 5/10/10 8:58 | 0.00 | 2.60 | 4.10 | | | | |
| 5/10/10 8:59 | 0.00 | 2.31 | 3.57 | | | | |
| 5/10/10 9:00 | 0.00 | 2.54 | 4.16 | | | | |
| 5/10/10 9:01 | 0.00 | 2.50 | 3.97 | **Run 2** | | | |
| 5/10/10 9:02 | 0.00 | 2.39 | 3.80 | | | | |
| 5/10/10 9:03 | 0.00 | 2.54 | 4.06 | | | | |
| 5/10/10 9:04 | 0.00 | 2.37 | 3.78 | | | | |
| 5/10/10 9:05 | 0.00 | 2.37 | 4.32 | | | | |
| 5/10/10 9:06 | 0.00 | 2.53 | 3.70 | | | | |
| 5/10/10 9:07 | 0.00 | 2.57 | 4.08 | | | | |

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|---|---|---|---|---|---|---|---|
| 5/10/10 9:08 | 0.00 | 2.65 | 3.61 | | | | |
| 5/10/10 9:09 | 0.00 | 2.70 | 4.39 | | | | |
| 5/10/10 9:10 | 0.00 | 2.58 | 3.56 | | | | |
| 5/10/10 9:11 | 0.00 | 2.83 | 4.24 | | | | |
| 5/10/10 9:12 | 0.00 | 2.63 | 3.86 | | | | |
| 5/10/10 9:13 | 0.00 | 2.79 | 3.99 | | | | |
| 5/10/10 9:14 | 0.00 | 2.63 | 4.24 | | | | |
| 5/10/10 9:15 | 0.00 | 2.51 | 4.27 | | | | |
| 5/10/10 9:16 | 0.00 | 2.53 | 3.91 | | | | |
| 5/10/10 9:17 | 0.00 | 2.41 | 4.13 | | | | |
| 5/10/10 9:18 | 0.00 | 2.41 | 4.16 | | | | |
| 5/10/10 9:19 | 0.00 | 2.54 | 4.16 | | | | |
| 5/10/10 9:20 | 0.00 | 2.56 | 4.12 | | | | |
| 5/10/10 9:21 | 0.00 | 2.64 | 4.07 | | | | |
| 5/10/10 9:22 | 0.00 | 2.94 | 4.02 | **Averages:** | **0.00** | **2.57** | **4.02** |
| 5/10/10 9:23 | 0.00 | 2.77 | 4.09 | | | | |
| 5/10/10 9:24 | 0.00 | 2.68 | 4.21 | | | | |
| 5/10/10 9:25 | 0.00 | 2.64 | 4.45 | | | | |
| 5/10/10 9:26 | 0.00 | 2.61 | 4.45 | | | | |
| 5/10/10 9:27 | 0.00 | 2.64 | 4.14 | | | | |
| 5/10/10 9:28 | 0.00 | 2.60 | 4.10 | | | | |
| 5/10/10 9:29 | 0.00 | 2.52 | 3.99 | | | | |
| 5/10/10 9:30 | 0.00 | 2.67 | 4.37 | | | | |
| 5/10/10 9:31 | 0.00 | 2.61 | 4.29 | | | | |
| 5/10/10 9:32 | 0.00 | 2.69 | 4.03 | **Run 3** | | | |
| 5/10/10 9:33 | 0.00 | 2.74 | 3.97 | | | | |
| 5/10/10 9:34 | 0.00 | 2.71 | 4.04 | | | | |
| 5/10/10 9:35 | 0.00 | 2.77 | 3.85 | | | | |
| 5/10/10 9:36 | 0.00 | 2.66 | 4.26 | | | | |
| 5/10/10 9:37 | 0.00 | 2.66 | 3.98 | | | | |
| 5/10/10 9:38 | 0.00 | 2.62 | 4.13 | | | | |
| 5/10/10 9:39 | 0.00 | 2.52 | 4.06 | | | | |
| 5/10/10 9:40 | 0.00 | 2.48 | 3.88 | | | | |
| 5/10/10 9:41 | 0.00 | 2.71 | 3.90 | | | | |
| 5/10/10 9:42 | 0.00 | 2.47 | 4.27 | | | | |
| 5/10/10 9:43 | 0.00 | 2.77 | 4.22 | | | | |
| 5/10/10 9:44 | 0.00 | 2.98 | 4.09 | | | | |
| 5/10/10 9:45 | 0.00 | 2.74 | 4.38 | | | | |
| 5/10/10 9:46 | 0.00 | 2.69 | 4.11 | | | | |
| 5/10/10 9:47 | 0.00 | 2.70 | 4.32 | | | | |
| 5/10/10 9:48 | 0.00 | 2.56 | 3.98 | | | | |
| 5/10/10 9:49 | 0.00 | 2.57 | 3.86 | | | | |
| 5/10/10 9:50 | 0.00 | 2.58 | 3.83 | | | | |
| 5/10/10 9:51 | 0.00 | 2.68 | 3.87 | | | | |
| 5/10/10 9:52 | 0.00 | 2.79 | 4.16 | | | | |
| 5/10/10 9:53 | 0.00 | 2.59 | 4.19 | **Averages:** | **0.00** | **2.67** | **4.06** |
| 5/10/10 9:54 | 0.00 | 2.79 | 4.18 | | | | |
| 5/10/10 9:55 | 0.00 | 2.97 | 4.08 | | | | |
| 5/10/10 9:56 | 0.00 | 2.78 | 4.29 | | | | |
| 5/10/10 9:57 | 0.00 | 2.85 | 4.13 | | | | |
| 5/10/10 9:58 | 0.00 | 2.71 | 4.32 | | | | |
| 5/10/10 9:59 | 0.00 | 2.60 | 4.05 | | | | |
| 5/10/10 10:00 | 0.00 | 2.57 | 3.86 | | | | |
| 5/10/10 10:01 | 0.00 | 2.55 | 3.75 | | | | |

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|---|---|---|---|---|---|---|---|
| 5/10/10 10:02 | 0.00 | 2.64 | 4.27 | | | | |
| 5/10/10 10:03 | 0.00 | 2.59 | 4.23 | **Run 4** | | | |
| 5/10/10 10:04 | 0.00 | 2.44 | 3.92 | | | | |
| 5/10/10 10:05 | 0.00 | 2.70 | 3.62 | | | | |
| 5/10/10 10:06 | 0.00 | 2.81 | 4.08 | | | | |
| 5/10/10 10:07 | 0.00 | 2.64 | 4.08 | | | | |
| 5/10/10 10:08 | 0.00 | 2.59 | 4.09 | | | | |
| 5/10/10 10:09 | 0.00 | 2.56 | 4.19 | | | | |
| 5/10/10 10:10 | 0.00 | 2.40 | 4.31 | | | | |
| 5/10/10 10:11 | 0.00 | 2.81 | 3.89 | | | | |
| 5/10/10 10:12 | 0.00 | 2.73 | 4.14 | | | | |
| 5/10/10 10:13 | 0.00 | 2.60 | 4.13 | | | | |
| 5/10/10 10:14 | 0.00 | 2.74 | 4.14 | | | | |
| 5/10/10 10:15 | 0.00 | 2.54 | 4.05 | | | | |
| 5/10/10 10:16 | 0.00 | 2.77 | 4.33 | | | | |
| 5/10/10 10:17 | 0.00 | 2.83 | 4.27 | | | | |
| 5/10/10 10:18 | 0.00 | 2.71 | 3.99 | | | | |
| 5/10/10 10:19 | 0.00 | 2.62 | 3.88 | | | | |
| 5/10/10 10:20 | 0.00 | 2.67 | 3.75 | | | | |
| 5/10/10 10:21 | 0.00 | 2.56 | 4.07 | | | | |
| 5/10/10 10:22 | 0.00 | 2.54 | 3.55 | | | | |
| 5/10/10 10:23 | 0.00 | 2.52 | 4.37 | | | | |
| 5/10/10 10:24 | 0.00 | 2.26 | 4.02 | **Averages:** | **0.00** | **2.62** | **4.05** |
| 5/10/10 10:25 | 0.00 | 2.84 | 4.25 | | | | |
| 5/10/10 10:26 | 0.00 | 2.79 | 4.15 | | | | |
| 5/10/10 10:27 | 0.00 | 2.80 | 3.95 | | | | |
| 5/10/10 10:28 | 0.00 | 2.80 | 3.88 | | | | |
| 5/10/10 10:29 | 0.00 | 2.70 | 4.10 | | | | |
| 5/10/10 10:30 | 0.00 | 2.68 | 4.14 | | | | |
| 5/10/10 10:31 | 0.00 | 2.61 | 4.01 | | | | |
| 5/10/10 10:32 | 0.00 | 2.51 | 4.16 | | | | |
| 5/10/10 10:33 | 0.00 | 2.59 | 4.04 | | | | |
| 5/10/10 10:34 | 0.00 | 2.33 | 3.99 | **Run 5** | | | |
| 5/10/10 10:35 | 0.00 | 2.31 | 3.95 | | | | |
| 5/10/10 10:36 | 0.00 | 2.41 | 4.16 | | | | |
| 5/10/10 10:37 | 0.00 | 2.45 | 3.85 | | | | |
| 5/10/10 10:38 | 0.00 | 2.93 | 3.84 | | | | |
| 5/10/10 10:39 | 0.00 | 2.76 | 4.32 | | | | |
| 5/10/10 10:40 | 0.00 | 2.70 | 3.97 | | | | |
| 5/10/10 10:41 | 0.00 | 3.29 | 4.02 | | | | |
| 5/10/10 10:42 | 0.00 | 3.94 | 4.71 | | | | |
| 5/10/10 10:43 | 0.00 | 3.84 | 4.04 | | | | |
| 5/10/10 10:44 | 0.00 | 3.59 | 4.38 | | | | |
| 5/10/10 10:45 | 0.00 | 3.26 | 4.26 | | | | |
| 5/10/10 10:46 | 0.00 | 2.96 | 4.02 | | | | |
| 5/10/10 10:47 | 0.00 | 2.86 | 4.22 | | | | |
| 5/10/10 10:48 | 0.00 | 2.65 | 4.00 | | | | |
| 5/10/10 10:49 | 0.00 | 2.74 | 4.39 | | | | |
| 5/10/10 10:50 | 0.00 | 2.66 | 4.23 | | | | |
| 5/10/10 10:51 | 0.00 | 2.56 | 3.87 | | | | |
| 5/10/10 10:52 | 0.00 | 2.56 | 4.34 | | | | |
| 5/10/10 10:53 | 0.00 | 2.57 | 4.12 | | | | |
| 5/10/10 10:54 | 0.00 | 2.34 | 4.15 | | | | |
| 5/10/10 10:55 | 0.00 | 2.83 | 4.14 | **Averages:** | **0.00** | **2.84** | **4.14** |

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|---|---|---|---|---|---|---|---|
| 5/10/10 10:56 | 0.00 | 2.87 | 4.35 | | | | |
| 5/10/10 10:57 | 0.00 | 2.83 | 4.25 | | | | |
| 5/10/10 10:58 | 0.00 | 3.01 | 4.21 | | | | |
| 5/10/10 10:59 | 0.00 | 2.79 | 4.14 | | | | |
| 5/10/10 11:00 | 0.00 | 2.84 | 4.08 | | | | |
| 5/10/10 11:01 | 0.00 | 2.69 | 4.38 | | | | |
| 5/10/10 11:02 | 0.00 | 2.43 | 3.98 | | | | |
| 5/10/10 11:03 | 0.00 | 2.56 | 4.29 | | | | |
| 5/10/10 11:04 | 0.00 | 2.58 | 4.01 | | | | |
| 5/10/10 11:05 | 0.00 | 2.41 | 4.12 | **Run 6** | | | |
| 5/10/10 11:06 | 0.00 | 2.49 | 3.91 | | | | |
| 5/10/10 11:07 | 0.00 | 2.41 | 4.23 | | | | |
| 5/10/10 11:08 | 0.00 | 2.41 | 4.17 | | | | |
| 5/10/10 11:09 | 0.00 | 2.67 | 4.22 | | | | |
| 5/10/10 11:10 | 0.00 | 2.56 | 4.33 | | | | |
| 5/10/10 11:11 | 0.00 | 2.55 | 4.07 | | | | |
| 5/10/10 11:12 | 0.00 | 2.49 | 4.00 | | | | |
| 5/10/10 11:13 | 0.00 | 2.58 | 3.88 | | | | |
| 5/10/10 11:14 | 0.00 | 2.60 | 4.19 | | | | |
| 5/10/10 11:15 | 0.00 | 2.61 | 4.17 | | | | |
| 5/10/10 11:16 | 0.00 | 2.48 | 3.99 | | | | |
| 5/10/10 11:17 | 0.00 | 2.55 | 4.04 | | | | |
| 5/10/10 11:18 | 0.00 | 2.62 | 3.93 | | | | |
| 5/10/10 11:19 | 0.00 | 2.53 | 4.12 | | | | |
| 5/10/10 11:20 | 0.00 | 2.48 | 4.02 | | | | |
| 5/10/10 11:21 | 0.00 | 2.65 | 3.79 | | | | |
| 5/10/10 11:22 | 0.00 | 2.92 | 4.06 | | | | |
| 5/10/10 11:23 | 0.00 | 2.72 | 3.63 | | | | |
| 5/10/10 11:24 | 0.00 | 2.79 | 4.35 | | | | |
| 5/10/10 11:25 | 0.00 | 2.72 | 4.23 | | | | |
| 5/10/10 11:26 | 0.00 | 2.60 | 4.27 | **Averages:** | **0.00** | **2.58** | **4.08** |
| 5/10/10 11:27 | 0.00 | 2.59 | 4.21 | | | | |
| 5/10/10 11:28 | 0.00 | 2.54 | 4.08 | | | | |
| 5/10/10 11:29 | 0.00 | 2.45 | 3.82 | | | | |
| 5/10/10 11:30 | 0.00 | 2.49 | 3.97 | | | | |
| 5/10/10 11:31 | 0.00 | 2.74 | 4.06 | | | | |
| 5/10/10 11:32 | 0.00 | 2.55 | 4.04 | | | | |
| 5/10/10 11:33 | 0.00 | 2.72 | 3.90 | | | | |
| 5/10/10 11:34 | 0.00 | 2.55 | 4.49 | | | | |
| 5/10/10 11:35 | 0.00 | 2.56 | 3.92 | | | | |
| 5/10/10 11:36 | 0.00 | 2.65 | 4.19 | | | | |
| 5/10/10 11:37 | 0.00 | 2.55 | 4.10 | **Run 7** | | | |
| 5/10/10 11:38 | 0.00 | 2.52 | 4.32 | | | | |
| 5/10/10 11:39 | 0.00 | 2.57 | 3.92 | | | | |
| 5/10/10 11:40 | 0.00 | 2.31 | 3.89 | | | | |
| 5/10/10 11:41 | 0.00 | 2.58 | 4.21 | | | | |
| 5/10/10 11:42 | 0.00 | 2.99 | 4.18 | | | | |
| 5/10/10 11:43 | 0.00 | 2.91 | 4.30 | | | | |
| 5/10/10 11:44 | 0.00 | 3.04 | 3.77 | | | | |
| 5/10/10 11:45 | 0.00 | 2.78 | 4.01 | | | | |
| 5/10/10 11:46 | 0.00 | 2.59 | 4.03 | | | | |
| 5/10/10 11:47 | 0.00 | 2.58 | 3.68 | | | | |
| 5/10/10 11:48 | 0.00 | 2.53 | 4.22 | | | | |
| 5/10/10 11:49 | 0.00 | 2.55 | 4.48 | | | | |
| 5/10/10 11:50 | 0.00 | 2.55 | 4.05 | | | | |

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|---|---|---|---|---|---|---|---|
| 5/10/10 11:51 | 0.00 | 2.43 | 3.70 | | | | |
| 5/10/10 11:52 | 0.00 | 2.59 | 3.81 | | | | |
| 5/10/10 11:53 | 0.00 | 2.45 | 4.11 | | | | |
| 5/10/10 11:54 | 0.00 | 2.67 | 4.19 | | | | |
| 5/10/10 11:55 | 0.00 | 3.11 | 3.96 | | | | |
| 5/10/10 11:56 | 0.00 | 2.84 | 4.19 | | | | |
| 5/10/10 11:57 | 0.00 | 2.69 | 4.03 | | | | |
| 5/10/10 11:58 | 0.00 | 2.67 | 4.29 | **Averages:** | **0.00** | **2.66** | **4.07** |
| 5/10/10 11:59 | 0.00 | 2.57 | 4.35 | | | | |
| 5/10/10 12:00 | 0.00 | 2.48 | 4.06 | | | | |
| 5/10/10 12:01 | 0.00 | 2.47 | 3.96 | | | | |
| 5/10/10 12:02 | 0.00 | 2.49 | 4.05 | | | | |
| 5/10/10 12:03 | 0.00 | 2.54 | 3.92 | | | | |
| 5/10/10 12:04 | 0.00 | 2.46 | 4.01 | | | | |
| 5/10/10 12:05 | 0.00 | 2.51 | 4.20 | | | | |
| 5/10/10 12:06 | 0.00 | 2.73 | 4.06 | | | | |
| 5/10/10 12:07 | 0.00 | 2.53 | 3.97 | **Run 8** | | | |
| 5/10/10 12:08 | 0.00 | 2.56 | 4.08 | | | | |
| 5/10/10 12:09 | 0.00 | 2.51 | 4.06 | | | | |
| 5/10/10 12:10 | 0.00 | 2.48 | 3.90 | | | | |
| 5/10/10 12:11 | 0.00 | 2.45 | 4.41 | | | | |
| 5/10/10 12:12 | 0.00 | 2.49 | 4.07 | | | | |
| 5/10/10 12:13 | 0.00 | 2.23 | 4.22 | | | | |
| 5/10/10 12:14 | 0.00 | 2.84 | 4.10 | | | | |
| 5/10/10 12:15 | 0.00 | 3.37 | 4.33 | | | | |
| 5/10/10 12:16 | 0.00 | 2.92 | 3.95 | | | | |
| 5/10/10 12:17 | 0.00 | 2.80 | 3.96 | | | | |
| 5/10/10 12:18 | 0.00 | 2.64 | 3.99 | | | | |
| 5/10/10 12:19 | 0.00 | 2.57 | 4.04 | | | | |
| 5/10/10 12:20 | 0.00 | 2.57 | 4.24 | | | | |
| 5/10/10 12:21 | 0.00 | 2.51 | 4.32 | | | | |
| 5/10/10 12:22 | 0.00 | 2.51 | 4.12 | | | | |
| 5/10/10 12:23 | 0.00 | 2.46 | 4.00 | | | | |
| 5/10/10 12:24 | 0.00 | 2.30 | 4.28 | | | | |
| 5/10/10 12:25 | 0.00 | 2.61 | 4.21 | | | | |
| 5/10/10 12:26 | 0.00 | 2.57 | 4.35 | | | | |
| 5/10/10 12:27 | 0.00 | 2.63 | 4.05 | | | | |
| 5/10/10 12:28 | 0.00 | 2.80 | 3.96 | **Averages:** | **0.00** | **2.61** | **4.12** |
| 5/10/10 12:29 | 0.00 | 2.61 | 4.24 | | | | |
| 5/10/10 12:30 | 0.00 | 2.58 | 4.18 | | | | |
| 5/10/10 12:31 | 0.00 | 2.59 | 4.41 | | | | |
| 5/10/10 12:32 | 0.00 | 2.49 | 4.20 | | | | |
| 5/10/10 12:33 | 0.00 | 2.60 | 4.02 | | | | |
| 5/10/10 12:34 | 0.00 | 2.65 | 3.88 | | | | |
| 5/10/10 12:35 | 0.00 | 2.40 | 4.20 | | | | |
| 5/10/10 12:36 | 0.00 | 2.57 | 4.14 | | | | |
| 5/10/10 12:37 | 0.00 | 2.51 | 3.74 | | | | |
| 5/10/10 12:38 | 0.00 | 2.56 | 4.08 | **Run 9** | | | |
| 5/10/10 12:39 | 0.00 | 2.85 | 3.95 | | | | |
| 5/10/10 12:40 | 0.00 | 2.66 | 4.07 | | | | |
| 5/10/10 12:41 | 0.00 | 2.40 | 4.44 | | | | |
| 5/10/10 12:42 | 0.00 | 2.56 | 4.31 | | | | |
| 5/10/10 12:43 | 0.00 | 2.43 | 3.99 | | | | |
| 5/10/10 12:44 | 0.00 | 2.35 | 4.03 | | | | |

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|---|---|---|---|---|---|---|---|
| 5/10/10 12:45 | 0.00 | 2.51 | 4.02 | | | | |
| 5/10/10 12:46 | 0.00 | 2.32 | 4.01 | | | | |
| 5/10/10 12:47 | 0.00 | 2.71 | 4.26 | | | | |
| 5/10/10 12:48 | 0.00 | 2.82 | 4.24 | | | | |
| 5/10/10 12:49 | 0.00 | 2.86 | 4.56 | | | | |
| 5/10/10 12:50 | 0.00 | 3.01 | 4.16 | | | | |
| 5/10/10 12:51 | 0.00 | 2.95 | 4.38 | | | | |
| 5/10/10 12:52 | 0.00 | 2.79 | 4.23 | | | | |
| 5/10/10 12:53 | 0.00 | 2.65 | 3.61 | | | | |
| 5/10/10 12:54 | 0.00 | 2.47 | 4.19 | | | | |
| 5/10/10 12:55 | 0.00 | 2.49 | 4.19 | | | | |
| 5/10/10 12:56 | 0.00 | 2.51 | 4.57 | | | | |
| 5/10/10 12:57 | 0.00 | 2.64 | 4.20 | | | | |
| 5/10/10 12:58 | 0.00 | 2.68 | 4.11 | | | | |
| 5/10/10 12:59 | 0.00 | 2.54 | 4.32 | **Averages:** | **0.00** | **2.63** | **4.18** |
| 5/10/10 13:00 | 0.00 | 2.68 | 4.38 | | | | |

**CHS, Inc. - Laurel Refinery**
**Zone D SRU RATA CEM Data**

Don't need

All dry

| NOTE: CEM Times have not been changed to DST | SRU SO2 1 min ppm | Stack Flow 1 min SCFH | SRU SO2 1 min Lbs/hr | SRU SO2 Corr 0% O2 1 min ppm | O2 1 min % | | SRU SO2 1 min ppm | Stack Flow 1 min SCFH | SRU SO2 1 min Lbs/hr | SRU SO2 Corr 0% O2 1 min ppm | O2 1 min % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | Avg | Avg | Avg | Avg | Avg | | | | | | |
| 5/11/10 8:10 | 12 | 252796 | 0.5 | 21.6 | 9.03 | | | | | | |
| 5/11/10 8:11 | 13 | 220600 | 0.5 | 18.6 | 6.27 | | | | | | |
| 5/11/10 8:12 | 12 | 255474 | 0.5 | 21.4 | 9.17 | | | | | | |
| 5/11/10 8:13 | 12 | 223910 | 0.5 | 17.5 | 6.29 | | | | | | |
| 5/11/10 8:14 | 12 | 257654 | 0.5 | 20.5 | 9.12 | | | | | | |
| 5/11/10 8:15 | 12 | 224823 | 0.5 | 17.3 | 6.10 | **Run 1** | | | | | |
| 5/11/10 8:16 | 12 | 257561 | 0.5 | 21.1 | 9.05 | | | | | | |
| 5/11/10 8:17 | 13 | 225659 | 0.5 | 17.8 | 6.06 | | | | | | |
| 5/11/10 8:18 | 12 | 261887 | 0.5 | 21.5 | 8.99 | | | | | | |
| 5/11/10 8:19 | 13 | 226387 | 0.5 | 18.0 | 6.08 | | | | | | |
| 5/11/10 8:20 | 12 | 250394 | 0.5 | 21.0 | 9.11 | | | | | | |
| 5/11/10 8:21 | 13 | 213432 | 0.5 | 18.0 | 6.04 | | | | | | |
| 5/11/10 8:22 | 12 | 242639 | 0.5 | 20.9 | 9.01 | | | | | | |
| 5/11/10 8:23 | 12 | 211261 | 0.4 | 17.5 | 6.01 | | | | | | |
| 5/11/10 8:24 | 11 | 246930 | 0.5 | 20.2 | 9.06 | | | | | | |
| 5/11/10 8:25 | 13 | 220442 | 0.5 | 17.8 | 6.04 | | | | | | |
| 5/11/10 8:26 | 12 | 266886 | 0.5 | 20.9 | 8.91 | | | | | | |
| 5/11/10 8:27 | 13 | 257071 | 0.5 | 17.9 | 5.99 | | | | | | |
| 5/11/10 8:28 | 12 | 299800 | 0.6 | 20.5 | 9.10 | | | | | | |
| 5/11/10 8:29 | 13 | 272604 | 0.6 | 17.7 | 5.98 | | | | | | |
| 5/11/10 8:30 | 12 | 300584 | 0.6 | 20.5 | 9.05 | | | | | | |
| 5/11/10 8:31 | 13 | 270916 | 0.6 | 17.9 | 6.01 | | | | | | |
| 5/11/10 8:32 | 12 | 299779 | 0.6 | 20.6 | 9.16 | | | | | | |
| 5/11/10 8:33 | 13 | 272579 | 0.6 | 18.2 | 5.93 | | | | | | |
| 5/11/10 8:34 | 12 | 298082 | 0.6 | 21.3 | 9.00 | | | | | | |
| 5/11/10 8:35 | 13 | 271949 | 0.6 | 17.8 | 5.99 | | | | | | |
| 5/11/10 8:36 | 12 | 296834 | 0.6 | 21.1 | 9.07 | **Averages:** | **12.18** | **258,568** | **0.52** | **19.34** | **7.53** |
| 5/11/10 8:37 | 12 | 274912 | 0.6 | 17.2 | 5.94 | | | | | | |
| 5/11/10 8:38 | 12 | 298228 | 0.6 | 20.7 | 9.11 | | | | | | |
| 5/11/10 8:39 | 13 | 274023 | 0.6 | 18.1 | 6.00 | | | | | | |
| 5/11/10 8:40 | 12 | 298053 | 0.6 | 21.3 | 9.20 | | | | | | |
| 5/11/10 8:41 | 13 | 273621 | 0.6 | 18.3 | 5.99 | | | | | | |
| 5/11/10 8:42 | 12 | 294666 | 0.6 | 21.3 | 9.20 | | | | | | |
| 5/11/10 8:43 | 13 | 274123 | 0.6 | 18.4 | 6.25 | | | | | | |
| 5/11/10 8:44 | 12 | 296031 | 0.6 | 21.9 | 9.32 | | | | | | |
| 5/11/10 8:45 | 13 | 274827 | 0.6 | 18.2 | 6.22 | **Run 2** | | | | | |
| 5/11/10 8:46 | 12 | 293805 | 0.6 | 22.5 | 9.34 | | | | | | |
| 5/11/10 8:47 | 13 | 272789 | 0.6 | 18.5 | 6.33 | | | | | | |
| 5/11/10 8:48 | 12 | 291281 | 0.6 | 22.1 | 9.33 | | | | | | |
| 5/11/10 8:49 | 13 | 274319 | 0.6 | 18.1 | 6.18 | | | | | | |
| 5/11/10 8:50 | 12 | 289994 | 0.6 | 22.0 | 9.21 | | | | | | |
| 5/11/10 8:51 | 13 | 275347 | 0.6 | 18.2 | 6.28 | | | | | | |
| 5/11/10 8:52 | 12 | 287825 | 0.6 | 21.4 | 9.15 | | | | | | |
| 5/11/10 8:53 | 13 | 281110 | 0.6 | 18.2 | 6.48 | | | | | | |
| 5/11/10 8:54 | 12 | 287943 | 0.6 | 22.0 | 8.97 | | | | | | |
| 5/11/10 8:55 | 13 | 282735 | 0.6 | 18.6 | 6.70 | | | | | | |
| 5/11/10 8:56 | 12 | 288893 | 0.6 | 21.6 | 8.90 | | | | | | |
| 5/11/10 8:57 | 13 | 285505 | 0.6 | 18.5 | 6.64 | | | | | | |
| 5/11/10 8:58 | 13 | 285580 | 0.6 | 22.3 | 8.68 | | | | | | |
| 5/11/10 8:59 | 12 | 287039 | 0.6 | 18.8 | 6.93 | | | | | | |
| 5/11/10 9:00 | 12 | 286414 | 0.6 | 20.6 | 8.62 | | | | | | |
| 5/11/10 9:01 | 12 | 285756 | 0.6 | 17.5 | 6.85 | | | | | | |
| 5/11/10 9:02 | 13 | 284144 | 0.6 | 21.5 | 8.58 | | | | | | |
| 5/11/10 9:03 | 12 | 286805 | 0.6 | 18.5 | 6.88 | | | | | | |
| 5/11/10 9:04 | 13 | 284561 | 0.6 | 21.5 | 8.46 | | | | | | |
| 5/11/10 9:05 | 13 | 286538 | 0.6 | 19.0 | 6.97 | | | | | | |
| 5/11/10 9:06 | 13 | 281472 | 0.6 | 21.4 | 8.42 | **Averages:** | **12.45** | **284,304** | **0.59** | **20.04** | **7.73** |
| 5/11/10 9:07 | 12 | 287393 | 0.6 | 18.9 | 7.01 | | | | | | |
| 5/11/10 9:08 | 12 | 279305 | 0.6 | 21.1 | 8.36 | | | | | | |
| 5/11/10 9:09 | 12 | 286741 | 0.6 | 18.8 | 7.22 | | | | | | |
| 5/11/10 9:10 | 13 | 278570 | 0.6 | 21.3 | 8.28 | | | | | | |
| 5/11/10 9:11 | 12 | 286619 | 0.6 | 18.6 | 7.16 | | | | | | |
| 5/11/10 9:12 | 13 | 275825 | 0.6 | 21.0 | 8.25 | | | | | | |

| NOTE: CEM Times have not been changed to DST | SRU SO2 1 min ppm | Stack Flow 1 min SCFH | SRU SO2 1 min Lbs/hr | SRU SO2 Corr 0% O2 1 min ppm | O2 1 min % | | SRU SO2 1 min ppm | Stack Flow 1 min SCFH | SRU SO2 1 min Lbs/hr | SRU SO2 Corr 0% O2 1 min ppm | O2 1 min % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | Avg | Avg | Avg | Avg | Avg | | | | | | |
| 5/11/10 9:13 | 12 | 287359 | 0.6 | 18.7 | 7.52 | | | | | | |
| 5/11/10 9:14 | 12 | 278658 | 0.6 | 20.6 | 8.12 | | | | | | |
| 5/11/10 9:15 | 12 | 288729 | 0.6 | 19.6 | 7.58 | **Run 3** | | | | | |
| 5/11/10 9:16 | 13 | 275127 | 0.6 | 21.1 | 8.26 | | | | | | |
| 5/11/10 9:17 | 12 | 291324 | 0.6 | 18.9 | 7.77 | | | | | | |
| 5/11/10 9:18 | 12 | 274021 | 0.6 | 20.1 | 7.93 | | | | | | |
| 5/11/10 9:19 | 12 | 290082 | 0.6 | 18.9 | 7.86 | | | | | | |
| 5/11/10 9:20 | 13 | 271252 | 0.6 | 21.3 | 7.92 | | | | | | |
| 5/11/10 9:21 | 12 | 290715 | 0.6 | 19.9 | 7.98 | | | | | | |
| 5/11/10 9:22 | 13 | 270970 | 0.6 | 20.5 | 7.76 | | | | | | |
| 5/11/10 9:23 | 12 | 290737 | 0.6 | 20.1 | 8.23 | | | | | | |
| 5/11/10 9:24 | 12 | 268251 | 0.6 | 20.2 | 7.74 | | | | | | |
| 5/11/10 9:25 | 12 | 289454 | 0.6 | 19.5 | 8.22 | | | | | | |
| 5/11/10 9:26 | 12 | 264826 | 0.6 | 20.1 | 7.61 | | | | | | |
| 5/11/10 9:27 | 12 | 289512 | 0.6 | 20.5 | 8.51 | | | | | | |
| 5/11/10 9:28 | 13 | 262547 | 0.6 | 21.1 | 7.47 | | | | | | |
| 5/11/10 9:29 | 12 | 291853 | 0.6 | 21.7 | 8.75 | | | | | | |
| 5/11/10 9:30 | 13 | 261418 | 0.6 | 21.0 | 7.50 | | | | | | |
| 5/11/10 9:31 | 12 | 289998 | 0.6 | 20.9 | 8.85 | | | | | | |
| 5/11/10 9:32 | 14 | 261296 | 0.6 | 21.5 | 7.31 | | | | | | |
| 5/11/10 9:33 | 12 | 289082 | 0.6 | 22.1 | 9.12 | | | | | | |
| 5/11/10 9:34 | 14 | 262693 | 0.6 | 21.4 | 7.35 | | | | | | |
| 5/11/10 9:35 | 12 | 291520 | 0.6 | 22.2 | 9.17 | | | | | | |
| 5/11/10 9:36 | 14 | 267349 | 0.6 | 21.3 | 7.11 | **Averages:** | **12.55** | **278,762** | **0.58** | **20.62** | **8.00** |
| 5/11/10 9:37 | 12 | 288459 | 0.6 | 22.9 | 9.57 | | | | | | |
| 5/11/10 9:38 | 13 | 276732 | 0.6 | 19.9 | 6.97 | | | | | | |
| 5/11/10 9:39 | 12 | 275273 | 0.6 | 22.2 | 9.29 | | | | | | |
| 5/11/10 9:40 | 12 | 292462 | 0.6 | 21.8 | 9.15 | | | | | | |
| 5/11/10 9:41 | 13 | 275477 | 0.6 | 20.3 | 7.31 | | | | | | |
| 5/11/10 9:42 | 13 | 278985 | 0.6 | 23.5 | 9.26 | | | | | | |
| 5/11/10 9:43 | 12 | 294607 | 0.6 | 21.3 | 8.71 | | | | | | |
| 5/11/10 9:44 | 14 | 278548 | 0.6 | 21.5 | 7.41 | | | | | | |
| 5/11/10 9:45 | 13 | 279206 | 0.6 | 22.8 | 9.06 | **Run 4** | | | | | |
| 5/11/10 9:46 | 13 | 280386 | 0.6 | 22.1 | 8.99 | | | | | | |
| 5/11/10 9:47 | 13 | 292060 | 0.6 | 22.0 | 8.31 | | | | | | |
| 5/11/10 9:48 | 14 | 274987 | 0.7 | 23.0 | 7.77 | | | | | | |
| 5/11/10 9:49 | 13 | 279806 | 0.6 | 24.0 | 9.19 | | | | | | |
| 5/11/10 9:50 | 13 | 289535 | 0.6 | 21.5 | 7.94 | | | | | | |
| 5/11/10 9:51 | 15 | 275754 | 0.7 | 23.8 | 8.01 | | | | | | |
| 5/11/10 9:52 | 14 | 281225 | 0.7 | 24.7 | 9.06 | | | | | | |
| 5/11/10 9:53 | 14 | 286579 | 0.7 | 22.7 | 7.77 | | | | | | |
| 5/11/10 9:54 | 15 | 279771 | 0.7 | 24.8 | 8.20 | | | | | | |
| 5/11/10 9:55 | 14 | 286319 | 0.7 | 24.9 | 8.89 | | | | | | |
| 5/11/10 9:56 | 14 | 286179 | 0.7 | 21.9 | 7.62 | | | | | | |
| 5/11/10 9:57 | 14 | 277273 | 0.7 | 24.1 | 8.25 | | | | | | |
| 5/11/10 9:58 | 14 | 292438 | 0.7 | 24.2 | 8.96 | | | | | | |
| 5/11/10 9:59 | 15 | 285642 | 0.7 | 21.9 | 6.87 | | | | | | |
| 5/11/10 10:00 | 15 | 279951 | 0.7 | 25.1 | 8.60 | | | | | | |
| 5/11/10 10:01 | 14 | 293737 | 0.7 | 25.0 | 8.97 | | | | | | |
| 5/11/10 10:02 | 15 | 282936 | 0.7 | 22.3 | 6.79 | | | | | | |
| 5/11/10 10:03 | 15 | 278138 | 0.7 | 25.8 | 8.65 | | | | | | |
| 5/11/10 10:04 | 14 | 293843 | 0.7 | 25.0 | 8.92 | | | | | | |
| 5/11/10 10:05 | 15 | 283386 | 0.7 | 22.2 | 6.78 | | | | | | |
| 5/11/10 10:06 | 15 | 279783 | 0.7 | 25.0 | 8.69 | **Averages:** | **14.16** | **283,588** | **0.67** | **23.60** | **8.29** |
| 5/11/10 10:07 | 13 | 298329 | 0.7 | 22.7 | 8.53 | | | | | | |
| 5/11/10 10:08 | 13 | 279353 | 0.6 | 19.5 | 6.75 | | | | | | |
| 5/11/10 10:09 | 13 | 289961 | 0.6 | 22.0 | 8.80 | | | | | | |
| 5/11/10 10:10 | 13 | 288232 | 0.6 | 20.0 | 7.05 | | | | | | |
| 5/11/10 10:11 | 13 | 276979 | 0.6 | 22.2 | 8.30 | | | | | | |
| 5/11/10 10:12 | 13 | 296687 | 0.6 | 21.5 | 8.35 | | | | | | |
| 5/11/10 10:13 | 14 | 266197 | 0.6 | 20.8 | 6.98 | | | | | | |
| 5/11/10 10:14 | 13 | 297036 | 0.6 | 22.4 | 8.73 | | | | | | |
| 5/11/10 10:15 | 14 | 266611 | 0.6 | 21.5 | 6.65 | **Run 5** | | | | | |
| 5/11/10 10:16 | 12 | 297951 | 0.6 | 21.0 | 8.67 | | | | | | |
| 5/11/10 10:17 | 14 | 266178 | 0.6 | 20.4 | 6.68 | | | | | | |
| 5/11/10 10:18 | 12 | 297890 | 0.6 | 21.6 | 8.74 | | | | | | |

| NOTE: CEM Times have not been changed to DST | SRU SO2 1 min ppm | Stack Flow 1 min SCFH | SRU SO2 1 min Lbs/hr | SRU SO2 Corr 0% O2 1 min ppm | O2 1 min % | | SRU SO2 1 min ppm | Stack Flow 1 min SCFH | SRU SO2 1 min Lbs/hr | SRU SO2 Corr 0% O2 1 min ppm | O2 1 min % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | Avg | Avg | Avg | Avg | Avg | | | | | | |
| 5/11/10 10:19 | 14 | 268869 | 0.6 | 21.7 | 6.77 | | | | | | |
| 5/11/10 10:20 | 14 | 299543 | 0.7 | 23.5 | 8.80 | | | | | | |
| 5/11/10 10:21 | 14 | 265325 | 0.6 | 21.6 | 6.74 | | | | | | |
| 5/11/10 10:22 | 13 | 295779 | 0.7 | 23.0 | 8.82 | | | | | | |
| 5/11/10 10:23 | 15 | 266617 | 0.7 | 21.7 | 6.60 | | | | | | |
| 5/11/10 10:24 | 14 | 299974 | 0.7 | 23.8 | 8.86 | | | | | | |
| 5/11/10 10:25 | 14 | 266522 | 0.6 | 21.1 | 6.62 | | | | | | |
| 5/11/10 10:26 | 12 | 297234 | 0.6 | 22.0 | 8.96 | | | | | | |
| 5/11/10 10:27 | 14 | 266750 | 0.6 | 20.4 | 6.61 | | | | | | |
| 5/11/10 10:28 | 13 | 295324 | 0.6 | 22.8 | 8.82 | | | | | | |
| 5/11/10 10:29 | 14 | 264480 | 0.6 | 21.1 | 6.67 | | | | | | |
| 5/11/10 10:30 | 13 | 296612 | 0.6 | 22.8 | 8.96 | | | | | | |
| 5/11/10 10:31 | 14 | 266663 | 0.6 | 20.4 | 6.55 | | | | | | |
| 5/11/10 10:32 | 12 | 297541 | 0.6 | 21.9 | 8.94 | | | | | | |
| 5/11/10 10:33 | 14 | 265142 | 0.6 | 20.0 | 6.52 | | | | | | |
| 5/11/10 10:34 | 13 | 298216 | 0.6 | 22.6 | 9.01 | | | | | | |
| 5/11/10 10:35 | 14 | 265796 | 0.6 | 20.3 | 6.42 | | | | | | |
| 5/11/10 10:36 | 12 | 293759 | 0.6 | 22.0 | 8.94 | **Averages:** | **13.46** | **281,762** | **0.63** | **21.68** | **7.74** |
| 5/11/10 10:37 | 13 | 265210 | 0.6 | 19.4 | 6.33 | | | | | | |
| 5/11/10 10:38 | 13 | 296713 | 0.6 | 22.9 | 8.98 | | | | | | |
| 5/11/10 10:39 | 14 | 264890 | 0.6 | 20.7 | 6.31 | | | | | | |
| 5/11/10 10:40 | 13 | 294932 | 0.6 | 22.7 | 9.08 | | | | | | |
| 5/11/10 10:41 | 14 | 264011 | 0.6 | 20.3 | 6.45 | | | | | | |
| 5/11/10 10:42 | 12 | 292892 | 0.6 | 21.9 | 9.01 | | | | | | |
| 5/11/10 10:43 | 14 | 262173 | 0.6 | 19.6 | 6.26 | | | | | | |
| 5/11/10 10:44 | 13 | 291444 | 0.6 | 23.1 | 9.29 | | | | | | |
| 5/11/10 10:45 | 13 | 262098 | 0.6 | 19.5 | 6.46 | **Run 6** | | | | | |
| 5/11/10 10:46 | 13 | 293420 | 0.6 | 23.0 | 9.27 | | | | | | |
| 5/11/10 10:47 | 13 | 259278 | 0.6 | 19.1 | 6.55 | | | | | | |
| 5/11/10 10:48 | 13 | 286088 | 0.6 | 23.0 | 9.36 | | | | | | |
| 5/11/10 10:49 | 14 | 262551 | 0.6 | 19.8 | 6.24 | | | | | | |
| 5/11/10 10:50 | 13 | 290838 | 0.6 | 23.7 | 9.39 | | | | | | |
| 5/11/10 10:51 | 14 | 261862 | 0.6 | 20.6 | 6.50 | | | | | | |
| 5/11/10 10:52 | 13 | 286963 | 0.6 | 23.9 | 9.61 | | | | | | |
| 5/11/10 10:53 | 14 | 264029 | 0.6 | 20.5 | 6.48 | | | | | | |
| 5/11/10 10:54 | 13 | 284414 | 0.6 | 24.5 | 9.48 | | | | | | |
| 5/11/10 10:55 | 14 | 266191 | 0.6 | 20.4 | 6.51 | | | | | | |
| 5/11/10 10:56 | 14 | 284873 | 0.6 | 25.2 | 9.61 | | | | | | |
| 5/11/10 10:57 | 13 | 270894 | 0.6 | 19.4 | 6.67 | | | | | | |
| 5/11/10 10:58 | 13 | 281639 | 0.6 | 23.2 | 9.37 | | | | | | |
| 5/11/10 10:59 | 13 | 268612 | 0.6 | 19.5 | 6.51 | | | | | | |
| 5/11/10 11:00 | 13 | 281215 | 0.6 | 24.2 | 9.41 | | | | | | |
| 5/11/10 11:01 | 14 | 276766 | 0.6 | 20.5 | 6.92 | | | | | | |
| 5/11/10 11:02 | 14 | 278372 | 0.7 | 25.2 | 9.14 | | | | | | |
| 5/11/10 11:03 | 14 | 279628 | 0.7 | 21.9 | 7.31 | | | | | | |
| 5/11/10 11:04 | 15 | 276649 | 0.7 | 25.6 | 8.85 | | | | | | |
| 5/11/10 11:05 | 13 | 283593 | 0.6 | 21.0 | 7.67 | | | | | | |
| 5/11/10 11:06 | 15 | 269426 | 0.7 | 25.2 | 8.25 | **Averages:** | **13.53** | **275,882** | **0.62** | **22.21** | **7.98** |
| 5/11/10 11:07 | 14 | 284499 | 0.7 | 23.7 | 8.22 | | | | | | |
| 5/11/10 11:08 | 15 | 264957 | 0.7 | 24.5 | 7.67 | | | | | | |
| 5/11/10 11:09 | 14 | 292951 | 0.7 | 24.1 | 8.68 | | | | | | |
| 5/11/10 11:10 | 15 | 263870 | 0.7 | 23.9 | 7.25 | | | | | | |
| 5/11/10 11:11 | 13 | 291700 | 0.6 | 23.5 | 8.99 | | | | | | |
| 5/11/10 11:12 | 16 | 263881 | 0.7 | 24.1 | 7.05 | | | | | | |
| 5/11/10 11:13 | 14 | 291463 | 0.7 | 25.8 | 9.33 | | | | | | |
| 5/11/10 11:14 | 16 | 263661 | 0.7 | 22.8 | 6.56 | | | | | | |
| 5/11/10 11:15 | 14 | 287793 | 0.7 | 25.5 | 9.52 | **Run 7** | | | | | |
| 5/11/10 11:16 | 15 | 269401 | 0.7 | 22.1 | 6.36 | | | | | | |
| 5/11/10 11:17 | 14 | 281663 | 0.7 | 26.2 | 9.36 | | | | | | |
| 5/11/10 11:18 | 15 | 272169 | 0.7 | 21.7 | 6.79 | | | | | | |
| 5/11/10 11:19 | 14 | 278925 | 0.6 | 24.5 | 9.18 | | | | | | |
| 5/11/10 11:20 | 14 | 279594 | 0.7 | 22.4 | 7.34 | | | | | | |
| 5/11/10 11:21 | 14 | 270329 | 0.6 | 24.5 | 8.64 | | | | | | |
| 5/11/10 11:22 | 14 | 287154 | 0.7 | 22.6 | 8.10 | | | | | | |
| 5/11/10 11:23 | 15 | 269847 | 0.7 | 24.4 | 7.86 | | | | | | |
| 5/11/10 11:24 | 14 | 292626 | 0.7 | 23.9 | 8.72 | | | | | | |

| NOTE: CEM Times have not been changed to DST | SRU SO2 1 min ppm | Stack Flow 1 min SCFH | SRU SO2 1 min Lbs/hr | SRU SO2 Corr 0% O2 1 min ppm | O2 1 min % | | SRU SO2 1 min ppm | Stack Flow 1 min SCFH | SRU SO2 1 min Lbs/hr | SRU SO2 Corr 0% O2 1 min ppm | O2 1 min % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | Avg | Avg | Avg | Avg | Avg | | | | | | |
| 5/11/10 11:25 | 15 | 266348 | 0.7 | 23.1 | 7.19 | | | | | | |
| 5/11/10 11:26 | 14 | 296498 | 0.7 | 25.0 | 9.20 | | | | | | |
| 5/11/10 11:27 | 15 | 270054 | 0.7 | 22.8 | 6.86 | | | | | | |
| 5/11/10 11:28 | 13 | 291292 | 0.6 | 23.1 | 9.42 | | | | | | |
| 5/11/10 11:29 | 14 | 263630 | 0.6 | 21.0 | 6.54 | | | | | | |
| 5/11/10 11:30 | 14 | 288383 | 0.7 | 25.5 | 9.51 | | | | | | |
| 5/11/10 11:31 | 14 | 268554 | 0.6 | 20.8 | 6.51 | | | | | | |
| 5/11/10 11:32 | 14 | 286283 | 0.7 | 25.1 | 9.44 | | | | | | |
| 5/11/10 11:33 | 13 | 268565 | 0.6 | 19.7 | 6.65 | | | | | | |
| 5/11/10 11:34 | 13 | 283020 | 0.6 | 23.1 | 9.43 | | | | | | |
| 5/11/10 11:35 | 14 | 269324 | 0.6 | 20.0 | 6.60 | | | | | | |
| 5/11/10 11:36 | 13 | 280506 | 0.6 | 23.1 | 9.33 | **Averages:** | **14.01** | **278,271** | **0.65** | **23.19** | **8.12** |
| 5/11/10 11:37 | 14 | 272287 | 0.6 | 20.4 | 6.85 | | | | | | |
| 5/11/10 11:38 | 13 | 279994 | 0.6 | 24.3 | 9.13 | | | | | | |
| 5/11/10 11:39 | 14 | 274807 | 0.6 | 20.1 | 6.82 | | | | | | |
| 5/11/10 11:40 | 14 | 279513 | 0.7 | 25.9 | 9.25 | | | | | | |
| 5/11/10 11:41 | 14 | 276482 | 0.7 | 21.7 | 7.06 | | | | | | |
| 5/11/10 11:42 | 15 | 275851 | 0.7 | 26.1 | 9.09 | | | | | | |
| 5/11/10 11:43 | 14 | 275504 | 0.6 | 21.7 | 7.16 | | | | | | |
| 5/11/10 11:44 | 14 | 272869 | 0.7 | 24.9 | 8.86 | | | | | | |
| 5/11/10 11:45 | 13 | 278292 | 0.6 | 20.9 | 7.44 | **Run 8** | | | | | |
| 5/11/10 11:46 | 14 | 269185 | 0.6 | 24.5 | 8.54 | | | | | | |
| 5/11/10 11:47 | 13 | 284635 | 0.6 | 21.6 | 7.94 | | | | | | |
| 5/11/10 11:48 | 14 | 264062 | 0.6 | 22.7 | 8.06 | | | | | | |
| 5/11/10 11:49 | 13 | 283825 | 0.6 | 21.9 | 8.35 | | | | | | |
| 5/11/10 11:50 | 14 | 263633 | 0.6 | 23.1 | 7.72 | | | | | | |
| 5/11/10 11:51 | 13 | 288136 | 0.6 | 21.9 | 8.81 | | | | | | |
| 5/11/10 11:52 | 14 | 258111 | 0.6 | 22.4 | 7.38 | | | | | | |
| 5/11/10 11:53 | 13 | 288638 | 0.6 | 23.7 | 9.21 | | | | | | |
| 5/11/10 11:54 | 14 | 260156 | 0.6 | 22.1 | 7.05 | | | | | | |
| 5/11/10 11:55 | 13 | 286870 | 0.6 | 24.0 | 9.55 | | | | | | |
| 5/11/10 11:56 | 14 | 257724 | 0.6 | 21.0 | 6.75 | | | | | | |
| 5/11/10 11:57 | 13 | 287398 | 0.6 | 25.1 | 9.66 | | | | | | |
| 5/11/10 11:58 | 14 | 257845 | 0.6 | 20.7 | 6.64 | | | | | | |
| 5/11/10 11:59 | 13 | 286839 | 0.7 | 25.0 | 9.53 | | | | | | |
| 5/11/10 12:00 | 13 | 261820 | 0.6 | 19.6 | 6.46 | | | | | | |
| 5/11/10 12:01 | 13 | 286848 | 0.6 | 23.8 | 9.61 | | | | | | |
| 5/11/10 12:02 | 14 | 262462 | 0.6 | 20.2 | 6.53 | | | | | | |
| 5/11/10 12:03 | 13 | 284960 | 0.6 | 23.5 | 9.52 | | | | | | |
| 5/11/10 12:04 | 14 | 264908 | 0.6 | 20.1 | 6.21 | | | | | | |
| 5/11/10 12:05 | 13 | 286068 | 0.6 | 24.1 | 9.59 | | | | | | |
| 5/11/10 12:06 | 16 | 266054 | 0.7 | 23.5 | 6.50 | **Averages:** | **13.65** | **274,021** | **0.62** | **22.51** | **8.05** |
| 5/11/10 12:07 | 13 | 286396 | 0.6 | 23.4 | 9.46 | | | | | | |
| 5/11/10 12:08 | 13 | 273352 | 0.6 | 19.3 | 6.70 | | | | | | |
| 5/11/10 12:09 | 13 | 282265 | 0.6 | 23.2 | 9.48 | | | | | | |
| 5/11/10 12:10 | 13 | 272673 | 0.6 | 19.3 | 6.95 | | | | | | |
| 5/11/10 12:11 | 12 | 278540 | 0.6 | 22.0 | 9.25 | | | | | | |
| 5/11/10 12:12 | 13 | 274239 | 0.6 | 19.6 | 7.07 | | | | | | |
| 5/11/10 12:13 | 13 | 271627 | 0.6 | 23.1 | 9.18 | | | | | | |
| 5/11/10 12:14 | 12 | 273610 | 0.6 | 19.2 | 7.26 | | | | | | |
| 5/11/10 12:15 | 12 | 269041 | 0.6 | 21.8 | 9.08 | **Run 9** | | | | | |
| 5/11/10 12:16 | 13 | 270751 | 0.6 | 20.1 | 7.48 | | | | | | |
| 5/11/10 12:17 | 12 | 266463 | 0.6 | 22.2 | 9.13 | | | | | | |
| 5/11/10 12:18 | 13 | 275513 | 0.6 | 20.7 | 7.91 | | | | | | |
| 5/11/10 12:19 | 14 | 265465 | 0.6 | 24.0 | 8.88 | | | | | | |
| 5/11/10 12:20 | 13 | 274735 | 0.6 | 21.9 | 8.15 | | | | | | |
| 5/11/10 12:21 | 13 | 260084 | 0.6 | 23.0 | 8.67 | | | | | | |
| 5/11/10 12:22 | 13 | 281720 | 0.6 | 21.0 | 8.26 | | | | | | |
| 5/11/10 12:23 | 13 | 258694 | 0.6 | 21.6 | 8.10 | | | | | | |
| 5/11/10 12:24 | 13 | 279887 | 0.6 | 21.5 | 8.52 | | | | | | |
| 5/11/10 12:25 | 13 | 258843 | 0.6 | 21.3 | 7.87 | | | | | | |
| 5/11/10 12:26 | 12 | 278745 | 0.6 | 21.4 | 8.71 | | | | | | |
| 5/11/10 12:27 | 13 | 252608 | 0.6 | 21.6 | 7.85 | | | | | | |
| 5/11/10 12:28 | 12 | 281276 | 0.6 | 22.0 | 9.01 | | | | | | |
| 5/11/10 12:29 | 13 | 260901 | 0.6 | 20.4 | 7.49 | | | | | | |
| 5/11/10 12:30 | 13 | 283162 | 0.6 | 23.2 | 9.57 | | | | | | |

| NOTE: CEM Times have not been changed to DST | SRU SO2 1 min ppm | Stack Flow 1 min SCFH | SRU SO2 1 min Lbs/hr | SRU SO2 Corr 0% O2 1 min ppm | O2 1 min % | | SRU SO2 1 min ppm | Stack Flow 1 min SCFH | SRU SO2 1 min Lbs/hr | SRU SO2 Corr 0% O2 1 min ppm | O2 1 min % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | Avg | Avg | Avg | Avg | Avg | | | | | | |
| 5/11/10 12:31 | 13 | 261657 | 0.6 | 19.8 | 6.90 | | | | | | |
| 5/11/10 12:32 | 12 | 275948 | 0.5 | 21.2 | 9.48 | | | | | | |
| 5/11/10 12:33 | 13 | 268820 | 0.6 | 19.2 | 6.95 | | | | | | |
| 5/11/10 12:34 | 13 | 268902 | 0.6 | 24.0 | 9.26 | | | | | | |
| 5/11/10 12:35 | 14 | 278022 | 0.6 | 22.5 | 8.02 | | | | | | |
| 5/11/10 12:36 | 14 | 262880 | 0.6 | 23.8 | 8.28 | **Averages:** | **12.87** | **269,733** | **0.58** | **21.73** | **8.34** |
| 5/11/10 12:37 | 13 | 284740 | 0.6 | 23.5 | 8.87 | | | | | | |
| 5/11/10 12:38 | 14 | 258330 | 0.6 | 22.8 | 7.47 | | | | | | |
| 5/11/10 12:39 | 13 | 284990 | 0.6 | 24.1 | 9.19 | | | | | | |
| 5/11/10 12:40 | 15 | 259222 | 0.6 | 21.7 | 6.71 | | | | | | |
| 5/11/10 12:41 | 14 | 283390 | 0.7 | 25.5 | 9.66 | | | | | | |
| 5/11/10 12:42 | 14 | 263496 | 0.6 | 20.7 | 6.54 | | | | | | |
| 5/11/10 12:43 | 14 | 281264 | 0.7 | 25.9 | 9.55 | | | | | | |
| 5/11/10 12:44 | 15 | 267060 | 0.7 | 22.4 | 6.69 | | | | | | |
| 5/11/10 12:45 | 14 | 278459 | 0.6 | 26.0 | 9.72 | | | | | | |

Dry

| Date / Time | Zone A H2S ppm 1 Minute Average | e A Raw H2S ppm 1 Minute Average | | H2S ppm 1 Minute Average | Raw H2S ppm 1 Minute |
|---|---|---|---|---|---|
| 5/12/2010 7:40 | 7.16 | 7.16 | | | |
| 5/12/2010 7:41 | 7.16 | 7.16 | | | |
| 5/12/2010 7:42 | 7.06 | 7.06 | | | |
| 5/12/2010 7:43 | 7.05 | 7.05 | | | |
| 5/12/2010 7:44 | 7.05 | 7.05 | | | |
| 5/12/2010 7:45 | 7.05 | 7.05 | Run 1 | | |
| 5/12/2010 7:46 | 7.05 | 7.05 | | | |
| 5/12/2010 7:47 | 7.15 | 7.15 | | | |
| 5/12/2010 7:48 | 7.16 | 7.16 | | | |
| 5/12/2010 7:49 | 7.16 | 7.16 | | | |
| 5/12/2010 7:50 | 7.15 | 7.15 | | | |
| 5/12/2010 7:51 | 7.15 | 7.15 | | | |
| 5/12/2010 7:52 | 7.16 | 7.16 | | | |
| 5/12/2010 7:53 | 7.15 | 7.15 | | | |
| 5/12/2010 7:54 | 7.16 | 7.16 | | | |
| 5/12/2010 7:55 | 7.16 | 7.16 | AVG | 7.14 | 7.14 |
| 5/12/2010 7:56 | 7.16 | 7.16 | | | |
| 5/12/2010 7:57 | 7.27 | 7.27 | | | |
| 5/12/2010 7:58 | 7.28 | 7.28 | | | |
| 5/12/2010 7:59 | 7.28 | 7.28 | | | |
| 5/12/2010 8:00 | 7.28 | 7.28 | | | |
| 5/12/2010 8:01 | 7.28 | 7.28 | | | |
| 5/12/2010 8:02 | 7.34 | 7.34 | | | |
| 5/12/2010 8:03 | 7.34 | 7.34 | | | |
| 5/12/2010 8:04 | 7.34 | 7.34 | | | |
| 5/12/2010 8:05 | 7.35 | 7.35 | | | |
| 5/12/2010 8:06 | 7.34 | 7.34 | | | |
| 5/12/2010 8:07 | 7.44 | 7.44 | | | |
| 5/12/2010 8:08 | 7.44 | 7.44 | | | |
| 5/12/2010 8:09 | 7.45 | 7.45 | | | |
| 5/12/2010 8:10 | 7.44 | 7.44 | | | |
| 5/12/2010 8:11 | 7.44 | 7.44 | | | |
| 5/12/2010 8:12 | 7.35 | 7.35 | | | |
| 5/12/2010 8:13 | 7.34 | 7.34 | | | |
| 5/12/2010 8:14 | 7.34 | 7.34 | | | |
| 5/12/2010 8:15 | 7.34 | 7.34 | Run 2 | | |
| 5/12/2010 8:16 | 7.34 | 7.34 | | | |
| 5/12/2010 8:17 | 7.17 | 7.17 | | | |
| 5/12/2010 8:18 | 7.16 | 7.16 | | | |
| 5/12/2010 8:19 | 7.16 | 7.16 | | | |
| 5/12/2010 8:20 | 7.16 | 7.16 | | | |

| Date / Time | Zone A H2S ppm 1 Minute Average | A Raw H2S ppm 1 Minute Average | | H2S ppm 1 Minute Average | Raw H2S ppm 1 Minute |
|---|---|---|---|---|---|
| 5/12/2010 8:21 | 7.16 | 7.16 | | | |
| 5/12/2010 8:22 | 7.07 | 7.07 | | | |
| 5/12/2010 8:23 | 7.05 | 7.05 | | | |
| 5/12/2010 8:24 | 7.05 | 7.05 | | | |
| 5/12/2010 8:25 | 7.05 | 7.05 | AVG | 7.16 | 7.16 |
| 5/12/2010 8:26 | 7.05 | 7.05 | | | |
| 5/12/2010 8:27 | 7.05 | 7.05 | | | |
| 5/12/2010 8:28 | 7.05 | 7.05 | | | |
| 5/12/2010 8:29 | 7.05 | 7.05 | | | |
| 5/12/2010 8:30 | 7.05 | 7.05 | | | |
| 5/12/2010 8:31 | 7.05 | 7.05 | | | |
| 5/12/2010 8:32 | 7.05 | 7.05 | | | |
| 5/12/2010 8:33 | 7.05 | 7.05 | | | |
| 5/12/2010 8:34 | 7.05 | 7.05 | | | |
| 5/12/2010 8:35 | 7.05 | 7.05 | | | |
| 5/12/2010 8:36 | 7.05 | 7.05 | | | |
| 5/12/2010 8:37 | 7.05 | 7.05 | | | |
| 5/12/2010 8:38 | 7.05 | 7.05 | | | |
| 5/12/2010 8:39 | 7.05 | 7.05 | | | |
| 5/12/2010 8:40 | 7.05 | 7.05 | | | |
| 5/12/2010 8:41 | 7.05 | 7.05 | | | |
| 5/12/2010 8:42 | 7.15 | 7.15 | | | |
| 5/12/2010 8:43 | 7.17 | 7.17 | | | |
| 5/12/2010 8:44 | 7.16 | 7.16 | | | |
| 5/12/2010 8:45 | 7.16 | 7.16 | Run 3 | | |
| 5/12/2010 8:46 | 7.16 | 7.16 | | | |
| 5/12/2010 8:47 | 7.16 | 7.16 | | | |
| 5/12/2010 8:48 | 7.16 | 7.16 | | | |
| 5/12/2010 8:49 | 7.17 | 7.17 | | | |
| 5/12/2010 8:50 | 7.16 | 7.16 | | | |
| 5/12/2010 8:51 | 7.17 | 7.17 | | | |
| 5/12/2010 8:52 | 7.17 | 7.17 | | | |
| 5/12/2010 8:53 | 7.17 | 7.17 | | | |
| 5/12/2010 8:54 | 7.16 | 7.16 | | | |
| 5/12/2010 8:55 | 7.17 | 7.17 | AVG | 7.16 | 7.16 |
| 5/12/2010 8:56 | 7.17 | 7.17 | | | |
| 5/12/2010 8:57 | 7.27 | 7.27 | | | |
| 5/12/2010 8:58 | 7.28 | 7.28 | | | |
| 5/12/2010 8:59 | 7.28 | 7.28 | | | |
| 5/12/2010 9:00 | 7.28 | 7.28 | | | |
| 5/12/2010 9:01 | 7.28 | 7.28 | | | |

| Date / Time | Zone A H2S ppm 1 Minute Average | | e A Raw H2S ppm 1 Minute Average | H2S ppm 1 Minute Average | Raw H2S ppm 1 Minute |
|---|---|---|---|---|---|
| 5/12/2010 9:02 | 7.17 | | 7.17 | | |
| 5/12/2010 9:03 | 7.16 | | 7.16 | | |
| 5/12/2010 9:04 | 7.17 | | 7.17 | | |
| 5/12/2010 9:05 | 7.16 | | 7.16 | | |
| 5/12/2010 9:06 | 7.16 | | 7.16 | | |
| 5/12/2010 9:07 | 7 | | 7 | | |
| 5/12/2010 9:08 | 6.99 | | 6.99 | | |
| 5/12/2010 9:09 | 6.98 | | 6.98 | | |
| 5/12/2010 9:10 | 6.98 | | 6.98 | | |
| 5/12/2010 9:11 | 6.98 | | 6.98 | | |
| 5/12/2010 9:12 | 6.98 | CALibration | 6.98 | | |
| 5/12/2010 9:13 | 6.98 | CALibration | 6.99 | | |
| 5/12/2010 9:14 | 6.98 | CALibration | 6.98 | | |
| 5/12/2010 9:15 | 6.98 | CALibration | 6.99 | | |
| 5/12/2010 9:16 | 6.98 | CALibration | 6.98 | | |
| 5/12/2010 9:17 | 6.98 | CALibration | 29.36 | | |
| 5/12/2010 9:18 | 6.98 | CALibration | 31.4 | | |
| 5/12/2010 9:19 | 6.98 | CALibration | 31.4 | | |
| 5/12/2010 9:20 | 6.98 | CALibration | 31.4 | | |
| 5/12/2010 9:21 | 6.98 | CALibration | 31.4 | | |
| 5/12/2010 9:22 | 6.98 | CALibration | 31.81 | | |
| 5/12/2010 9:23 | 6.98 | CALibration | 31.85 | | |
| 5/12/2010 9:24 | 6.98 | CALibration | 31.86 | | |
| 5/12/2010 9:25 | 6.98 | CALibration | 31.85 | | |
| 5/12/2010 9:26 | 6.98 | CALibration | 31.86 | | |
| 5/12/2010 9:27 | 6.98 | CALibration | 31.97 | | |
| 5/12/2010 9:28 | 6.98 | CALibration | 31.99 | | |
| 5/12/2010 9:29 | 6.98 | CALibration | 31.99 | | |
| 5/12/2010 9:30 | 6.98 | CALibration | 31.99 | | |
| 5/12/2010 9:31 | 6.98 | CALibration | 31.98 | | |
| 5/12/2010 9:32 | 6.98 | CALibration | 150.1 | | |
| 5/12/2010 9:33 | 6.98 | CALibration | 160.85 | | |
| 5/12/2010 9:34 | 6.98 | CALibration | 160.88 | | |
| 5/12/2010 9:35 | 6.98 | CALibration | 160.88 | | |
| 5/12/2010 9:36 | 6.98 | CALibration | 160.88 | | |
| 5/12/2010 9:37 | 6.98 | CALibration | 161.93 | | |
| 5/12/2010 9:38 | 6.98 | CALibration | 162.02 | | |
| 5/12/2010 9:39 | 6.98 | CALibration | 162.02 | | |
| 5/12/2010 9:40 | 6.98 | CALibration | 162.02 | | |
| 5/12/2010 9:41 | 6.98 | CALibration | 162.02 | | |
| 5/12/2010 9:42 | 6.98 | CALibration | 162.37 | | |

| Date / Time | Zone A H2S ppm 1 Minute Average | | e A Raw H2S ppm 1 Minute Average | | H2S ppm 1 Minute Average | Raw H2S ppm 1 Minute |
|---|---|---|---|---|---|---|
| 5/12/2010 9:43 | 6.98 | CALibration | 162.4 | | | |
| 5/12/2010 9:44 | 6.98 | CALibration | 162.4 | | | |
| 5/12/2010 9:45 | 6.98 | CALibration | 162.4 | | | |
| 5/12/2010 9:46 | 6.98 | CALibration | 162.4 | | | |
| 5/12/2010 9:47 | 6.98 | CALibration | 162.4 | | | |
| 5/12/2010 9:48 | 6.98 | CALibration | 162.4 | | | |
| 5/12/2010 9:49 | 6.98 | CALibration | 162.4 | | | |
| 5/12/2010 9:50 | 6.98 | CALibration | 162.4 | Run 4 | | |
| 5/12/2010 9:51 | 6.98 | CALibration | 162.4 | | | |
| 5/12/2010 9:52 | 7.71 | CALibration | 21.55 | | | |
| 5/12/2010 9:53 | 8.73 | | 8.73 | | | |
| 5/12/2010 9:54 | 8.72 | | 8.72 | | | |
| 5/12/2010 9:55 | 8.7 | | 8.7 | | | |
| 5/12/2010 9:56 | 8.68 | | 8.68 | | | |
| 5/12/2010 9:57 | 8 | | 8 | | | |
| 5/12/2010 9:58 | 7.92 | | 7.92 | | | |
| 5/12/2010 9:59 | 7.93 | | 7.93 | | | |
| 5/12/2010 10:00 | 7.92 | | 7.92 | AVG | 8.02 | 37.54 |
| 5/12/2010 10:01 | 7.91 | | 7.91 | | | |
| 5/12/2010 10:02 | 7.65 | | 7.65 | | | |
| 5/12/2010 10:03 | 7.63 | | 7.63 | | | |
| 5/12/2010 10:04 | 7.63 | | 7.63 | | | |
| 5/12/2010 10:05 | 7.63 | | 7.63 | | | |
| 5/12/2010 10:06 | 7.63 | | 7.63 | | | |
| 5/12/2010 10:07 | 7.52 | | 7.52 | | | |
| 5/12/2010 10:08 | 7.51 | | 7.51 | | | |
| 5/12/2010 10:09 | 7.51 | | 7.51 | | | |
| 5/12/2010 10:10 | 7.51 | | 7.51 | | | |
| 5/12/2010 10:11 | 7.51 | | 7.51 | | | |
| 5/12/2010 10:12 | 7.51 | | 7.51 | | | |
| 5/12/2010 10:13 | 7.51 | | 7.51 | | | |
| 5/12/2010 10:14 | 7.51 | | 7.51 | | | |
| 5/12/2010 10:15 | 7.51 | | 7.51 | | | |
| 5/12/2010 10:16 | 7.51 | | 7.51 | | | |
| 5/12/2010 10:17 | 7.45 | | 7.45 | | | |
| 5/12/2010 10:18 | 7.44 | | 7.44 | | | |
| 5/12/2010 10:19 | 7.46 | | 7.46 | | | |
| 5/12/2010 10:20 | 7.45 | | 7.45 | Run 5 | | |
| 5/12/2010 10:21 | 7.45 | | 7.45 | | | |
| 5/12/2010 10:22 | 7.3 | | 7.3 | | | |
| 5/12/2010 10:23 | 7.28 | | 7.28 | | | |

| Date / Time | Zone A H2S ppm 1 Minute Average | e A Raw H2S ppm 1 Minute Average | | H2S ppm 1 Minute Average | Raw H2S ppm 1 Minute |
|---|---|---|---|---|---|
| 5/12/2010 10:24 | 7.28 | 7.28 | | | |
| 5/12/2010 10:25 | 7.28 | 7.28 | | | |
| 5/12/2010 10:26 | 7.28 | 7.28 | | | |
| 5/12/2010 10:27 | 7.28 | 7.28 | | | |
| 5/12/2010 10:28 | 7.28 | 7.28 | | | |
| 5/12/2010 10:29 | 7.28 | 7.28 | | | |
| 5/12/2010 10:30 | 7.28 | 7.28 | AVG | 7.31 | 7.31 |
| 5/12/2010 10:31 | 7.28 | 7.28 | | | |
| 5/12/2010 10:32 | 7.17 | 7.17 | | | |
| 5/12/2010 10:33 | 7.17 | 7.17 | | | |
| 5/12/2010 10:34 | 7.17 | 7.17 | | | |
| 5/12/2010 10:35 | 7.17 | 7.17 | | | |
| 5/12/2010 10:36 | 7.17 | 7.17 | | | |
| 5/12/2010 10:37 | 7.01 | 7.01 | | | |
| 5/12/2010 10:38 | 6.99 | 6.99 | | | |
| 5/12/2010 10:39 | 6.98 | 6.98 | | | |
| 5/12/2010 10:40 | 6.99 | 6.99 | | | |
| 5/12/2010 10:41 | 6.99 | 6.99 | | | |
| 5/12/2010 10:42 | 7.05 | 7.05 | | | |
| 5/12/2010 10:43 | 7.05 | 7.05 | | | |
| 5/12/2010 10:44 | 7.05 | 7.05 | | | |
| 5/12/2010 10:45 | 7.05 | 7.05 | | | |
| 5/12/2010 10:46 | 7.05 | 7.05 | | | |
| 5/12/2010 10:47 | 7.26 | 7.26 | | | |
| 5/12/2010 10:48 | 7.28 | 7.28 | | | |
| 5/12/2010 10:49 | 7.28 | 7.28 | | | |
| 5/12/2010 10:50 | 7.28 | 7.28 | Run 6 | | |
| 5/12/2010 10:51 | 7.28 | 7.28 | | | |
| 5/12/2010 10:52 | 7.33 | 7.33 | | | |
| 5/12/2010 10:53 | 7.34 | 7.34 | | | |
| 5/12/2010 10:54 | 7.33 | 7.33 | | | |
| 5/12/2010 10:55 | 7.34 | 7.34 | | | |
| 5/12/2010 10:56 | 7.34 | 7.34 | | | |
| 5/12/2010 10:57 | 7.28 | 7.28 | | | |
| 5/12/2010 10:58 | 7.28 | 7.28 | | | |
| 5/12/2010 10:59 | 7.28 | 7.28 | | | |
| 5/12/2010 11:00 | 7.28 | 7.28 | AVG | 7.31 | 7.31 |
| 5/12/2010 11:01 | 7.28 | 7.28 | | | |
| 5/12/2010 11:02 | 7.28 | 7.28 | | | |
| 5/12/2010 11:03 | 7.28 | 7.28 | | | |
| 5/12/2010 11:04 | 7.28 | 7.28 | | | |

| Date / Time | Zone A H2S ppm 1 Minute Average | e A Raw H2S ppm 1 Minute Average | H2S ppm 1 Minute Average | Raw H2S ppm 1 Minute |
|---|---|---|---|---|
| 5/12/2010 11:05 | 7.28 | 7.28 | | |
| 5/12/2010 11:06 | 7.28 | 7.28 | | |
| 5/12/2010 11:07 | 7.16 | 7.16 | | |
| 5/12/2010 11:08 | 7.15 | 7.15 | | |
| 5/12/2010 11:09 | 7.16 | 7.16 | | |
| 5/12/2010 11:10 | 7.15 | 7.15 | | |
| 5/12/2010 11:11 | 7.15 | 7.15 | | |
| 5/12/2010 11:12 | 7.06 | 7.06 | | |
| 5/12/2010 11:13 | 7.05 | 7.05 | | |
| 5/12/2010 11:14 | 7.05 | 7.05 | | |
| 5/12/2010 11:15 | 7.05 | 7.05 | | |
| 5/12/2010 11:16 | 7.05 | 7.05 | | |
| 5/12/2010 11:17 | 6.98 | 6.98 | | |
| 5/12/2010 11:18 | 6.98 | 6.98 | | |
| 5/12/2010 11:19 | 6.98 | 6.98 | | |
| 5/12/2010 11:20 | 6.98 | 6.98 | **Run 7** | |
| 5/12/2010 11:21 | 6.98 | 6.98 | | |
| 5/12/2010 11:22 | 6.98 | 6.98 | | |
| 5/12/2010 11:23 | 6.98 | 6.98 | | |
| 5/12/2010 11:24 | 6.98 | 6.98 | | |
| 5/12/2010 11:25 | 6.98 | 6.98 | | |
| 5/12/2010 11:26 | 6.98 | 6.98 | | |
| 5/12/2010 11:27 | 7.14 | 7.14 | | |
| 5/12/2010 11:28 | 7.16 | 7.16 | | |
| 5/12/2010 11:29 | 7.16 | 7.16 | | |
| 5/12/2010 11:30 | 7.15 | 7.15 | **AVG** **7.04** | **7.04** |
| 5/12/2010 11:31 | 7.16 | 7.16 | | |
| 5/12/2010 11:32 | 7.31 | 7.31 | | |
| 5/12/2010 11:33 | 7.32 | 7.32 | | |
| 5/12/2010 11:34 | 7.33 | 7.33 | | |
| 5/12/2010 11:35 | 7.33 | 7.33 | | |
| 5/12/2010 11:36 | 7.34 | 7.34 | | |
| 5/12/2010 11:37 | 7.49 | 7.49 | | |
| 5/12/2010 11:38 | 7.51 | 7.51 | | |
| 5/12/2010 11:39 | 7.51 | 7.51 | | |
| 5/12/2010 11:40 | 7.51 | 7.51 | | |
| 5/12/2010 11:41 | 7.51 | 7.51 | | |
| 5/12/2010 11:42 | 7.72 | 7.72 | | |
| 5/12/2010 11:43 | 7.74 | 7.74 | | |
| 5/12/2010 11:44 | 7.73 | 7.73 | | |
| 5/12/2010 11:45 | 7.74 | 7.74 | | |

| Date / Time | Zone A H2S ppm 1 Minute Average | Zone A Raw H2S ppm 1 Minute Average | | H2S ppm 1 Minute Average | Raw H2S ppm 1 Minute |
|---|---|---|---|---|---|
| 5/12/2010 11:46 | 7.73 | 7.73 | | | |
| 5/12/2010 11:47 | 7.88 | 7.88 | | | |
| 5/12/2010 11:48 | 7.89 | 7.89 | | | |
| 5/12/2010 11:49 | 7.89 | 7.89 | | | |
| 5/12/2010 11:50 | 7.9 | 7.9 | Run 8 | | |
| 5/12/2010 11:51 | 7.9 | 7.9 | | | |
| 5/12/2010 11:52 | 7.75 | 7.75 | | | |
| 5/12/2010 11:53 | 7.74 | 7.74 | | | |
| 5/12/2010 11:54 | 7.74 | 7.74 | | | |
| 5/12/2010 11:55 | 7.73 | 7.73 | | | |
| 5/12/2010 11:56 | 7.74 | 7.74 | | | |
| 5/12/2010 11:57 | 7.53 | 7.53 | | | |
| 5/12/2010 11:58 | 7.51 | 7.51 | | | |
| 5/12/2010 11:59 | 7.51 | 7.51 | | | |
| 5/12/2010 12:00 | 7.51 | 7.51 | AVG | 7.69 | 7.69 |
| 5/12/2010 12:01 | 7.51 | 7.51 | | | |
| 5/12/2010 12:02 | 7.51 | 7.51 | | | |
| 5/12/2010 12:03 | 7.51 | 7.51 | | | |
| 5/12/2010 12:04 | 7.51 | 7.51 | | | |
| 5/12/2010 12:05 | 7.51 | 7.51 | | | |
| 5/12/2010 12:06 | 7.51 | 7.51 | | | |
| 5/12/2010 12:07 | 7.51 | 7.51 | | | |
| 5/12/2010 12:08 | 7.51 | 7.51 | | | |
| 5/12/2010 12:09 | 7.51 | 7.51 | | | |
| 5/12/2010 12:10 | 7.51 | 7.51 | | | |
| 5/12/2010 12:11 | 7.51 | 7.51 | | | |
| 5/12/2010 12:12 | 7.34 | 7.34 | | | |
| 5/12/2010 12:13 | 7.33 | 7.33 | | | |
| 5/12/2010 12:14 | 7.33 | 7.33 | | | |
| 5/12/2010 12:15 | 7.34 | 7.34 | | | |
| 5/12/2010 12:16 | 7.34 | 7.34 | | | |
| 5/12/2010 12:17 | 7.43 | 7.43 | | | |
| 5/12/2010 12:18 | 7.44 | 7.44 | | | |
| 5/12/2010 12:19 | 7.44 | 7.44 | | | |
| 5/12/2010 12:20 | 7.44 | 7.44 | Run 9 | | |
| 5/12/2010 12:21 | 7.44 | 7.44 | | | |
| 5/12/2010 12:22 | 7.5 | 7.5 | | | |
| 5/12/2010 12:23 | 7.51 | 7.51 | | | |
| 5/12/2010 12:24 | 7.51 | 7.51 | | | |
| 5/12/2010 12:25 | 7.51 | 7.51 | | | |
| 5/12/2010 12:26 | 7.51 | 7.51 | | | |

| Date / Time | Zone A H2S ppm 1 Minute Average | e A Raw H2S ppm 1 Minute Average | | H2S ppm 1 Minute Average | Raw H2S ppm 1 Minute |
|---|---|---|---|---|---|
| 5/12/2010 12:27 | 7.79 | 7.79 | | | |
| 5/12/2010 12:28 | 7.81 | 7.81 | | | |
| 5/12/2010 12:29 | 7.81 | 7.81 | | | |
| 5/12/2010 12:30 | 7.81 | 7.81 | AVG | 7.60 | 7.60 |
| 5/12/2010 12:31 | 7.81 | 7.81 | | | |
| 5/12/2010 12:32 | 7.81 | 7.81 | | | |
| 5/12/2010 12:33 | 7.81 | 7.81 | | | |
| 5/12/2010 12:34 | 7.81 | 7.81 | | | |
| 5/12/2010 12:35 | 7.81 | 7.81 | | | |
| 5/12/2010 12:36 | 7.81 | 7.81 | | | |
| 5/12/2010 12:37 | 7.88 | 7.88 | | | |
| 5/12/2010 12:38 | 7.89 | 7.89 | | | |
| 5/12/2010 12:39 | 7.89 | 7.89 | | | |
| 5/12/2010 12:40 | 7.89 | 7.89 | | | |
| 5/12/2010 12:41 | 7.89 | 7.89 | | | |
| 5/12/2010 12:42 | 7.82 | 7.82 | | | |
| 5/12/2010 12:43 | 7.81 | 7.81 | | | |
| 5/12/2010 12:44 | 7.81 | 7.81 | | | |
| 5/12/2010 12:45 | 7.81 | 7.81 | | | |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **1-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:10-09:31** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 9:10 | 39.8 | 2.6 | 37.2 |
| 2 | 9:11 | 36.3 | 2.7 | 37.2 |
| 3 | 9:12 | 34.6 | 2.5 | 37.0 |
| 4 | 9:13 | 36.8 | 2.4 | 37.9 |
| 5 | 9:14 | 36.3 | 2.7 | 37.3 |
| 6 | 9:15 | 39.0 | 2.4 | 37.0 |
| 7 | 9:16 | 36.9 | 2.5 | 37.7 |
| 8 | 9:17 | 34.8 | 2.6 | 37.3 |
| 9 | 9:18 | 37.4 | 2.6 | 37.4 |
| 10 | 9:19 | 37.2 | 2.6 | 37.1 |
| 11 | 9:20 | 34.3 | 2.5 | 37.8 |
| 12 | 9:21 | 38.5 | 2.7 | 37.9 |
| 13 | 9:22 | 35.5 | 2.7 | 37.4 |
| 14 | 9:23 | 35.5 | 2.6 | 37.3 |
| 15 | 9:24 | 38.7 | 2.4 | 37.6 |
| 16 | 9:25 | 36.0 | 2.6 | 37.9 |
| 17 | 9:26 | 37.5 | 2.5 | 37.0 |
| 18 | 9:27 | 36.2 | 2.5 | 37.5 |
| 19 | 9:28 | 39.6 | 2.6 | 37.2 |
| 20 | 9:29 | 37.0 | 2.8 | 37.2 |
| 21 | 9:30 | 39.9 | 2.6 | 37.9 |
| 22 | 9:31 | 36.1 | 2.7 | 37.4 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **37.00** | **2.58** | **37.42** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 1-COO2NOx
**Source :** Zone C FCCU **Date:** 05/03/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 8:37 | 0 | 0.3 | 0.3 |
| 8:35 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:33 | 0 | 0.3 | 0.3 | 0.0 |
| 9:35 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 8:37 | 0.0 | 0.1 | 0.5 |
| 8:35 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:33 | 0.0 | 0.1 | 0.5 | 0.0 |
| 9:35 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 42 | 44 seconds |
| $O_2$ | 37 | 35 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 1-COO2NOx
**Source:** Zone C FCCU **Date:** 05/03/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.1 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:31 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 8:41 | 0.0 | 0.2 | 0.2 |
| 8:39 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:33 | 0.0 | 0.2 | 0.2 | 0.0 |
| 9:37 | 51.5 | 51.3 | -0.2 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| $NO_x$ | 42 | 45 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.32 "Hg |
| Static Pressure | 0.15 "$H_2O$ |
| Ps | 26.331 "Hg |
| Gas Flow | 66,589.0 adcfm |
| Avg. Stack Temp, Ts | 507 °F |
| | 967 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 37.00 ppm v/v d |
| $O_2$ | 2.58 % v/v d |
| NOx | 37.42 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 37.1 ppm v/v d |
| $O_2$ | 2.5 % v/v d |
| $NO_x$ | 37.5 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

**Client:** CHS, Inc. - Laurel Refinery
**Location:** Laurel, Montana
**Source:** Zone C FCCU

**Run #:** 2-COO2NOx
**Time:** 09:41-10:02
**Date:** 05/03/10

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 9:41 | 38.2 | 2.8 | 37.1 |
| 2 | 9:42 | 39.5 | 2.6 | 37.1 |
| 3 | 9:43 | 35.6 | 2.7 | 37.3 |
| 4 | 9:44 | 34.2 | 2.6 | 37.2 |
| 5 | 9:45 | 35.8 | 2.5 | 36.7 |
| 6 | 9:46 | 33.8 | 2.4 | 37.0 |
| 7 | 9:47 | 35.3 | 2.4 | 37.1 |
| 8 | 9:48 | 37.5 | 2.4 | 37.0 |
| 9 | 9:49 | 38.9 | 2.4 | 37.2 |
| 10 | 9:50 | 40.8 | 2.4 | 37.3 |
| 11 | 9:51 | 42.2 | 2.5 | 37.6 |
| 12 | 9:52 | 38.9 | 2.5 | 37.8 |
| 13 | 9:53 | 38.1 | 2.6 | 37.8 |
| 14 | 9:54 | 39.5 | 2.6 | 37.5 |
| 15 | 9:55 | 38.2 | 2.7 | 37.5 |
| 16 | 9:56 | 35.1 | 2.7 | 37.3 |
| 17 | 9:57 | 36.5 | 2.8 | 37.3 |
| 18 | 9:58 | 35.7 | 2.8 | 37.2 |
| 19 | 9:59 | 37.5 | 2.8 | 37.4 |
| 20 | 10:00 | 40.8 | 2.9 | 38.0 |
| 21 | 10:01 | 37.1 | 2.9 | 37.8 |
| 22 | 10:02 | 37.0 | 2.7 | 36.3 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **37.55** | **2.62** | **37.30** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 2-COO2NOx
**Source :** Zone C FCCU **Date:** 05/03/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:33 | 0 | 0.3 | 0.3 |
| 9:35 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:04 | 0 | 0.3 | 0.3 | 0.0 |
| 10:06 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:33 | 0.0 | 0.1 | 0.5 |
| 9:35 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:04 | 0.0 | 0.1 | 0.5 | 0.0 |
| 10:06 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 42 | 44 seconds |
| $O_2$ | 37 | 35 seconds |

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.1 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:31 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:33 | 0.0 | 0.2 | 0.2 |
| 9:37 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:04 | 0.0 | 0.2 | 0.2 | 0.0 |
| 10:08 | 51.5 | 51.3 | -0.2 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| $NO_x$ | 42 | 45 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.32 "Hg |
| Static Pressure | 0.15 "$H_2O$ |
| Ps | 26.331 "Hg |
| Gas Flow | 66,685.5 adcfm |
| Avg. Stack Temp, Ts | 512 °F |
| | 972 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 37.55 ppm v/v d |
| $O_2$ | 2.62 % v/v d |
| NOx | 37.30 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 37.7 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 37.4 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

**Client:** CHS, Inc. - Laurel Refinery
**Location:** Laurel, Montana
**Source:** Zone C FCCU

**Run #:** 3-COO2NOx
**Time:** 10:12-10:33
**Date:** 05/03/10

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 10:12 | 32.3 | 2.6 | 38.6 |
| 2 | 10:13 | 31.8 | 2.4 | 37.5 |
| 3 | 10:14 | 39.0 | 2.2 | 35.6 |
| 4 | 10:15 | 42.1 | 2.2 | 35.6 |
| 5 | 10:16 | 42.1 | 2.2 | 36.2 |
| 6 | 10:17 | 39.0 | 2.4 | 37.0 |
| 7 | 10:18 | 39.0 | 2.5 | 37.7 |
| 8 | 10:19 | 38.2 | 2.4 | 35.3 |
| 9 | 10:20 | 38.7 | 2.4 | 34.9 |
| 10 | 10:21 | 42.7 | 2.9 | 38.9 |
| 11 | 10:22 | 39.1 | 2.3 | 35.6 |
| 12 | 10:23 | 40.0 | 2.7 | 36.7 |
| 13 | 10:24 | 47.1 | 2.7 | 36.9 |
| 14 | 10:25 | 48.6 | 2.3 | 35.7 |
| 15 | 10:26 | 38.0 | 2.3 | 36.1 |
| 16 | 10:27 | 42.2 | 2.2 | 35.7 |
| 17 | 10:28 | 40.4 | 2.1 | 35.1 |
| 18 | 10:29 | 38.1 | 2.1 | 35.8 |
| 19 | 10:30 | 41.0 | 2.3 | 37.0 |
| 20 | 10:31 | 38.0 | 2.4 | 37.5 |
| 21 | 10:32 | 38.0 | 2.6 | 38.1 |
| 22 | 10:33 | 38.7 | 2.9 | 38.7 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **39.73** | **2.41** | **36.65** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 3-COO2NOx
**Source :** Zone C FCCU **Date:** 05/03/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:04 | 0 | 0.3 | 0.3 |
| 10:06 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:35 | 0 | 0.4 | 0.4 | 0.1 |
| 10:37 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:04 | 0.0 | 0.1 | 0.5 |
| 10:06 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:35 | 0.0 | 0.1 | 0.5 | 0.0 |
| 10:37 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 42 | 44 seconds |
| $O_2$ | 37 | 35 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 3-COO2NOx
**Source:** Zone C FCCU **Date:** 05/03/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.1 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:31 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:04 | 0.0 | 0.2 | 0.2 |
| 10:08 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:35 | 0.0 | 0.1 | 0.1 | -0.1 |
| 10:39 | 51.5 | 51.3 | -0.2 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 42 | 45 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.32 "Hg |
| Static Pressure | 0.15 "$H_2O$ |
| Ps | 26.331 "Hg |
| Gas Flow | 66,630.5 adcfm |
| Avg. Stack Temp, Ts | 503 °F |
| | 963 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 39.73 ppm v/v d |
| $O_2$ | 2.41 % v/v d |
| NOx | 36.65 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 39.9 ppm v/v d |
| $O_2$ | 2.3 % v/v d |
| $NO_x$ | 36.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **4-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:43-11:04** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 10:43 | 34.1 | 2.7 | 38.4 |
| 2 | 10:44 | 27.5 | 2.8 | 39.2 |
| 3 | 10:45 | 28.5 | 2.8 | 39.4 |
| 4 | 10:46 | 26.9 | 2.8 | 39.6 |
| 5 | 10:47 | 27.2 | 2.6 | 37.9 |
| 6 | 10:48 | 30.5 | 2.3 | 36.1 |
| 7 | 10:49 | 36.1 | 2.3 | 36.1 |
| 8 | 10:50 | 35.8 | 2.3 | 36.3 |
| 9 | 10:51 | 35.1 | 2.3 | 36.9 |
| 10 | 10:52 | 34.6 | 2.5 | 37.9 |
| 11 | 10:53 | 36.4 | 2.7 | 39.9 |
| 12 | 10:54 | 35.5 | 2.7 | 40.6 |
| 13 | 10:55 | 31.3 | 2.7 | 38.8 |
| 14 | 10:56 | 34.2 | 2.8 | 38.2 |
| 15 | 10:57 | 32.5 | 2.9 | 38.5 |
| 16 | 10:58 | 32.6 | 3.0 | 39.8 |
| 17 | 10:59 | 31.1 | 3.0 | 40.2 |
| 18 | 11:00 | 36.1 | 3.1 | 41.2 |
| 19 | 11:01 | 36.2 | 3.0 | 40.0 |
| 20 | 11:02 | 35.6 | 2.5 | 36.7 |
| 21 | 11:03 | 31.7 | 2.3 | 35.2 |
| 22 | 11:04 | 33.7 | 2.3 | 35.1 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **32.87** | **2.65** | **38.27** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 4-COO2NOx
**Source :** Zone C FCCU **Date:** 05/03/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:35 | 0 | 0.4 | 0.4 |
| 10:37 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:06 | 0 | 0.4 | 0.4 | 0.0 |
| 11:08 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:35 | 0.0 | 0.1 | 0.5 |
| 10:37 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:06 | 0.0 | 0.1 | 0.5 | 0.0 |
| 11:08 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 42 | 44 seconds |
| $O_2$ | 37 | 35 seconds |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **4-COO2NOx** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.1 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:31 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:35 | 0.0 | 0.1 | 0.1 |
| 10:39 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:06 | 0.0 | 0.1 | 0.1 | 0.0 |
| 11:10 | 51.5 | 51.2 | -0.3 | -0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 42 | 45 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.32 | "Hg |
| Static Pressure | 0.15 | "$H_2O$ |
| Ps | 26.331 | "Hg |
| Gas Flow | 66,150.7 | adcfm |
| Avg. Stack Temp, Ts | 510 | °F |
| | 970 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 32.87 ppm v/v d |
| $O_2$ | 2.65 % v/v d |
| NOx | 38.27 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 32.9 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 38.4 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **5-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:14-11:35** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 11:14 | 37.0 | 2.1 | 35.8 |
| 2 | 11:15 | 37.3 | 2.1 | 36.1 |
| 3 | 11:16 | 39.8 | 2.2 | 36.5 |
| 4 | 11:17 | 35.9 | 2.4 | 37.6 |
| 5 | 11:18 | 35.9 | 2.7 | 39.1 |
| 6 | 11:19 | 37.9 | 2.9 | 40.5 |
| 7 | 11:20 | 35.4 | 2.9 | 40.5 |
| 8 | 11:21 | 39.3 | 2.8 | 39.0 |
| 9 | 11:22 | 37.6 | 2.8 | 37.8 |
| 10 | 11:23 | 35.3 | 2.6 | 36.8 |
| 11 | 11:24 | 37.0 | 2.5 | 36.1 |
| 12 | 11:25 | 37.9 | 2.4 | 36.0 |
| 13 | 11:26 | 39.1 | 2.4 | 36.2 |
| 14 | 11:27 | 36.7 | 2.4 | 36.2 |
| 15 | 11:28 | 35.6 | 2.4 | 36.4 |
| 16 | 11:29 | 36.8 | 2.4 | 36.8 |
| 17 | 11:30 | 39.3 | 2.5 | 36.8 |
| 18 | 11:31 | 33.6 | 2.6 | 38.3 |
| 19 | 11:32 | 28.8 | 2.6 | 38.8 |
| 20 | 11:33 | 26.5 | 2.5 | 37.6 |
| 21 | 11:34 | 37.9 | 2.5 | 37.0 |
| 22 | 11:35 | 35.4 | 2.6 | 37.0 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **36.18** | **2.51** | **37.40** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 5-COO2NOx
**Source :** Zone C FCCU **Date:** 05/03/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:06 | 0 | 0.4 | 0.4 |
| 11:08 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:37 | 0 | 0.3 | 0.3 | -0.1 |
| 11:39 | 44.4 | 44.1 | -0.3 | -0.1 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:06 | 0.0 | 0.1 | 0.5 |
| 11:08 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:37 | 0.0 | 0.0 | 0.0 | -0.5 |
| 11:39 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 42 | 44 seconds |
| $O_2$ | 37 | 35 seconds |

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.1 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:31 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:06 | 0.0 | 0.1 | 0.1 |
| 11:10 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:37 | 0.0 | 0.2 | 0.2 | 0.1 |
| 11:41 | 51.5 | 51.2 | -0.3 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| $NO_x$ | 42 | 45 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.32 "Hg |
| Static Pressure | 0.15 "$H_2O$ |
| Ps | 26.331 "Hg |
| Gas Flow | 66,294.5 adcfm |
| Avg. Stack Temp, Ts | 502 °F |
| | 962 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 36.18 ppm v/v d |
| $O_2$ | 2.51 % v/v d |
| NOx | 37.40 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 36.3 ppm v/v d |
| $O_2$ | 2.5 % v/v d |
| $NO_x$ | 37.6 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **6-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:45-12:06** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 11:45 | 45.6 | 2.4 | 35.7 |
| 2 | 11:46 | 35.2 | 2.5 | 36.4 |
| 3 | 11:47 | 36.6 | 2.5 | 36.5 |
| 4 | 11:48 | 34.2 | 2.6 | 36.6 |
| 5 | 11:49 | 39.6 | 2.6 | 36.4 |
| 6 | 11:50 | 34.4 | 2.6 | 36.3 |
| 7 | 11:51 | 38.8 | 2.6 | 36.7 |
| 8 | 11:52 | 35.1 | 2.5 | 36.3 |
| 9 | 11:53 | 39.1 | 2.5 | 35.7 |
| 10 | 11:54 | 38.6 | 2.6 | 36.4 |
| 11 | 11:55 | 38.9 | 2.6 | 36.1 |
| 12 | 11:56 | 38.3 | 2.6 | 36.4 |
| 13 | 11:57 | 38.1 | 2.6 | 37.4 |
| 14 | 11:58 | 39.5 | 2.6 | 38.1 |
| 15 | 11:59 | 29.9 | 2.6 | 38.4 |
| 16 | 12:00 | 29.6 | 2.5 | 37.5 |
| 17 | 12:01 | 38.8 | 2.5 | 38.2 |
| 18 | 12:02 | 40.0 | 2.6 | 38.1 |
| 19 | 12:03 | 35.5 | 2.5 | 37.5 |
| 20 | 12:04 | 35.7 | 2.5 | 37.2 |
| 21 | 12:05 | 39.9 | 2.7 | 37.4 |
| 22 | 12:06 | 35.1 | 2.9 | 38.7 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **37.11** | **2.57** | **37.00** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 6-COO2NOx
**Source :** Zone C FCCU **Date:** 05/03/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:37 | 0 | 0.3 | 0.3 |
| 11:39 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:08 | 0 | 0.3 | 0.3 | 0.0 |
| 12:10 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:37 | 0.0 | 0.0 | 0.0 |
| 11:39 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:08 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12:10 | 8.51 | 8.4 | -0.5 | -0.5 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 42 | 44 seconds |
| $O_2$ | 37 | 35 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 6-COO2NOx
**Source:** Zone C FCCU **Date:** 05/03/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.1 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:31 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:37 | 0.0 | 0.2 | 0.2 |
| 11:41 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:08 | 0.0 | 0.2 | 0.2 | 0.0 |
| 12:12 | 51.5 | 51.2 | -0.3 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| $NO_x$ | 42 | 45 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.32 "Hg |
| Static Pressure | 0.15 "$H_2O$ |
| Ps | 26.331 "Hg |
| Gas Flow | 66,033.7 adcfm |
| Avg. Stack Temp, Ts | 513 °F |
| | 973 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 37.11 ppm v/v d |
| $O_2$ | 2.57 % v/v d |
| NOx | 37.00 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 37.3 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 37.2 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **7-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:16-12:37** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 12:16 | 31.9 | 2.7 | 38.3 |
| 2 | 12:17 | 32.2 | 2.7 | 38.7 |
| 3 | 12:18 | 29.7 | 2.7 | 38.7 |
| 4 | 12:19 | 30.9 | 2.7 | 38.7 |
| 5 | 12:20 | 29.9 | 2.6 | 38.7 |
| 6 | 12:21 | 31.9 | 2.6 | 40.5 |
| 7 | 12:22 | 31.4 | 2.7 | 40.8 |
| 8 | 12:23 | 33.0 | 2.5 | 39.2 |
| 9 | 12:24 | 32.6 | 2.2 | 37.7 |
| 10 | 12:25 | 31.5 | 2.2 | 36.8 |
| 11 | 12:26 | 30.7 | 2.3 | 36.8 |
| 12 | 12:27 | 32.2 | 2.5 | 37.4 |
| 13 | 12:28 | 31.0 | 2.5 | 37.7 |
| 14 | 12:29 | 32.8 | 2.6 | 37.6 |
| 15 | 12:30 | 30.3 | 2.6 | 37.6 |
| 16 | 12:31 | 32.0 | 2.6 | 37.4 |
| 17 | 12:32 | 29.6 | 2.6 | 37.8 |
| 18 | 12:33 | 31.4 | 2.8 | 38.9 |
| 19 | 12:34 | 30.9 | 2.9 | 38.9 |
| 20 | 12:35 | 31.9 | 2.9 | 39.8 |
| 21 | 12:36 | 33.1 | 2.9 | 40.0 |
| 22 | 12:37 | 30.7 | 2.8 | 39.6 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **31.44** | **2.62** | **38.53** |

**Client:** CHS, Inc. - Laurel Refinery
**Source :** Zone C FCCU

**Test #:** 7-COO2NOx
**Date:** 05/03/10

## Instrument Calibration Checks

Calibration Span, CS: 98.0 ppm v/v Dry

CO Instrument

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:08 | 0 | 0.3 | 0.3 |
| 12:10 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:39 | 0 | 0.3 | 0.3 | 0.0 |
| 12:41 | 44.4 | 44.1 | -0.3 | 0.0 |

Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Instrument

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:08 | 0.0 | 0.0 | 0.0 |
| 12:10 | 8.51 | 8.4 | -0.5 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:39 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12:41 | 8.51 | 8.4 | -0.5 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 42 | 44 seconds |
| $O_2$ | 37 | 35 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 7-COO2NOx
**Source:** Zone C FCCU **Date:** 05/03/10

**Instrument Calibration Checks - continued**

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.1 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:31 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:08 | 0.0 | 0.2 | 0.2 |
| 12:12 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:39 | 0.0 | 0.2 | 0.2 | 0.0 |
| 12:43 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 42 | 45 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.32 "Hg |
| Static Pressure | 0.15 "$H_2O$ |
| Ps | 26.331 "Hg |
| Gas Flow | 65,839.2 adcfm |
| Avg. Stack Temp, Ts | 513 °F |
| | 973 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 31.44 ppm v/v d |
| $O_2$ | 2.62 % v/v d |
| NOx | 38.53 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 31.6 ppm v/v d |
| $O_2$ | 2.7 % v/v d |
| $NO_x$ | 38.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **8-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:47-13:08** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 12:47 | 34.7 | 2.6 | 39.5 |
| 2 | 12:48 | 33.4 | 2.5 | 38.3 |
| 3 | 12:49 | 34.0 | 2.5 | 38.0 |
| 4 | 12:50 | 35.6 | 2.5 | 37.8 |
| 5 | 12:51 | 32.9 | 2.6 | 38.8 |
| 6 | 12:52 | 34.3 | 2.6 | 39.6 |
| 7 | 12:53 | 33.3 | 2.6 | 39.8 |
| 8 | 12:54 | 35.7 | 2.5 | 38.6 |
| 9 | 12:55 | 33.0 | 2.5 | 38.1 |
| 10 | 12:56 | 33.9 | 2.5 | 38.0 |
| 11 | 12:57 | 33.6 | 2.5 | 38.1 |
| 12 | 12:58 | 34.5 | 2.5 | 38.3 |
| 13 | 12:59 | 35.6 | 2.5 | 38.3 |
| 14 | 13:00 | 35.1 | 2.4 | 38.0 |
| 15 | 13:01 | 34.1 | 2.5 | 38.1 |
| 16 | 13:02 | 35.4 | 2.6 | 39.6 |
| 17 | 13:03 | 35.4 | 2.8 | 39.9 |
| 18 | 13:04 | 35.9 | 2.7 | 40.3 |
| 19 | 13:05 | 33.8 | 2.6 | 39.2 |
| 20 | 13:06 | 33.9 | 2.7 | 38.3 |
| 21 | 13:07 | 34.6 | 2.7 | 37.9 |
| 22 | 13:08 | 33.4 | 2.6 | 37.4 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **34.37** | **2.57** | **38.63** |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **8-COO2NOx** |
| **Source :** | **Zone C FCCU** | **Date:** | **05/03/10** |

**Instrument Calibration Checks**

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:39 | 0 | 0.3 | 0.3 |
| 12:41 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:10 | 0 | 0.3 | 0.3 | 0.0 |
| 13:12 | 44.4 | 44.2 | -0.2 | 0.1 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:39 | 0.0 | 0.0 | 0.0 |
| 12:41 | 8.51 | 8.4 | -0.5 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:10 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13:12 | 8.51 | 8.5 | 0.0 | 0.5 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| CO | 42 | 44 seconds |
| $O_2$ | 37 | 35 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 8-COO2NOx
**Source:** Zone C FCCU **Date:** 05/03/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.1 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:31 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:39 | 0.0 | 0.2 | 0.2 |
| 12:43 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:10 | 0.0 | 0.3 | 0.3 | 0.1 |
| 13:14 | 51.5 | 51.3 | -0.2 | 0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 42 | 45 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.32 "Hg |
| Static Pressure | 0.15 "$H_2O$ |
| Ps | 26.331 "Hg |
| Gas Flow | 65,723.7 adcfm |
| Avg. Stack Temp, Ts | 505 °F |
| | 965 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 34.37 ppm v/v d |
| $O_2$ | 2.57 % v/v d |
| NOx | 38.63 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 34.5 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 38.8 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **9-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:18-13:39** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 13:18 | 39.8 | 2.8 | 39.1 |
| 2 | 13:19 | 38.9 | 2.8 | 39.4 |
| 3 | 13:20 | 37.6 | 2.7 | 38.5 |
| 4 | 13:21 | 36.0 | 2.5 | 37.7 |
| 5 | 13:22 | 38.1 | 2.4 | 38.2 |
| 6 | 13:23 | 35.1 | 2.4 | 37.6 |
| 7 | 13:24 | 38.1 | 2.3 | 37.4 |
| 8 | 13:25 | 35.4 | 2.3 | 37.2 |
| 9 | 13:26 | 37.8 | 2.4 | 37.2 |
| 10 | 13:27 | 34.9 | 2.5 | 37.9 |
| 11 | 13:28 | 34.1 | 2.7 | 37.8 |
| 12 | 13:29 | 35.6 | 2.4 | 37.8 |
| 13 | 13:30 | 36.4 | 2.6 | 38.0 |
| 14 | 13:31 | 40.0 | 2.8 | 38.5 |
| 15 | 13:32 | 34.2 | 2.7 | 38.1 |
| 16 | 13:33 | 36.9 | 2.6 | 37.5 |
| 17 | 13:34 | 34.5 | 2.6 | 37.7 |
| 18 | 13:35 | 35.2 | 2.7 | 37.9 |
| 19 | 13:36 | 38.4 | 2.5 | 37.5 |
| 20 | 13:37 | 34.7 | 2.6 | 38.0 |
| 21 | 13:38 | 36.1 | 2.7 | 38.2 |
| 22 | 13:39 | 37.6 | 2.5 | 38.3 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **36.61** | **2.57** | **37.98** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 9-COO2NOx
**Source :** Zone C FCCU **Date:** 05/03/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 13:10 | 0 | 0.3 | 0.3 |
| 13:12 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:41 | 0 | 0.3 | 0.3 | 0.0 |
| 13:43 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 13:10 | 0.0 | 0.0 | 0.0 |
| 13:12 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:41 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13:43 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 42 | 44 seconds |
| $O_2$ | 37 | 35 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 9-COO2NOx
**Source:** Zone C FCCU **Date:** 05/03/10

**Instrument Calibration Checks - continued**

$NO_x$ Instrument Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.1 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:31 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 13:10 | 0.0 | 0.3 | 0.3 |
| 13:14 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:41 | 0.0 | 0.3 | 0.3 | 0.0 |
| 13:45 | 51.5 | 51.3 | -0.2 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 42 | 45 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.32 | "Hg |
| Static Pressure | 0.15 | "$H_2O$ |
| Ps | 26.331 | "Hg |
| Gas Flow | 66,440.8 | adcfm |
| Avg. Stack Temp, Ts | 509 | °F |
| | 969 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 36.61 ppm v/v d |
| $O_2$ | 2.57 % v/v d |
| NOx | 37.98 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 36.7 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 38.0 ppm v/v d |

**CHS, Inc. - Laurel Refinery**
**Zone C FCCU**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/03/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 8:20 | 0.2 | 0.0 | 0.1 | Initial Calibrations/Tank IDS |
| 8:21 | 0.2 | 0.0 | 0.1 | **$O_2$ Tanks** |
| 8:22 | 0.2 | 0.0 | 0.1 | ET0003451 @ 8.51%; Exp. 09/28/12 |
| 8:23 | 31.1 | 5.3 | 0.1 | ET0003519 @ 20.5%; Exp. 06/19/12 |
| 8:24 | 44.3 | 8.5 | 0.1 | $O_2$ Instrument: Servomex 1400 |
| 8:25 | 5.3 | 2.0 | 33.5 | **$NO_x$ Tanks** |
| 8:26 | 0.3 | 0.0 | 51.4 | LL82176 @ 51.5 ppm; Exp. 10-19-11 |
| 8:27 | 68.4 | 15.2 | 7.4 | LL31587 @ 100.7 ppm; Exp. 08-11-10 |
| 8:28 | 97.6 | 20.4 | 0.1 | LL82188 @ 53.3 ppm; Exp. 10-29-11 |
| 8:29 | 10.4 | 3.4 | 0.1 | $NO_x$ Instrument: CAI 400 |
| 8:30 | 0.2 | 0.0 | 71.6 | **CO Tanks** |
| 8:31 | 0.2 | 0.0 | 100.4 | ET0003451 @ 44.4 ppm; Exp. 09-28-12 |
| 8:32 | 0.2 | 0.0 | 17.3 | ET0003462 @ 98.0 ppm; Exp. 09-28-12 |
| 8:33 | 0.2 | 0.0 | 0.1 | CO Instrument: CAI 200 |
| 8:34 | 34.1 | 5.9 | 0.1 | $CO/O_2$ Response Time |
| 8:35 | 44.2 | 8.5 | 0.1 | |
| 8:36 | 7.8 | 1.7 | 0.1 | $CO/O_2$ Response Time |
| 8:37 | 0.3 | 0.1 | 0.1 | |
| 8:38 | 0.3 | 0.1 | 30.5 | $NO_x$ Response Time |
| 8:39 | 0.3 | 0.1 | 51.3 | |
| 8:40 | 0.2 | 0.0 | 6.4 | $NO_x$ Response Time |
| 8:41 | 0.2 | 0.0 | 0.2 | |
| 8:42 | 0.2 | 0.0 | 0.2 | |
| 8:43 | 0.2 | 0.0 | 30.7 | |
| 8:44 | 0.2 | 0.0 | 49.4 | |
| 8:45 | 0.2 | 0.0 | 49.4 | $NO_2$ Conversion Efficiency Check |
| 8:46 | 0.2 | 0.0 | 13.5 | |
| 8:47 | 0.2 | 0.0 | 0.2 | |
| 8:48 | 0.2 | 0.0 | 0.2 | |
| 8:49 | 0.2 | 0.0 | 0.2 | |
| 8:50 | 0.2 | 0.0 | 0.2 | |
| 8:51 | 0.2 | 0.0 | 0.2 | |
| 8:52 | 0.2 | 0.0 | 0.2 | |
| 8:53 | 0.2 | 0.0 | 0.2 | |
| 8:54 | 15.3 | 0.8 | 10.5 | |
| 8:55 | 34.5 | 2.8 | 37.9 | |
| 8:56 | 38.9 | 2.5 | 37.6 | |
| 8:57 | 41.4 | 2.5 | 37.2 | |
| 8:58 | 39.0 | 2.5 | 37.9 | |
| 8:59 | 42.1 | 2.5 | 37.0 | |
| 9:00 | 40.5 | 2.6 | 37.2 | |

**CHS, Inc. - Laurel Refinery**
**Zone C FCCU**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/03/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 9:01 | 36.3 | 2.8 | 37.5 | |
| 9:02 | 34.8 | 2.6 | 37.3 | |
| 9:03 | 35.0 | 2.4 | 38.0 | |
| 9:04 | 36.6 | 2.6 | 37.4 | |
| 9:05 | 37.8 | 2.6 | 37.5 | |
| 9:06 | 37.0 | 2.7 | 37.6 | |
| 9:07 | 39.1 | 2.8 | 37.6 | |
| 9:08 | 35.1 | 2.5 | 37.6 | |
| 9:09 | 37.7 | 2.5 | 37.5 | |
| 9:10 | 39.8 | 2.6 | 37.2 | Start Run 1 |
| 9:11 | 36.3 | 2.7 | 37.2 | |
| 9:12 | 34.6 | 2.5 | 37.0 | |
| 9:13 | 36.8 | 2.4 | 37.9 | |
| 9:14 | 36.3 | 2.7 | 37.3 | |
| 9:15 | 39.0 | 2.4 | 37.0 | |
| 9:16 | 36.9 | 2.5 | 37.7 | |
| 9:17 | 34.8 | 2.6 | 37.3 | |
| 9:18 | 37.4 | 2.6 | 37.4 | |
| 9:19 | 37.2 | 2.6 | 37.1 | |
| 9:20 | 34.3 | 2.5 | 37.8 | |
| 9:21 | 38.5 | 2.7 | 37.9 | |
| 9:22 | 35.5 | 2.7 | 37.4 | |
| 9:23 | 35.5 | 2.6 | 37.3 | |
| 9:24 | 38.7 | 2.4 | 37.6 | |
| 9:25 | 36.0 | 2.6 | 37.9 | |
| 9:26 | 37.5 | 2.5 | 37.0 | |
| 9:27 | 36.2 | 2.5 | 37.5 | |
| 9:28 | 39.6 | 2.6 | 37.2 | |
| 9:29 | 37.0 | 2.8 | 37.2 | |
| 9:30 | 39.9 | 2.6 | 37.9 | |
| 9:31 | 36.1 | 2.7 | 37.4 | End Run 1 |
| 9:32 | 5.3 | 0.3 | 4.9 | |
| 9:33 | 0.3 | 0.1 | 0.2 | |
| 9:34 | 31.0 | 4.9 | 0.2 | |
| 9:35 | 44.2 | 8.5 | 0.2 | |
| 9:36 | 6.7 | 1.3 | 35.1 | |
| 9:37 | 0.3 | 0.1 | 51.3 | |
| 9:38 | 0.3 | 0.1 | 7.1 | |
| 9:39 | 0.3 | 0.1 | 0.3 | |
| 9:40 | 21.1 | 2.0 | 14.6 | |
| 9:41 | 38.2 | 2.8 | 37.1 | Start Run 2 |
| 9:42 | 39.5 | 2.6 | 37.1 | |

**CHS, Inc. - Laurel Refinery**
**Zone C FCCU**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/03/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 9:43 | 35.6 | 2.7 | 37.3 | |
| 9:44 | 34.2 | 2.6 | 37.2 | |
| 9:45 | 35.8 | 2.5 | 36.7 | |
| 9:46 | 33.8 | 2.4 | 37.0 | |
| 9:47 | 35.3 | 2.4 | 37.1 | |
| 9:48 | 37.5 | 2.4 | 37.0 | |
| 9:49 | 38.9 | 2.4 | 37.2 | |
| 9:50 | 40.8 | 2.4 | 37.3 | |
| 9:51 | 42.2 | 2.5 | 37.6 | |
| 9:52 | 38.9 | 2.5 | 37.8 | |
| 9:53 | 38.1 | 2.6 | 37.8 | |
| 9:54 | 39.5 | 2.6 | 37.5 | |
| 9:55 | 38.2 | 2.7 | 37.5 | |
| 9:56 | 35.1 | 2.7 | 37.3 | |
| 9:57 | 36.5 | 2.8 | 37.3 | |
| 9:58 | 35.7 | 2.8 | 37.2 | |
| 9:59 | 37.5 | 2.8 | 37.4 | |
| 10:00 | 40.8 | 2.9 | 38.0 | |
| 10:01 | 37.1 | 2.9 | 37.8 | |
| 10:02 | 37.0 | 2.7 | 36.3 | End Run 2 |
| 10:03 | 11.3 | 0.3 | 8.1 | |
| 10:04 | 0.3 | 0.1 | 0.2 | |
| 10:05 | 29.8 | 5.0 | 0.2 | |
| 10:06 | 44.2 | 8.5 | 0.2 | |
| 10:07 | 10.4 | 2.1 | 30.8 | |
| 10:08 | 0.4 | 0.1 | 51.3 | |
| 10:09 | 0.3 | 0.1 | 14.6 | |
| 10:10 | 0.3 | 0.1 | 0.3 | |
| 10:11 | 17.0 | 1.7 | 20.0 | |
| 10:12 | 32.3 | 2.6 | 38.6 | Start Run 3 |
| 10:13 | 31.8 | 2.4 | 37.5 | |
| 10:14 | 39.0 | 2.2 | 35.6 | |
| 10:15 | 42.1 | 2.2 | 35.6 | |
| 10:16 | 42.1 | 2.2 | 36.2 | |
| 10:17 | 39.0 | 2.4 | 37.0 | |
| 10:18 | 39.0 | 2.5 | 37.7 | |
| 10:19 | 38.2 | 2.4 | 35.3 | |
| 10:20 | 38.7 | 2.4 | 34.9 | |
| 10:21 | 42.7 | 2.9 | 38.9 | |
| 10:22 | 39.1 | 2.3 | 35.6 | |
| 10:23 | 40.0 | 2.7 | 36.7 | |
| 10:24 | 47.1 | 2.7 | 36.9 | |

**CHS, Inc. - Laurel Refinery**
**Zone C FCCU**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/03/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 10:25 | 48.6 | 2.3 | 35.7 | |
| 10:26 | 38.0 | 2.3 | 36.1 | |
| 10:27 | 42.2 | 2.2 | 35.7 | |
| 10:28 | 40.4 | 2.1 | 35.1 | |
| 10:29 | 38.1 | 2.1 | 35.8 | |
| 10:30 | 41.0 | 2.3 | 37.0 | |
| 10:31 | 38.0 | 2.4 | 37.5 | |
| 10:32 | 38.0 | 2.6 | 38.1 | |
| 10:33 | 38.7 | 2.9 | 38.7 | End Run 3 |
| 10:34 | 5.8 | 0.2 | 4.8 | |
| 10:35 | 0.4 | 0.1 | 0.1 | |
| 10:36 | 32.7 | 6.1 | 0.1 | |
| 10:37 | 44.2 | 8.5 | 0.1 | |
| 10:38 | 7.9 | 3.2 | 36.3 | |
| 10:39 | 0.4 | 0.1 | 51.3 | |
| 10:40 | 0.4 | 0.1 | 12.7 | |
| 10:41 | 0.3 | 0.1 | 0.2 | |
| 10:42 | 15.4 | 1.1 | 17.7 | |
| 10:43 | 34.1 | 2.7 | 38.4 | Start Run 4 |
| 10:44 | 27.5 | 2.8 | 39.2 | |
| 10:45 | 28.5 | 2.8 | 39.4 | |
| 10:46 | 26.9 | 2.8 | 39.6 | |
| 10:47 | 27.2 | 2.6 | 37.9 | |
| 10:48 | 30.5 | 2.3 | 36.1 | |
| 10:49 | 36.1 | 2.3 | 36.1 | |
| 10:50 | 35.8 | 2.3 | 36.3 | |
| 10:51 | 35.1 | 2.3 | 36.9 | |
| 10:52 | 34.6 | 2.5 | 37.9 | |
| 10:53 | 36.4 | 2.7 | 39.9 | |
| 10:54 | 35.5 | 2.7 | 40.6 | |
| 10:55 | 31.3 | 2.7 | 38.8 | |
| 10:56 | 34.2 | 2.8 | 38.2 | |
| 10:57 | 32.5 | 2.9 | 38.5 | |
| 10:58 | 32.6 | 3.0 | 39.8 | |
| 10:59 | 31.1 | 3.0 | 40.2 | |
| 11:00 | 36.1 | 3.1 | 41.2 | |
| 11:01 | 36.2 | 3.0 | 40.0 | |
| 11:02 | 35.6 | 2.5 | 36.7 | |
| 11:03 | 31.7 | 2.3 | 35.2 | |
| 11:04 | 33.7 | 2.3 | 35.1 | End Run 4 |
| 11:05 | 10.5 | 0.3 | 8.8 | |
| 11:06 | 0.4 | 0.1 | 0.1 | |

**CHS, Inc. - Laurel Refinery**
**Zone C FCCU**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/03/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 11:07 | 34.1 | 5.1 | 0.1 | |
| 11:08 | 44.2 | 8.5 | 0.1 | |
| 11:09 | 9.4 | 2.2 | 36.6 | |
| 11:10 | 0.4 | 0.1 | 51.2 | |
| 11:11 | 0.4 | 0.1 | 9.9 | |
| 11:12 | 0.4 | 0.1 | 0.2 | |
| 11:13 | 20.3 | 0.9 | 22.1 | |
| 11:14 | 37.0 | 2.1 | 35.8 | Start Run 5 |
| 11:15 | 37.3 | 2.1 | 36.1 | |
| 11:16 | 39.8 | 2.2 | 36.5 | |
| 11:17 | 35.9 | 2.4 | 37.6 | |
| 11:18 | 35.9 | 2.7 | 39.1 | |
| 11:19 | 37.9 | 2.9 | 40.5 | |
| 11:20 | 35.4 | 2.9 | 40.5 | |
| 11:21 | 39.3 | 2.8 | 39.0 | |
| 11:22 | 37.6 | 2.8 | 37.8 | |
| 11:23 | 35.3 | 2.6 | 36.8 | |
| 11:24 | 37.0 | 2.5 | 36.1 | |
| 11:25 | 37.9 | 2.4 | 36.0 | |
| 11:26 | 39.1 | 2.4 | 36.2 | |
| 11:27 | 36.7 | 2.4 | 36.2 | |
| 11:28 | 35.6 | 2.4 | 36.4 | |
| 11:29 | 36.8 | 2.4 | 36.8 | |
| 11:30 | 39.3 | 2.5 | 36.8 | |
| 11:31 | 33.6 | 2.6 | 38.3 | |
| 11:32 | 28.8 | 2.6 | 38.8 | |
| 11:33 | 26.5 | 2.5 | 37.6 | |
| 11:34 | 37.9 | 2.5 | 37.0 | |
| 11:35 | 35.4 | 2.6 | 37.0 | End Run 5 |
| 11:36 | 12.6 | 0.1 | 11.3 | |
| 11:37 | 0.3 | 0.0 | 0.2 | |
| 11:38 | 30.4 | 6.0 | 0.2 | |
| 11:39 | 44.1 | 8.5 | 0.2 | |
| 11:40 | 7.6 | 2.1 | 39.9 | |
| 11:41 | 0.3 | 0.0 | 51.2 | |
| 11:42 | 0.3 | 0.0 | 8.0 | |
| 11:43 | 0.3 | 0.0 | 0.3 | |
| 11:44 | 24.1 | 1.8 | 9.1 | |
| 11:45 | 45.6 | 2.4 | 35.7 | Start Run 6 |
| 11:46 | 35.2 | 2.5 | 36.4 | |
| 11:47 | 36.6 | 2.5 | 36.5 | |
| 11:48 | 34.2 | 2.6 | 36.6 | |

**CHS, Inc. - Laurel Refinery**
**Zone C FCCU**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/03/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 11:49 | 39.6 | 2.6 | 36.4 | |
| 11:50 | 34.4 | 2.6 | 36.3 | |
| 11:51 | 38.8 | 2.6 | 36.7 | |
| 11:52 | 35.1 | 2.5 | 36.3 | |
| 11:53 | 39.1 | 2.5 | 35.7 | |
| 11:54 | 38.6 | 2.6 | 36.4 | |
| 11:55 | 38.9 | 2.6 | 36.1 | |
| 11:56 | 38.3 | 2.6 | 36.4 | |
| 11:57 | 38.1 | 2.6 | 37.4 | |
| 11:58 | 39.5 | 2.6 | 38.1 | |
| 11:59 | 29.9 | 2.6 | 38.4 | |
| 12:00 | 29.6 | 2.5 | 37.5 | |
| 12:01 | 38.8 | 2.5 | 38.2 | |
| 12:02 | 40.0 | 2.6 | 38.1 | |
| 12:03 | 35.5 | 2.5 | 37.5 | |
| 12:04 | 35.7 | 2.5 | 37.2 | |
| 12:05 | 39.9 | 2.7 | 37.4 | |
| 12:06 | 35.1 | 2.9 | 38.7 | End Run 6 |
| 12:07 | 5.5 | 0.1 | 13.2 | |
| 12:08 | 0.3 | 0.0 | 0.2 | |
| 12:09 | 35.7 | 4.3 | 0.2 | |
| 12:10 | 44.1 | 8.4 | 0.2 | |
| 12:11 | 7.2 | 1.1 | 30.2 | |
| 12:12 | 0.4 | 0.0 | 51.2 | |
| 12:13 | 0.3 | 0.0 | 11.8 | |
| 12:14 | 0.3 | 0.0 | 0.3 | |
| 12:15 | 19.3 | 2.0 | 20.8 | |
| 12:16 | 31.9 | 2.7 | 38.3 | Start Run 7 |
| 12:17 | 32.2 | 2.7 | 38.7 | |
| 12:18 | 29.7 | 2.7 | 38.7 | |
| 12:19 | 30.9 | 2.7 | 38.7 | |
| 12:20 | 29.9 | 2.6 | 38.7 | |
| 12:21 | 31.9 | 2.6 | 40.5 | |
| 12:22 | 31.4 | 2.7 | 40.8 | |
| 12:23 | 33.0 | 2.5 | 39.2 | |
| 12:24 | 32.6 | 2.2 | 37.7 | |
| 12:25 | 31.5 | 2.2 | 36.8 | |
| 12:26 | 30.7 | 2.3 | 36.8 | |
| 12:27 | 32.2 | 2.5 | 37.4 | |
| 12:28 | 31.0 | 2.5 | 37.7 | |
| 12:29 | 32.8 | 2.6 | 37.6 | |
| 12:30 | 30.3 | 2.6 | 37.6 | |

**CHS, Inc. - Laurel Refinery**
**Zone C FCCU**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/03/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 12:31 | 32.0 | 2.6 | 37.4 | |
| 12:32 | 29.6 | 2.6 | 37.8 | |
| 12:33 | 31.4 | 2.8 | 38.9 | |
| 12:34 | 30.9 | 2.9 | 38.9 | |
| 12:35 | 31.9 | 2.9 | 39.8 | |
| 12:36 | 33.1 | 2.9 | 40.0 | |
| 12:37 | 30.7 | 2.8 | 39.6 | End Run 7 |
| 12:38 | 8.8 | 0.3 | 11.1 | |
| 12:39 | 0.3 | 0.0 | 0.2 | |
| 12:40 | 33.3 | 4.5 | 0.2 | |
| 12:41 | 44.1 | 8.4 | 0.2 | |
| 12:42 | 13.1 | 2.3 | 37.7 | |
| 12:43 | 0.3 | 0.0 | 51.2 | |
| 12:44 | 0.3 | 0.0 | 6.0 | |
| 12:45 | 0.3 | 0.0 | 0.2 | |
| 12:46 | 20.7 | 1.1 | 19.2 | |
| 12:47 | 34.7 | 2.6 | 39.5 | Start Run 8 |
| 12:48 | 33.4 | 2.5 | 38.3 | |
| 12:49 | 34.0 | 2.5 | 38.0 | |
| 12:50 | 35.6 | 2.5 | 37.8 | |
| 12:51 | 32.9 | 2.6 | 38.8 | |
| 12:52 | 34.3 | 2.6 | 39.6 | |
| 12:53 | 33.3 | 2.6 | 39.8 | |
| 12:54 | 35.7 | 2.5 | 38.6 | |
| 12:55 | 33.0 | 2.5 | 38.1 | |
| 12:56 | 33.9 | 2.5 | 38.0 | |
| 12:57 | 33.6 | 2.5 | 38.1 | |
| 12:58 | 34.5 | 2.5 | 38.3 | |
| 12:59 | 35.6 | 2.5 | 38.3 | |
| 13:00 | 35.1 | 2.4 | 38.0 | |
| 13:01 | 34.1 | 2.5 | 38.1 | |
| 13:02 | 35.4 | 2.6 | 39.6 | |
| 13:03 | 35.4 | 2.8 | 39.9 | |
| 13:04 | 35.9 | 2.7 | 40.3 | |
| 13:05 | 33.8 | 2.6 | 39.2 | |
| 13:06 | 33.9 | 2.7 | 38.3 | |
| 13:07 | 34.6 | 2.7 | 37.9 | |
| 13:08 | 33.4 | 2.6 | 37.4 | End Run 8 |
| 13:09 | 12.1 | 0.3 | 9.0 | |
| 13:10 | 0.3 | 0.0 | 0.3 | |
| 13:11 | 28.4 | 5.1 | 0.3 | |
| 13:12 | 44.2 | 8.5 | 0.2 | |

**CHS, Inc. - Laurel Refinery**
**Zone C FCCU**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/03/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 13:13 | 9.7 | 2.0 | 31.5 | |
| 13:14 | 0.4 | 0.0 | 51.3 | |
| 13:15 | 0.3 | 0.0 | 13.1 | |
| 13:16 | 0.3 | 0.0 | 0.3 | |
| 13:17 | 24.8 | 1.6 | 20.8 | |
| 13:18 | 39.8 | 2.8 | 39.1 | Start Run 9 |
| 13:19 | 38.9 | 2.8 | 39.4 | |
| 13:20 | 37.6 | 2.7 | 38.5 | |
| 13:21 | 36.0 | 2.5 | 37.7 | |
| 13:22 | 38.1 | 2.4 | 38.2 | |
| 13:23 | 35.1 | 2.4 | 37.6 | |
| 13:24 | 38.1 | 2.3 | 37.4 | |
| 13:25 | 35.4 | 2.3 | 37.2 | |
| 13:26 | 37.8 | 2.4 | 37.2 | |
| 13:27 | 34.9 | 2.5 | 37.9 | |
| 13:28 | 34.1 | 2.7 | 37.8 | |
| 13:29 | 35.6 | 2.4 | 37.8 | |
| 13:30 | 36.4 | 2.6 | 38.0 | |
| 13:31 | 40.0 | 2.8 | 38.5 | |
| 13:32 | 34.2 | 2.7 | 38.1 | |
| 13:33 | 36.9 | 2.6 | 37.5 | |
| 13:34 | 34.5 | 2.6 | 37.7 | |
| 13:35 | 35.2 | 2.7 | 37.9 | |
| 13:36 | 38.4 | 2.5 | 37.5 | |
| 13:37 | 34.7 | 2.6 | 38.0 | |
| 13:38 | 36.1 | 2.7 | 38.2 | |
| 13:39 | 37.6 | 2.5 | 38.3 | End Run 9 |
| 13:40 | 8.6 | 0.4 | 6.9 | |
| 13:41 | 0.3 | 0.0 | 0.3 | |
| 13:42 | 36.1 | 6.2 | 0.3 | |
| 13:43 | 44.2 | 8.5 | 0.3 | |
| 13:44 | 12.0 | 3.1 | 40.2 | |
| 13:45 | 0.4 | 0.0 | 51.3 | |
| 13:46 | 0.3 | 0.0 | 11.6 | |
| 13:47 | 0.3 | 0.0 | 0.3 | |
| 13:48 | 0.3 | 0.0 | 0.3 | |
| 13:49 | 0.3 | 0.0 | 0.3 | |

# EPA METHODS #1- 4 & 6
# $SO_2$/GAS FLOW/MOISTURE
# EXAMPLE CALCULATION

COMPANY NAME: CHS, INC. - Laurel Refinery
PLANT LOCATION: Laurel, MT
SOURCE TESTED: FCCU
TEST DATE: 5/3/10
RUN #: 1 - $SO_2$ GF $H_2O$

Pm"Hg = 26.32 Pb"Hg + (2.12 ΔH"$H_2O$/13.6) = 26.476 (③) Pm"Hg

Ps"Hg = 26.32 Pb"Hg + (0.15 Static"$H_2O$/13.6) = 26.331 (③) Ps"Hg

1) Vm(std) = (15.390 (③) Vm)(17.65)(0.99 (②) Y) (26.476 Pm"Hg / 521 (①) Tm°A) = 13.666 (③) dscf ✓

2) Vw(std) = (0.04707)(27.0 gms $H_2O$) = 1.2709 (③) scf $H_2O$ ✓

3) Bws = (1.271 scf $H_2O$) / (1.271 scf $H_2O$ + 13.666 dscf Vm) = 0.085 (③) Bws x 100 = 8.51 (③) %$H_2O$

4) Vm(actual) = (0.99 Y)(15,390 Vm) / (1- 0.085 Bws) (967 Ts°A / 521 (①) Tm°A) (26.476 Pm"Hg / 26.331 (③) Ps"Hg) = 31.079 (③) awcf

5) Md = 0.44(15.7 (①) %$CO_2$) + 0.32(2.5 (①) %$O_2$) + 0.28(81.8 (①) %$N_2$ + %CO) = 30.61 (②) lb/lb mole

6) Ms = (30.61 lb/lb mole)(1- 0.085 Bws) + (18 x 0.085 Bws) = 29.54 (②) lb/lb mole

7a) Area = (3.1416)(7.000 (③) dia ft./2)² = 38.485 (③) sq.ft. ⊗

7b) Area = (____ (③) ft.)(____ (③) ft.) = ____ (③) sq.ft. □

8) Vs = (85.49)(0.84 (②) Cp)(Avg SQRT ΔP / 0.3937 (②))(√(967 Ts°A / 26.331 Ps"Hg(29.54 lb/lb mole))) = 31.52 (②) fps

9a) AWCFM = (31.52 fps)(38.485 sq.ft)(60sec/min) = 72,782.8 (①) awcfm

9b) ADCFM = (72,782.8 awcfm)(1- 0.085 Bws) = 66,589.0 (①) adcfm

10a)

Qsw = 3600(31.52 fps)(38.485 sq.ft)(528°A / 967 Ts°A)(26.331 Ps"Hg / 29.92 "Hg) = 2,098,424.8 (①) wscf/hr

10b)

Qsd = (1- 0.085 Bws)(2,098,424.8 wscf/hr) = 1,919,848.9 (①) dscf/hr

EEMC

# EPA METHODS #1- 4 & 6
# $SO_2$/GAS FLOW/MOISTURE
# EXAMPLE CALCULATION

COMPANY NAME: CHS, Inc. - Laurel Refinery
PLANT LOCATION: Laurel, Refinery
SOURCE TESTED: FCCU

TEST DATE: 5/3/10
RUN #: 1

Normality (N) = 0.0101

ml Ba ** = 33

11) Concentration $SO_2$ - ppm v/v dry

$$\text{ppm v/v dry} = \frac{(33 \text{ ml Ba++})(32)(0.0101 \text{ N})(13.29)}{(13,666 \text{ Vm std, dscf})} = 10.4 \text{ ppm v/v dry}$$

12) Concentration $SO_2$ - ppm v/v actual

ppm v/v actual = (10.4 ppm v/v dry)(1 - 0.085 Bws) = 9.5 ppm v/v actual

13) Concentration (Cd) $SO_2$ - lbs/dscf

$$\text{lbs/dscf} = \frac{(7.061 \times 10^{-5})(33 \text{ ml Ba}^{++})(0.0101 \text{ N})}{(13.666 \text{ Vm std, dscf})} = 1.72e^{-6} \text{ lbs/dscf}$$

~~14)~~ Emissions - lbs/MMBtu - Power Generation Sources Only

lbs/MMBtu = (_____ Cd)(_____ Fd)(20.9/(20.9 - _____ %$O_2$)) = _____ lbs/MMBtu

15) Emissions - lbs/hr

lbs/hr = ($1.72e^{-6}$ lbs/dscf)(1,919,848.9 dscf/hr) = 3.30 lbs/hr

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **1-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:10-09:31** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 710.000 | 0.15 | 2.12 | 61 | 508 | 0.3873 |
| 2 | 14 | | 0.15 | 2.12 | 61 | 508 | 0.3873 |
| 3 | 21 | | 0.16 | 2.12 | 61 | 508 | 0.4000 |
| 4 | | 725.390 | 0.16 | | | 508 | 0.4000 |
| 5 | | | 0.16 | | | 507 | 0.4000 |
| 6 | | | 0.16 | | | 507 | 0.4000 |
| 7 | | | 0.16 | | | 507 | 0.4000 |
| 8 | | | 0.15 | | | 507 | 0.3873 |
| 1 | | | 0.15 | | | 507 | 0.3873 |
| 2 | | | 0.15 | | | 506 | 0.3873 |
| 3 | | | 0.15 | | | 506 | 0.3873 |
| 4 | | | 0.16 | | | 506 | 0.4000 |
| 5 | | | 0.16 | | | 506 | 0.4000 |
| 6 | | | 0.16 | | | 506 | 0.4000 |
| 7 | | | 0.15 | | | 506 | 0.3873 |
| 8 | | | 0.15 | | | 506 | 0.3873 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.32 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 7.000 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.390 dcf | Stack Area | 38.485 sq.ft. |
| Water Volume | 27.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 2.5 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 33 ml |
| $\%CO_2$ Average | 15.7 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **1-SO2/GF** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.3937 "$H_2O$ |
| Avg Meter Temp. (Tm) | 61 °F | Avg Stack Temp. (Ts) | 507 °F |
| Avg Meter Temp. (Tm) | 521 °A (°R) | Avg Stack Temp. (Ts) | 967 °A (°R) |
| Pressure Meter (Pm) | 26.476 "Hg | Pressure Stack (Ps) | 26.331 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.666 dscf | Velocity (Vs) | 31.52 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 31.079 awcf | Volume (actual conditions) | 72,782.8 awcfm |
| Volume Water | | | 66,589.0 adcfm |
| Vapor, Vw(std) | 1.271 scf | Volume (std. conditions) | 2,098,424.8 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 34,973.7 wscfm |
| Moisture (Bws) | 0.0851 | | 1,919,848.8 dscf/hr |
| Percent Moisture | 8.51 %v | | 31,997.5 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.61 lb/lb-mole | Dry Basis | 10.4 ppmv d |
| Wet (Ms) | 29.54 lb/lb-mole | Wet Basis | 9.5 ppmv a |
| | | $SO_2$ Concentration | 1.720E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 3.30 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: FCC
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 1
DATE: 5/3/10
START TIME: 910
END TIME: 931

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.32 BAROMETRIC PRESSURE ("Hg)

- 1606 PITOT
- 3R METER BOX
- .99 Y FACTOR
- ± .15 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 13 POST
- TRAIN LEAK TEST, ($ft^3$/min) 000 PRE 002 POST
- 84" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 210.800 | | | | | | | | | |
| 1 | 2 | | | 2.12 | 61 | 5 | — | 45 | 505 | 15.8 | |
| 2 | 14 | | | 2.12 | 61 | 5 | | 45 | 508 | | |
| 3 | 21 | 225.390 | | 2.12 | 61 | 5 | | 46 | 507 | | |
| | | +15.390 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 508 | | |
| 2 | | | .15 | | | | | | 508 | | |
| 3 | | | .16 | | | | | | 508 | | |
| 4 | | | .16 | | | | | | 508 | | |
| 5 | | | .16 | | | | | | 507 | | |
| 6 | | | .16 | | | | | | 507 | | |
| 7 | | | .16 | | | | | | 507 | | |
| 8 | | | .15 | | | | | | 507 | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 507 | | |
| 2 | | | .15 | | | | | | 506 | | |
| 3 | | | .15 | | | | | | 506 | | |
| 4 | | | .16 | | | | | | 506 | | |
| 5 | | | .16 | | | | | | 506 | | |
| 6 | | | .16 | | | | | | 506 | | |
| 7 | | | .15 | | | | | | 506 | | |
| 8 | | | .15 | | | | | | 506 | | |
| | | | | | | | | | | | |
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Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 1 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-3-10 |
| SOURCE TESTED: | FCC | | |
| Weighed By: | | Balance Level: ✓ | Balance Zeroed: ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 637 |
| Initial Weight | 621 |
| Weight Gain | +16 |

**Impinger #2**

| | |
|---|---|
| Final Weight | 638 |
| Initial Weight | 632 |
| Weight Gain | +6 |

**Impinger #3**

| | |
|---|---|
| Final Weight | 500 |
| Initial Weight | 500 |
| Weight Gain | 0 |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 825 |
| Initial Weight | 820 |
| Weight Gain | +5 |

**Total Mass of Moisture Captured:** +27 grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **2-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:41:10:02** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 727.000 | 0.15 | 2.12 | 61 | 511 | 0.3873 |
| 2 | 14 | | 0.14 | 2.12 | 62 | 511 | 0.3742 |
| 3 | 21 | | 0.15 | 2.12 | 62 | 511 | 0.3873 |
| 4 | | 742.470 | 0.15 | | | 511 | 0.3873 |
| 5 | | | 0.15 | | | 512 | 0.3873 |
| 6 | | | 0.16 | | | 512 | 0.4000 |
| 7 | | | 0.16 | | | 512 | 0.4000 |
| 8 | | | 0.16 | | | 512 | 0.4000 |
| 1 | | | 0.15 | | | 512 | 0.3873 |
| 2 | | | 0.15 | | | 512 | 0.3873 |
| 3 | | | 0.15 | | | 512 | 0.3873 |
| 4 | | | 0.15 | | | 513 | 0.3873 |
| 5 | | | 0.16 | | | 513 | 0.4000 |
| 6 | | | 0.16 | | | 513 | 0.4000 |
| 7 | | | 0.16 | | | 513 | 0.4000 |
| 8 | | | 0.15 | | | 513 | 0.3873 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.32 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 7.000 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.470 dcf | Stack Area | 38.485 sq.ft. |
| Water Volume | 25.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 2.6 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 32 ml |
| $\%CO_2$ Average | 15.7 %v dry | | |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 2-SO2/GF
**Source:** Zone C FCCU **Date:** 05/03/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.3912 "$H_2O$ |
| Avg Meter Temp. (Tm) | 62 °F | Avg Stack Temp. (Ts) | 512 °F |
| Avg Meter Temp. (Tm) | 522 °A (°R) | Avg Stack Temp. (Ts) | 972 °A (°R) |
| Pressure Meter (Pm) | 26.476 "Hg | Pressure Stack (Ps) | 26.331 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.710 dscf | Velocity (Vs) | 31.36 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 31.138 awcf | Volume (actual conditions) | 72,413.4 awcfm |
| Volume Water | | | 66,685.5 adcfm |
| Vapor, Vw(std) | 1.177 scf | Volume (std. conditions) | 2,077,033.3 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 34,617.2 wscfm |
| Moisture (Bws) | 0.0791 | | 1,912,740.0 dscf/hr |
| Percent Moisture | 7.91 %v | | 31,879.0 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.62 lb/lb-mole | Dry Basis | 10.0 ppmv d |
| Wet (Ms) | 29.62 lb/lb-mole | Wet Basis | 9.2 ppmv a |
| | | $SO_2$ Concentration | 1.660E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 3.18 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: FCC
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 2
DATE: 5/3/10
START TIME: 941
END TIME: 1002

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 29.35 BAROMETRIC PRESSURE ("Hg)

- 166 PITOT
- .84 METER BOX
- .99 Y FACTOR
- .15 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 14 POST
- TRAIN LEAK TEST, ($ft^3$/min) 001 PRE 002 POST
- 84" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ΔP( "$H_2O$) | Meter ΔH | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 727.000 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 61 | 5 | | 46 | 511 | 15.2 | |
| 2 | 14 | | | 2.12 | 62 | 5 | | 46 | 511 | | |
| 3 | 21 | 742.470 | | 2.12 | 62 | 5 | | 46 | 513 | | |
| | | +15.470 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 511 | | |
| 2 | | | .14 | | | | | | 511 | | |
| 3 | | | .15 | | | | | | 511 | | |
| 4 | | | .15 | | | | | | 511 | | |
| 5 | | | .15 | | | | | | 512 | | |
| 6 | | | .16 | | | | | | 512 | | |
| 7 | | | .16 | | | | | | 512 | | |
| 8 | | | .16 | | | | | | 512 | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 512 | | |
| 2 | | | .15 | | | | | | 512 | | |
| 3 | | | .15 | | | | | | 512 | | |
| 4 | | | .15 | | | | | | 513 | | |
| 5 | | | .16 | | | | | | 513 | | |
| 6 | | | .16 | | | | | | 513 | | |
| 7 | | | .16 | | | | | | 513 | | |
| 8 | | | .15 | | | | | | 513 | | |
| | | | | | | | | | | | |
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EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | C H S | RUN # | 2 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-3-10 |
| SOURCE TESTED: | FCC | | |
| Weighed By: | | Balance Level: ✓ | Balance Zeroed: ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 645 |
| Initial Weight | 630 |
| Weight Gain | +15 |

**Impinger #2**

| | |
|---|---|
| Final Weight | 639 |
| Initial Weight | 634 |
| Weight Gain | +5 |

**Impinger #3**

| | |
|---|---|
| Final Weight | 501 |
| Initial Weight | 500 |
| Weight Gain | +1 |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 829 |
| Initial Weight | 825 |
| Weight Gain | +4 |

**Total Mass of Moisture Captured:** +25 grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **3-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:12-10:33** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 744.300 | 0.15 | 2.12 | 62 | 503 | 0.3873 |
| 2 | 14 | | 0.15 | 2.12 | 62 | 503 | 0.3873 |
| 3 | 21 | | 0.15 | 2.12 | 62 | 503 | 0.3873 |
| 4 | | 759.720 | 0.16 | | | 503 | 0.4000 |
| 5 | | | 0.16 | | | 503 | 0.4000 |
| 6 | | | 0.16 | | | 502 | 0.4000 |
| 7 | | | 0.15 | | | 502 | 0.3873 |
| 8 | | | 0.15 | | | 502 | 0.3873 |
| 1 | | | 0.15 | | | 502 | 0.3873 |
| 2 | | | 0.15 | | | 502 | 0.3873 |
| 3 | | | 0.16 | | | 502 | 0.4000 |
| 4 | | | 0.16 | | | 503 | 0.4000 |
| 5 | | | 0.16 | | | 503 | 0.4000 |
| 6 | | | 0.16 | | | 503 | 0.4000 |
| 7 | | | 0.16 | | | 503 | 0.4000 |
| 8 | | | 0.15 | | | 503 | 0.3873 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.32 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 7.000 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.420 dcf | Stack Area | 38.485 sq.ft. |
| Water Volume | 26.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 2.3 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 35.5 ml |
| $\%CO_2$ Average | 15.8 %v dry | | |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 3-SO2/GF
**Source:** Zone C FCCU **Date:** 05/03/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.3937 "$H_2O$ |
| Avg Meter Temp. (Tm) | 62 °F | Avg Stack Temp. (Ts) | 503 °F |
| Avg Meter Temp. (Tm) | 522 °A (°R) | Avg Stack Temp. (Ts) | 963 °A (°R) |
| Pressure Meter (Pm) | 26.476 "Hg | Pressure Stack (Ps) | 26.331 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.666 dscf | Velocity (Vs) | 31.44 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 30.854 awcf | Volume (actual conditions) | 72,598.1 awcfm |
| Volume Water | | | 66,630.5 adcfm |
| Vapor, Vw(std) | 1.224 scf | Volume (std. conditions) | 2,101,792.9 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 35,029.9 wscfm |
| Moisture (Bws) | 0.0822 | | 1,929,025.5 dscf/hr |
| Percent Moisture | 8.22 %v | | 32,150.4 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.62 lb/lb-mole | Dry Basis | 11.2 ppmv d |
| Wet (Ms) | 29.58 lb/lb-mole | Wet Basis | 10.3 ppmv a |
| | | $SO_2$ Concentration | 1.850E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 3.57 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: FCC
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 3
DATE: 5/13/18
START TIME: 1812
END TIME: 1833

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.32 BAROMETRIC PRESSURE ("Hg)
- 1666 PITOT
- SR METER BOX
- .991 Y FACTOR
- .15 STATIC PRESSURE ("H2O)
- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 12 POST
- TRAIN LEAK TEST, ($ft^3$/min) 000 PRE 002 POST
- 3/4" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 744.300 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 62 | 5 | | 46 | 506 | 15.8 | |
| 2 | 14 | | | 2.12 | 62 | 5 | | 47 | 503 | | |
| 3 | 21 | 759.720 | | 2.12 | 62 | 5 | | 47 | 502 | | |
| | ↘ | +15.420 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 503 | | |
| 2 | | | .15 | | | | | | 503 | | |
| 3 | | | .15 | | | | | | 503 | | |
| 4 | | | .16 | | | | | | 503 | | |
| 5 | | | .16 | | | | | | 503 | | |
| 6 | | | .16 | | | | | | 502 | | |
| 7 | | | .15 | | | | | | 502 | | |
| 8 | | | .15 | | | | | | 502 | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 502 | | |
| 2 | | | .15 | | | | | | 502 | | |
| 3 | | | .16 | | | | | | 502 | | |
| 4 | | | .16 | | | | | | 503 | | |
| 5 | | | .16 | | | | | | 503 | | |
| 6 | | | .16 | | | | | | 503 | | |
| 7 | | | .16 | | | | | | 503 | | |
| 8 | | | .15 | | | | | | 503 | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 3 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-3-10 |
| SOURCE TESTED: | FCC | | |
| Weighed By: | | Balance Level: ✓ | Balance Zeroed: ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 646 |
| Initial Weight | 630 |
| Weight Gain | + 16 |

**Impinger #2**

| | |
|---|---|
| Final Weight | 641 |
| Initial Weight | 636 |
| Weight Gain | + 5 |

**Impinger #3**

| | |
|---|---|
| Final Weight | 499 |
| Initial Weight | 499 |
| Weight Gain | 0 |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 834 |
| Initial Weight | 829 |
| Weight Gain | + 5 |

**Total Mass of Moisture Captured:** + 26 grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **4-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:43-11:04** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 761.200 | 0.14 | 2.12 | 62 | 510 | 0.3742 |
| 2 | 14 | | 0.14 | 2.12 | 63 | 510 | 0.3742 |
| 3 | 21 | | 0.15 | 2.12 | 63 | 510 | 0.3873 |
| 4 | | 776.730 | 0.15 | | | 511 | 0.3873 |
| 5 | | | 0.15 | | | 511 | 0.3873 |
| 6 | | | 0.16 | | | 511 | 0.4000 |
| 7 | | | 0.15 | | | 511 | 0.3873 |
| 8 | | | 0.15 | | | 510 | 0.3873 |
| 1 | | | 0.15 | | | 510 | 0.3873 |
| 2 | | | 0.15 | | | 510 | 0.3873 |
| 3 | | | 0.16 | | | 510 | 0.4000 |
| 4 | | | 0.16 | | | 509 | 0.4000 |
| 5 | | | 0.16 | | | 509 | 0.4000 |
| 6 | | | 0.16 | | | 509 | 0.4000 |
| 7 | | | 0.15 | | | 509 | 0.3873 |
| 8 | | | 0.15 | | | 509 | 0.3873 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.32 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 7.000 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.530 dcf | Stack Area | 38.485 sq.ft. |
| Water Volume | 26.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| %$O_2$ Average | 2.6 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 31.5 ml |
| %$CO_2$ Average | 15.9 %v dry | | |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 4-SO2/GF
**Source:** Zone C FCCU **Date:** 05/03/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.3896 "$H_2O$ |
| Avg Meter Temp. (Tm) | 63 °F | Avg Stack Temp. (Ts) | 510 °F |
| Avg Meter Temp. (Tm) | 523 °A (°R) | Avg Stack Temp. (Ts) | 970 °A (°R) |
| Pressure Meter (Pm) | 26.476 "Hg | Pressure Stack (Ps) | 26.331 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.737 dscf | Velocity (Vs) | 31.20 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 31.227 awcf | Volume (actual conditions) | 72,043.9 awcfm |
| Volume Water | | | 66,150.7 adcfm |
| Vapor, Vw(std) | 1.224 scf | Volume (std. conditions) | 2,070,696.9 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 34,511.6 wscfm |
| Moisture (Bws) | 0.0818 | | 1,901,313.9 dscf/hr |
| Percent Moisture | 8.18 %v | | 31,688.6 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.65 lb/lb-mole | Dry Basis | 9.8 ppmv d |
| Wet (Ms) | 29.62 lb/lb-mole | Wet Basis | 9.0 ppmv a |
| | | $SO_2$ Concentration | 1.640E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 3.12 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: FCC
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 4
DATE: 5/3/10
START TIME: 1043
END TIME: 1184

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.32 BAROMETRIC PRESSURE ("Hg)

- 166 PITOT
- BR METER BOX
- .99 Y FACTOR
- -15 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 13 POST
- TRAIN LEAK TEST, ($ft^3$/min) .001 PRE .003 POST
- 84" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 261.280 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 62 | 5 | — | 47 | 510 | 15.9 | |
| 2 | 14 | | | 2.12 | 63 | 5 | | 47 | 508 | | |
| 3 | 21 | 276.730 | | 2.12 | 63 | 5 | | 47 | 511 | | |
| — | — | +15.530 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .14 | | | | | | 510 | | |
| 2 | | | .14 | | | | | | 510 | | |
| 3 | | | .15 | | | | | | 510 | | |
| 4 | | | .15 | | | | | | 511 | | |
| 5 | | | .15 | | | | | | 511 | | |
| 6 | | | .16 | | | | | | 511 | | |
| 7 | | | .15 | | | | | | 511 | | |
| 8 | | | .15 | | | | | | 510 | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 510 | | |
| 2 | | | .15 | | | | | | 510 | | |
| 3 | | | .16 | | | | | | 510 | | |
| 4 | | | .16 | | | | | | 509 | | |
| 5 | | | .16 | | | | | | 509 | | |
| 6 | | | .16 | | | | | | 509 | | |
| 7 | | | .15 | | | | | | 509 | | |
| 8 | | | .15 | | | | | | 509 | | |
| | | | | | | | | | | | |
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| — | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: FCC
RUN # 4
TEST DATE: 5-3-10
Weighed By: _____ Balance Level: ✓ Balance Zeroed: ✓

**Weight (grams)**

**Impinger #1**
Final Weight 649
Initial Weight 634 ✓
Weight Gain +15

**Impinger #2**
Final Weight 640
Initial Weight 634 ✓
Weight Gain +6

**Impinger #3**
Final Weight 501
Initial Weight 500 ✓
Weight Gain +1

**Impinger #4 (if applicable)**
Final Weight _____
Initial Weight _____
Weight Gain _____

**Silica Gel Impinger**
Final Weight 838
Initial Weight 834 ✓
Weight Gain +4

**Total Mass of Moisture Captured:** +26 ✓ grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **5-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:14-11:35** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 778.200 | 0.15 | 2.12 | 63 | 501 | 0.3873 |
| 2 | 14 | | 0.15 | 2.12 | 63 | 501 | 0.3873 |
| 3 | 21 | | 0.16 | 2.12 | 64 | 501 | 0.4000 |
| 4 | | 793.760 | 0.16 | | | 502 | 0.4000 |
| 5 | | | 0.16 | | | 501 | 0.4000 |
| 6 | | | 0.15 | | | 502 | 0.3873 |
| 7 | | | 0.15 | | | 502 | 0.3873 |
| 8 | | | 0.15 | | | 502 | 0.3873 |
| 1 | | | 0.15 | | | 503 | 0.3873 |
| 2 | | | 0.16 | | | 503 | 0.4000 |
| 3 | | | 0.16 | | | 503 | 0.4000 |
| 4 | | | 0.16 | | | 503 | 0.4000 |
| 5 | | | 0.16 | | | 502 | 0.4000 |
| 6 | | | 0.15 | | | 502 | 0.3873 |
| 7 | | | 0.15 | | | 502 | 0.3873 |
| 8 | | | 0.15 | | | 502 | 0.3873 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.32 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 7.000 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.560 dcf | Stack Area | 38.485 sq.ft. |
| Water Volume | 27.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| %$O_2$ Average | 2.5 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 34.0 ml |
| %$CO_2$ Average | 15.9 %v dry | | |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 5-SO2/GF
**Source:** Zone C FCCU **Date:** 05/03/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.3929 "$H_2O$ |
| Avg Meter Temp. (Tm) | 63 °F | Avg Stack Temp. (Ts) | 502 °F |
| Avg Meter Temp. (Tm) | 523 °A (°R) | Avg Stack Temp. (Ts) | 962 °A (°R) |
| Pressure Meter (Pm) | 26.476 "Hg | Pressure Stack (Ps) | 26.331 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.764 dscf | Velocity (Vs) | 31.36 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 31.120 awcf | Volume (actual conditions) | 72,413.4 awcfm |
| Volume Water | | | 66,294.5 adcfm |
| Vapor, Vw(std) | 1.271 scf | Volume (std. conditions) | 2,098,624.1 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 34,977.1 wscfm |
| Moisture (Bws) | 0.0845 | | 1,921,290.4 dscf/hr |
| Percent Moisture | 8.45 %v | | 32,021.5 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.64 lb/lb-mole | Dry Basis | 10.6 ppmv d |
| Wet (Ms) | 29.57 lb/lb-mole | Wet Basis | 9.7 ppmv a |
| | | $SO_2$ Concentration | 1.760E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 3.38 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: FCC
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 5
DATE: 5/3/10
START TIME: 1114
END TIME: 1135

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.32 BAROMETRIC PRESSURE ("Hg)
- 166 PITOT
- 3R METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg)
- TRAIN LEAK TEST, ($ft^3$/min)
- .15 STATIC PRESSURE ("H2O)
- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- 15 PRE 14 POST
- 001 PRE 002 POST
- 84 11 STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 278.200 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 63 | 5 | — | 42 | 504 | 15.9 | |
| 2 | 14 | | | 2.12 | 63 | 5 | | 48 | 506 | | |
| 3 | 21 | 293.700 | | 2.12 | 64 | 5 | | 48 | 501 | | |
| — | — | +15.500 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 501 | | |
| 2 | | | .15 | | | | | | 501 | | |
| 3 | | | .16 | | | | | | 501 | | |
| 4 | | | .16 | | | | | | 502 | | |
| 5 | | | .16 | | | | | | 501 | | |
| 6 | | | .15 | | | | | | 502 | | |
| 7 | | | .15 | | | | | | 502 | | |
| 8 | | | .15 | | | | | | 502 | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 503 | | |
| 2 | | | .16 | | | | | | 503 | | |
| 3 | | | .16 | | | | | | 503 | | |
| 4 | | | .16 | | | | | | 503 | | |
| 5 | | | .16 | | | | | | 502 | | |
| 6 | | | .15 | | | | | | 502 | | |
| 7 | | | .15 | | | | | | 502 | | |
| 8 | | | .15 | | | | | | 502 | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 5 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-3-10 |
| SOURCE TESTED: | FCC | | |
| Weighed By: | | Balance Level: ✓ | Balance Zeroed: ✓ |

**Weight (grams)**

**Impinger #1**

Final Weight 642
Initial Weight 628
Weight Gain +14

**Impinger #2**

Final Weight 637
Initial Weight 630
Weight Gain +7

**Impinger #3**

Final Weight 500
Initial Weight 500
Weight Gain 0

**Impinger #4 (if applicable)**

Final Weight
Initial Weight
Weight Gain

**Silica Gel Impinger**

Final Weight 844
Initial Weight 838
Weight Gain +6

**Total Mass of Moisture Captured:** +27 grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **6-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:45-12:06** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 795.300 | 0.14 | 2.12 | 64 | 513 | 0.3742 |
| 2 | 14 | | 0.15 | 2.12 | 65 | 513 | 0.3873 |
| 3 | 21 | | 0.15 | 2.12 | 65 | 513 | 0.3873 |
| 4 | | 810.930 | 0.16 | | | 513 | 0.4000 |
| 5 | | | 0.15 | | | 513 | 0.3873 |
| 6 | | | 0.15 | | | 512 | 0.3873 |
| 7 | | | 0.15 | | | 512 | 0.3873 |
| 8 | | | 0.15 | | | 512 | 0.3873 |
| 1 | | | 0.14 | | | 512 | 0.3742 |
| 2 | | | 0.14 | | | 512 | 0.3742 |
| 3 | | | 0.15 | | | 513 | 0.3873 |
| 4 | | | 0.15 | | | 513 | 0.3873 |
| 5 | | | 0.15 | | | 514 | 0.3873 |
| 6 | | | 0.16 | | | 514 | 0.4000 |
| 7 | | | 0.16 | | | 514 | 0.4000 |
| 8 | | | 0.15 | | | 514 | 0.3873 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.32 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 7.000 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.630 dcf | Stack Area | 38.485 sq.ft. |
| Water Volume | 25.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| %$O_2$ Average | 2.6 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 34.0 ml |
| %$CO_2$ Average | 16.0 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **6-SO2/GF** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.3872 "$H_2O$ |
| Avg Meter Temp. (Tm) | 65 °F | Avg Stack Temp. (Ts) | 513 °F |
| Avg Meter Temp. (Tm) | 525 °A (°R) | Avg Stack Temp. (Ts) | 973 °A (°R) |
| Pressure Meter (Pm) | 26.476 "Hg | Pressure Stack (Ps) | 26.331 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.773 dscf | Velocity (Vs) | 31.04 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 31.299 awcf | Volume (actual conditions) | 71,674.5 awcfm |
| Volume Water | | | 66,033.7 adcfm |
| Vapor, Vw(std) | 1.177 scf | Volume (std. conditions) | 2,053,726.2 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 34,228.8 wscfm |
| Moisture (Bws) | 0.0787 | | 1,892,097.9 dscf/hr |
| Percent Moisture | 7.87 %v | | 31,535.0 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.66 lb/lb-mole | Dry Basis | 10.6 ppmv d |
| Wet (Ms) | 29.66 lb/lb-mole | Wet Basis | 9.8 ppmv a |
| | | $SO_2$ Concentration | 1.760E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 3.33 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS — RUN #: 6
PLANT LOCATION: Laurel — DATE: 5/3/10
SOURCE TESTED: FCC — START TIME: 1145
METER BOX OPERATOR: JW — TECHNICIANS: DW — END TIME: 1206

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.33 BAROMETRIC PRESSURE ("Hg)

166 PITOT
BB METER BOX
.99 Y FACTOR
.15 STATIC PRESSURE ("H2O)

NOZZLE # 21 TEST TIME
NOZZLE DIA.
M T/C READOUT
TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 13 POST
TRAIN LEAK TEST, (ft³/min) 000 PRE 002 POST
34" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ΔP( "$H_2O$) | Meter ΔH | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 795.300 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 64 | 5 | — | 49 | 512 | 16.0 | |
| 2 | 14 | | | 2.12 | 65 | 5 | | 49 | 513 | | |
| 3 | 21 | 810.930 | | 2.12 | 65 | 5 | | 50 | 509 | | |
| | — | +15.630 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .14 | | | | | | 513 | | |
| 2 | | | .15 | | | | | | 513 | | |
| 3 | | | .15 | | | | | | 513 | | |
| 4 | | | .16 | | | | | | 513 | | |
| 5 | | | .15 | | | | | | 513 | | |
| 6 | | | .15 | | | | | | 512 | | |
| 7 | | | .15 | | | | | | 512 | | |
| 8 | | | .15 | | | | | | 512 | | |
| | | | | | | | | | | | |
| 1 | | | .14 | | | | | | 512 | | |
| 2 | | | .14 | | | | | | 512 | | |
| 3 | | | .15 | | | | | | 513 | | |
| 4 | | | .15 | | | | | | 513 | | |
| 5 | | | .15 | | | | | | 514 | | |
| 6 | | | .16 | | | | | | 514 | | |
| 7 | | | .16 | | | | | | 514 | | |
| 8 | | | .15 | | | | | | 514 | | |
| | | | | | | | | | | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 6 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-3-10 |
| SOURCE TESTED: | FCC | | |
| Weighed By: | | Balance Level: ✓ | Balance Zeroed: ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 642 |
| Initial Weight | 627 |
| Weight Gain | +15 |

**Impinger #2**

| | |
|---|---|
| Final Weight | 636 |
| Initial Weight | 631 |
| Weight Gain | +5 |

**Impinger #3**

| | |
|---|---|
| Final Weight | 500 |
| Initial Weight | 500 |
| Weight Gain | 0 |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 833 |
| Initial Weight | 828 |
| Weight Gain | +5 |

**Total Mass of Moisture Captured:** +25 grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **7-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:16-12:37** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft.) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 812.400 | 0.15 | 2.12 | 65 | 512 | 0.3873 |
| 2 | 14 | | 0.15 | 2.12 | 66 | 512 | 0.3873 |
| 3 | 21 | | 0.15 | 2.12 | 66 | 512 | 0.3873 |
| 4 | | 827.910 | 0.16 | | | 512 | 0.4000 |
| 5 | | | 0.16 | | | 513 | 0.4000 |
| 6 | | | 0.15 | | | 513 | 0.3873 |
| 7 | | | 0.15 | | | 514 | 0.3873 |
| 8 | | | 0.15 | | | 514 | 0.3873 |
| 1 | | | 0.14 | | | 514 | 0.3742 |
| 2 | | | 0.14 | | | 514 | 0.3742 |
| 3 | | | 0.15 | | | 514 | 0.3873 |
| 4 | | | 0.15 | | | 514 | 0.3873 |
| 5 | | | 0.15 | | | 514 | 0.3873 |
| 6 | | | 0.15 | | | 514 | 0.3873 |
| 7 | | | 0.15 | | | 514 | 0.3873 |
| 8 | | | 0.15 | | | 514 | 0.3873 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.32 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 7.000 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.510 dcf | Stack Area | 38.485 sq.ft. |
| Water Volume | 26.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| %$O_2$ Average | 2.6 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 33.0 ml |
| %$CO_2$ Average | 16.0 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **7-SO2/GF** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.3873 "$H_2O$ |
| Avg Meter Temp. (Tm) | 66 °F | Avg Stack Temp. (Ts) | 513 °F |
| Avg Meter Temp. (Tm) | 526 °A (°R) | Avg Stack Temp. (Ts) | 973 °A (°R) |
| Pressure Meter (Pm) | 26.476 "Hg | Pressure Stack (Ps) | 26.331 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.641 dscf | Velocity (Vs) | 31.07 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 31.121 awcf | Volume (actual conditions) | 71,743.7 awcfm |
| Volume Water | | | 65,839.2 adcfm |
| Vapor, Vw(std) | 1.224 scf | Volume (std. conditions) | 2,055,711.1 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 34,261.9 wscfm |
| Moisture (Bws) | 0.0823 | | 1,886,526.1 dscf/hr |
| Percent Moisture | 8.23 %v | | 31,442.1 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.66 lb/lb-mole | Dry Basis | 10.4 ppmv d |
| Wet (Ms) | 29.62 lb/lb-mole | Wet Basis | 9.5 ppmv a |
| | | $SO_2$ Concentration | 1.730E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 3.26 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS | RUN #: 2
PLANT LOCATION: Laurel | DATE: 5/3/18
SOURCE TESTED: FCC | START TIME: 1216
METER BOX OPERATOR: JW | TECHNICIANS: DW | END TIME: 1232

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.33 BAROMETRIC PRESSURE ("Hg)

- 166 PITOT
- SR METER BOX
- .99 Y FACTOR
- .15 STATIC PRESSURE ("H2O)

- NOZZLE #
- NOZZLE DIA.
- M T/C READOUT
- 15 TRAIN LEAK TEST VACUUM, ("Hg) PRE
- 001 TRAIN LEAK TEST, (ft³/min) PRE
- 84" STACK DIMENSIONS

21 TEST TIME
14 POST
001 POST

| Sample Point | Time (min) | Dry Gas Meter Reading (ft³) | Pitot Reading ^P( "H2O) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 812.400 | | | | | | | | | |
| 1 | 2 | | | 2.12 | 65 | 5 | — | 49 | 515 | 16.0 | |
| 2 | 14 | | | 2.12 | 66 | 5 | | 49 | 512 | | |
| 3 | 21 | 827.910 | | 2.12 | 66 | 5 | | 49 | 514 | | |
| — | — | +15.510 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 512 | | |
| 2 | | | .15 | | | | | | 512 | | |
| 3 | | | .15 | | | | | | 512 | | |
| 4 | | | .16 | | | | | | 512 | | |
| 5 | | | .16 | | | | | | 513 | | |
| 6 | | | .15 | | | | | | 513 | | |
| 7 | | | .15 | | | | | | 514 | | |
| 8 | | | .15 | | | | | | 514 | | |
| | | | | | | | | | | | |
| 1 | | | .14 | | | | | | 514 | | |
| 2 | | | .14 | | | | | | 514 | | |
| 3 | | | .15 | | | | | | 514 | | |
| 4 | | | .15 | | | | | | 514 | | |
| 5 | | | .15 | | | | | | 515 | | |
| 6 | | | .15 | | | | | | 514 | | |
| 7 | | | .15 | | | | | | 514 | | |
| 8 | | | .15 | | | | | | 514 | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 7 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-3-10 |
| SOURCE TESTED: | FCC | | |
| Weighed By: | | Balance Level: ✓ | Balance Zeroed: ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 645 |
| Initial Weight | 631 |
| Weight Gain | +14 |

**Impinger #2**

| | |
|---|---|
| Final Weight | 641 |
| Initial Weight | 635 |
| Weight Gain | + 6 |

**Impinger #3**

| | |
|---|---|
| Final Weight | 501 |
| Initial Weight | 500 |
| Weight Gain | +1 |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 838 |
| Initial Weight | 833 |
| Weight Gain | + 5 |

**Total Mass of Moisture Captured:** +26 grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **8-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:42-13:08** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft.) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 829.400 | 0.14 | 2.12 | 67 | 506 | 0.3742 |
| 2 | 14 | | 0.15 | 2.12 | 67 | 506 | 0.3873 |
| 3 | 21 | | 0.15 | 2.12 | 68 | 506 | 0.3873 |
| 4 | | 845.090 | 0.15 | | | 506 | 0.3873 |
| 5 | | | 0.15 | | | 506 | 0.3873 |
| 6 | | | 0.16 | | | 505 | 0.4000 |
| 7 | | | 0.15 | | | 505 | 0.3873 |
| 8 | | | 0.15 | | | 505 | 0.3873 |
| 1 | | | 0.15 | | | 505 | 0.3873 |
| 2 | | | 0.15 | | | 505 | 0.3873 |
| 3 | | | 0.15 | | | 504 | 0.3873 |
| 4 | | | 0.16 | | | 504 | 0.4000 |
| 5 | | | 0.16 | | | 504 | 0.4000 |
| 6 | | | 0.15 | | | 504 | 0.3873 |
| 7 | | | 0.15 | | | 504 | 0.3873 |
| 8 | | | 0.15 | | | 504 | 0.3873 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.32 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 7.000 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.690 dcf | Stack Area | 38.485 sq.ft. |
| Water Volume | 27.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| %$O_2$ Average | 2.6 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 32.5 ml |
| %$CO_2$ Average | 15.9 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **8-SO2/GF** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.3889 "$H_2O$ |
| Avg Meter Temp. (Tm) | 67 °F | Avg Stack Temp. (Ts) | 505 °F |
| Avg Meter Temp. (Tm) | 527 °A (°R) | Avg Stack Temp. (Ts) | 965 °A (°R) |
| Pressure Meter (Pm) | 26.476 "Hg | Pressure Stack (Ps) | 26.331 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.774 dscf | Velocity (Vs) | 31.09 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 31.239 awcf | Volume (actual conditions) | 71,789.9 awcfm |
| Volume Water | | | 65,723.7 adcfm |
| Vapor, Vw(std) | 1.271 scf | Volume (std. conditions) | 2,074,087.6 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 34,568.1 wscfm |
| Moisture (Bws) | 0.0845 | | 1,898,827.2 dscf/hr |
| Percent Moisture | 8.45 %v | | 31,647.1 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.65 lb/lb-mole | Dry Basis | 10.1 ppmv d |
| Wet (Ms) | 29.58 lb/lb-mole | Wet Basis | 9.2 ppmv a |
| | | $SO_2$ Concentration | 1.680E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 3.19 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: FCC
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 8
DATE: 5/3/10
START TIME: 1242
END TIME: 1308

EQUIPMENT / IDENTIFICATION CHECKS:

| | | | | | |
|---|---|---|---|---|---|
| ✓ | PITOTS, PRE-TEST | 166 | PITOT | ——— | NOZZLE # 21 TEST TIME |
| ✓ | PITOTS, POST-TEST | SR | METER BOX | ——— | NOZZLE DIA. |
| ✓ | ORSAT SAMPLING SYSTEM | .99 | Y FACTOR | M | T/C READOUT |
| ✓ | TEDLAR BAG | | TRAIN LEAK TEST VACUUM, ("Hg) | 15 | PRE 13 POST |
| ✓ | THERMOCOUPLE @ °F | | TRAIN LEAK TEST, (ft³/min) | 000 | PRE 002 POST |
| 26.38 | BAROMETRIC PRESSURE ("Hg) | .15 | STATIC PRESSURE ("H2O) | 84" | STACK DIMENSIONS |

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ΔP( "$H_2O$) | Meter ΔH | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 829.400 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 67 | 5 | — | 49 | 508 | 15.9 | |
| 2 | 14 | | | 2.12 | 67 | 5 | | 50 | 506 | | |
| 3 | 21 | 845.090 | | 2.12 | 68 | 5 | | 50 | 509 | | |
| | ~~—~~ | +15.690 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .14 | | | | | | 506 | | |
| 2 | | | .15 | | | | | | 506 | | |
| 3 | | | .15 | | | | | | 506 | | |
| 4 | | | .15 | | | | | | 506 | | |
| 5 | | | .15 | | | | | | 506 | | |
| 6 | | | .16 | | | | | | 505 | | |
| 7 | | | .15 | | | | | | 505 | | |
| 8 | | | .15 | | | | | | 505 | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 505 | | |
| 2 | | | .15 | | | | | | 505 | | |
| 3 | | | .15 | | | | | | 504 | | |
| 4 | | | .16 | | | | | | 504 | | |
| 5 | | | .16 | | | | | | 504 | | |
| 6 | | | .15 | | | | | | 504 | | |
| 7 | | | .15 | | | | | | 504 | | |
| 8 | | | .15 | | | | | | 504 | | |
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| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: FCC
RUN # 8
TEST DATE: 5-3-10
Weighed By: _____ Balance Level: ✓ Balance Zeroed: —

**Weight (grams)**

**Impinger #1**
Final Weight 651
Initial Weight 636
Weight Gain +15

**Impinger #2**
Final Weight 638
Initial Weight 632
Weight Gain +6

**Impinger #3**
Final Weight 501
Initial Weight 501
Weight Gain 0

**Impinger #4 (if applicable)**
Final Weight _____
Initial Weight _____
Weight Gain _____

**Silica Gel Impinger**
Final Weight 844
Initial Weight 838
Weight Gain +6

**Total Mass of Moisture Captured:** +27 grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **9-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:18-13:39** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft.) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 846.600 | 0.15 | 2.12 | 68 | 508 | 0.3873 |
| 2 | 14 | | 0.15 | 2.12 | 68 | 508 | 0.3873 |
| 3 | 21 | | 0.16 | 2.12 | 68 | 509 | 0.4000 |
| 4 | | 862.330 | 0.16 | | | 508 | 0.4000 |
| 5 | | | 0.16 | | | 509 | 0.4000 |
| 6 | | | 0.15 | | | 509 | 0.3873 |
| 7 | | | 0.15 | | | 509 | 0.3873 |
| 8 | | | 0.15 | | | 509 | 0.3873 |
| 1 | | | 0.15 | | | 509 | 0.3873 |
| 2 | | | 0.15 | | | 509 | 0.3873 |
| 3 | | | 0.16 | | | 509 | 0.4000 |
| 4 | | | 0.16 | | | 509 | 0.4000 |
| 5 | | | 0.15 | | | 508 | 0.3873 |
| 6 | | | 0.15 | | | 508 | 0.3873 |
| 7 | | | 0.15 | | | 508 | 0.3873 |
| 8 | | | 0.15 | | | 508 | 0.3873 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.32 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 7.000 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.730 dcf | Stack Area | 38.485 sq.ft. |
| Water Volume | 26.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| %$O_2$ Average | 2.6 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 32.0 ml |
| %$CO_2$ Average | 15.8 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **9-SO2/GF** |
| **Source:** | **Zone C FCCU** | **Date:** | **05/03/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.3913 "$H_2O$ |
| Avg Meter Temp. (Tm) | 68 °F | Avg Stack Temp. (Ts) | 509 °F |
| Avg Meter Temp. (Tm) | 528 °A (°R) | Avg Stack Temp. (Ts) | 969 °A (°R) |
| Pressure Meter (Pm) | 26.476 "Hg | Pressure Stack (Ps) | 26.331 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.782 dscf | Velocity (Vs) | 31.33 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 31.290 awcf | Volume (actual conditions) | 72,344.1 awcfm |
| Volume Water | | | 66,440.8 adcfm |
| Vapor, Vw(std) | 1.224 scf | Volume (std. conditions) | 2,081,470.7 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 34,691.2 wscfm |
| Moisture (Bws) | 0.0816 | | 1,911,622.7 dscf/hr |
| Percent Moisture | 8.16 %v | | 31,860.4 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.63 lb/lb-mole | Dry Basis | 10.0 ppmv d |
| Wet (Ms) | 29.60 lb/lb-mole | Wet Basis | 9.2 ppmv a |
| | | $SO_2$ Concentration | 1.660E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 3.17 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: FCC
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 9
DATE: 5/13/10
START TIME: 1318
END TIME: 1339

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.33 BAROMETRIC PRESSURE ("Hg)

- 166 PITOT
- BR METER BOX
- .99 Y FACTOR
- .15 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 14 POST
- TRAIN LEAK TEST, ($ft^3$/min) 000 PRE 000 POST
- 84" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 846.620 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 68 | 5 | — | 50 | 510 | 15.8 | |
| 2 | 14 | | | 2.12 | 68 | 5 | | 50 | 513 | | |
| 3 | 21 | 862.330 | | 2.12 | 68 | 5 | | 51 | 508 | | |
| | | +15.710 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 508 | | |
| 2 | | | .15 | | | | | | 508 | | |
| 3 | | | .16 | | | | | | 509 | | |
| 4 | | | .16 | | | | | | 508 | | |
| 5 | | | .16 | | | | | | 509 | | |
| 6 | | | .15 | | | | | | 509 | | |
| 7 | | | .15 | | | | | | 509 | | |
| 8 | | | .15 | | | | | | 509 | | |
| | | | | | | | | | | | |
| 1 | | | .15 | | | | | | 509 | | |
| 2 | | | .15 | | | | | | 509 | | |
| 3 | | | .16 | | | | | | 509 | | |
| 4 | | | .16 | | | | | | 509 | | |
| 5 | | | .15 | | | | | | 508 | | |
| 6 | | | .15 | | | | | | 508 | | |
| 7 | | | .15 | | | | | | 508 | | |
| 8 | | | .15 | | | | | | 508 | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | C H S | RUN # | 4 |
| PLANT LOCATION: | Laurel 1 | TEST DATE: | 5-3-10 |
| SOURCE TESTED: | FCC | | |
| Weighed By: | | Balance Level: ✓ | Balance Zeroed: ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 649 |
| Initial Weight | 632 |
| Weight Gain | ~~+17~~ +17 |

**Impinger #2**

| | |
|---|---|
| Final Weight | 635 |
| Initial Weight | 631 |
| Weight Gain | +4 |

**Impinger #3**

| | |
|---|---|
| Final Weight | 500 |
| Initial Weight | 500 |
| Weight Gain | 0 |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 849 |
| Initial Weight | 844 |
| Weight Gain | +5 |

**Total Mass of Moisture Captured:** +26 grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

EEMC

# ORSAT SHEET

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: FCC
TEST DATE: 5/3/10

| | Gas | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| Run # 1 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 15.2 | 15.2 | 15.2 | 15.2 |
| | $O_2$ | | | | |
| Run # 2 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 15.2 | 15.8 | 15.7 | 15.2 |
| | $O_2$ | | | | |
| Run # 3 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 15.7 | 15.8 | 15.8 | 15.8 |
| | $O_2$ | | | | |
| Run # 4 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 15.8 | 15.9 | 15.9 | 15.9 |
| | $O_2$ | | | | |
| Run # 5 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 15.9 | 15.9 | 15.9 | 15.9 |
| | $O_2$ | | | | |
| Run # 6 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 16.0 | 15.9 | 16.0 | 16.0 |
| | $O_2$ | | | | |
| Run # 7 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 16.0 | 16.0 | 15.9 | 16.0 |
| | $O_2$ | | | | |
| Run # 8 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 15.9 | 15.9 | 15.9 | 15.9 |
| | $O_2$ | | | | |
| Run # 9 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 15.9 | 15.8 | 15.8 | 15.8 |
| | $O_2$ | | | | |
| Run # | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | | | | |
| | $O_2$ | | | | |

Notes:

WorldDrive01:\Forms\Forms\Orsat3.xls
Revised 4/12/07 jmf

EEMC

# $SO_2$ ANALYSIS TITRATION

COMPANY NAME: Cenex DATE: 5-3-10

SOURCE TESTED: FCCU Normality $Ba(ClO_4)_2$ : .0101

| Run # | Aliquot (ml.) | Total Volume | Ba++ (ml.) | Dilution: | Blank (ml.) | Total Titration: |
|---|---|---|---|---|---|---|
| Blank | 25 | | 0 | | | 0 |
| 1 | 25 | 500 | 1.65<br>1.65 | - | 0 | 33.0 |
| 2 | 25 | 500 | 1.6<br>1.6 | - | 0 | 32.0 |
| 3 | 25 | 500 | 1.8<br>1.75 | - | 0 | 35.5 |
| 4 | 25 | 500 | 1.6<br>1.55 | - | 0 | 31.5 |
| 5 | 25 | 500 | 1.7<br>1.7 | - | 0 | 34.0 |
| 6 | 25 | 500 | 1.7<br>1.7 | - | 0 | 34.0 |
| 7 | 25 | 500 | 1.65<br>1.65 | - | 0 | 33.0 |
| 8 | 25 | 500 | 1.65<br>1.6 | - | 0 | 32.5 |
| 9 | 25 | 500 | 1.6<br>1.6 | - | 0 | 32.0 |

WorldDrive01:\Forms\Forms\SO2 Analysis Titration1.xls
Revised 06/25/07 jmf

**Relative Accuracy Reference Data**
**EPA Method #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **1-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:00-09:21** |
| **Source:** | **Boiler #10** | **Date:** | **05/04/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 9:00 | 78.9 | 5.8 | 29.9 |
| 2 | 9:01 | 78.8 | 6.1 | 29.7 |
| 3 | 9:02 | 78.1 | 5.9 | 29.6 |
| 4 | 9:03 | 78.1 | 6.1 | 29.8 |
| 5 | 9:04 | 79.4 | 5.8 | 29.8 |
| 6 | 9:05 | 78.6 | 6.1 | 29.6 |
| 7 | 9:06 | 78.2 | 5.8 | 29.7 |
| 8 | 9:07 | 79.1 | 5.9 | 29.9 |
| 9 | 9:08 | 79.4 | 6.0 | 29.9 |
| 10 | 9:09 | 77.7 | 5.8 | 29.8 |
| 11 | 9:10 | 78.2 | 6.0 | 29.6 |
| 12 | 9:11 | 77.9 | 6.1 | 29.7 |
| 13 | 9:12 | 77.9 | 5.8 | 29.7 |
| 14 | 9:13 | 79.3 | 6.0 | 29.8 |
| 15 | 9:14 | 79.3 | 6.0 | 29.8 |
| 16 | 9:15 | 78.6 | 6.0 | 29.8 |
| 17 | 9:16 | 79.3 | 5.8 | 29.8 |
| 18 | 9:17 | 79.4 | 6.1 | 29.7 |
| 19 | 9:18 | 78.2 | 6.0 | 29.6 |
| 20 | 9:19 | 78.6 | 6.0 | 29.8 |
| 21 | 9:20 | 79.1 | 6.0 | 29.8 |
| 22 | 9:21 | 78.6 | 5.9 | 29.9 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **78.67** | **5.95** | **29.76** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 1-COO2NOx
**Source :** Boiler #10 **Date:** 05/04/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.1 | 0.1 |
| 8:24 | 44.4 | 44.2 | -0.2 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 8:36 | 0 | 0.2 | 0.2 |
| 8:34 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:23 | 0 | 0.3 | 0.3 | 0.1 |
| 9:25 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 8:36 | 0.0 | 0.1 | 0.5 |
| 8:34 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:23 | 0.0 | 0.1 | 0.5 | 0.0 |
| 9:25 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 35 seconds |
| $O_2$ | 28 | 26 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 1-COO2NOx
**Source:** Boiler #10 **Date:** 05/04/10

**Instrument Calibration Checks - continued**

$NO_x$ Instrument Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.2 | 0.2 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | From FCC on 5/3/10 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 8:40 | 0.0 | 0.3 | 0.3 |
| 8:38 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:23 | 0.0 | 0.3 | 0.3 | 0.0 |
| 9:27 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 34 seconds |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 78.67 ppm v/v d |
| $O_2$ | 5.95 % v/v d |
| NOx | 29.76 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 79.4 ppm v/v d |
| $O_2$ | 5.9 % v/v d |
| $NO_x$ | 29.8 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Method #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **2-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:30-09:51** |
| **Source:** | **Boiler #10** | **Date:** | **05/04/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 9:30 | 81.7 | 5.8 | 29.7 |
| 2 | 9:31 | 80.1 | 6.1 | 29.8 |
| 3 | 9:32 | 80.8 | 5.9 | 29.8 |
| 4 | 9:33 | 80.2 | 6.0 | 29.9 |
| 5 | 9:34 | 81.4 | 6.1 | 29.6 |
| 6 | 9:35 | 80.8 | 6.1 | 29.8 |
| 7 | 9:36 | 80.9 | 6.0 | 29.6 |
| 8 | 9:37 | 82.5 | 5.9 | 29.7 |
| 9 | 9:38 | 82.6 | 6.0 | 29.7 |
| 10 | 9:39 | 82.5 | 6.0 | 29.7 |
| 11 | 9:40 | 81.1 | 6.0 | 29.8 |
| 12 | 9:41 | 80.2 | 5.9 | 29.8 |
| 13 | 9:42 | 81.5 | 5.9 | 29.6 |
| 14 | 9:43 | 80.6 | 5.8 | 29.8 |
| 15 | 9:44 | 81.7 | 5.9 | 29.8 |
| 16 | 9:45 | 81.1 | 6.1 | 29.9 |
| 17 | 9:46 | 78.4 | 6.1 | 29.7 |
| 18 | 9:47 | 79.4 | 6.0 | 29.8 |
| 19 | 9:48 | 79.8 | 6.0 | 29.8 |
| 20 | 9:49 | 80.9 | 5.9 | 29.8 |
| 21 | 9:50 | 79.9 | 5.9 | 29.7 |
| 22 | 9:51 | 81.0 | 6.0 | 29.9 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **80.87** | **5.97** | **29.76** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 2-COO2NOx
**Source :** Boiler #10 **Date:** 05/04/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.1 | 0.1 |
| 8:24 | 44.4 | 44.2 | -0.2 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:23 | 0 | 0.3 | 0.3 |
| 9:25 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:53 | 0 | 0.3 | 0.3 | 0.0 |
| 9:55 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:23 | 0.0 | 0.1 | 0.5 |
| 9:25 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:53 | 0.0 | 0.1 | 0.5 | 0.0 |
| 9:55 | 8.51 | 8.4 | -0.5 | -0.5 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 35 seconds |
| $O_2$ | 28 | 26 seconds |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.2 | 0.2 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | From FCC on 5/3/10 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:23 | 0.0 | 0.3 | 0.3 |
| 9:27 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:53 | 0.0 | 0.3 | 0.3 | 0.0 |
| 9:57 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 34 seconds |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 80.87 ppm v/v d |
| $O_2$ | 5.97 % v/v d |
| NOx | 29.76 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 81.7 ppm v/v d |
| $O_2$ | 6.0 % v/v d |
| $NO_x$ | 29.8 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Method #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **3-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:00-10:21** |
| **Source:** | **Boiler #10** | **Date:** | **05/04/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 10:00 | 79.5 | 5.9 | 29.8 |
| 2 | 10:01 | 80.6 | 5.8 | 29.6 |
| 3 | 10:02 | 78.8 | 5.9 | 29.9 |
| 4 | 10:03 | 80.4 | 5.8 | 29.7 |
| 5 | 10:04 | 80.2 | 5.9 | 29.7 |
| 6 | 10:05 | 80.5 | 5.9 | 29.7 |
| 7 | 10:06 | 80.7 | 5.9 | 29.6 |
| 8 | 10:07 | 78.8 | 5.9 | 29.7 |
| 9 | 10:08 | 79.8 | 5.9 | 29.8 |
| 10 | 10:09 | 80.3 | 5.8 | 29.7 |
| 11 | 10:10 | 79.3 | 5.8 | 29.8 |
| 12 | 10:11 | 79.0 | 5.8 | 29.9 |
| 13 | 10:12 | 79.1 | 5.8 | 29.8 |
| 14 | 10:13 | 79.3 | 5.9 | 29.8 |
| 15 | 10:14 | 80.8 | 5.9 | 29.7 |
| 16 | 10:15 | 78.9 | 5.9 | 29.8 |
| 17 | 10:16 | 80.3 | 5.9 | 29.8 |
| 18 | 10:17 | 79.0 | 5.9 | 29.7 |
| 19 | 10:18 | 80.9 | 5.9 | 29.7 |
| 20 | 10:19 | 80.7 | 5.9 | 29.7 |
| 21 | 10:20 | 80.4 | 5.9 | 29.7 |
| 22 | 10:21 | 80.5 | 5.8 | 29.7 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **79.90** | **5.87** | **29.74** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 3-COO2NOx
**Source :** Boiler #10 **Date:** 05/04/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.1 | 0.1 |
| 8:24 | 44.4 | 44.2 | -0.2 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:53 | 0 | 0.3 | 0.3 |
| 9:55 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:23 | 0 | 0.2 | 0.2 | -0.1 |
| 10:25 | 44.4 | 44.0 | -0.4 | -0.1 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:53 | 0.0 | 0.1 | 0.5 |
| 9:55 | 8.51 | 8.4 | -0.5 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:23 | 0.0 | 0.1 | 0.5 | 0.0 |
| 10:25 | 8.51 | 8.4 | -0.5 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 35 seconds |
| $O_2$ | 28 | 26 seconds |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.2 | 0.2 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | From FCC on 5/3/10 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:53 | 0.0 | 0.3 | 0.3 |
| 9:57 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:23 | 0.0 | 0.3 | 0.3 | 0.0 |
| 10:27 | 51.5 | 51.3 | -0.2 | 0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 34 seconds |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 79.90 ppm v/v d |
| $O_2$ | 5.87 % v/v d |
| NOx | 29.74 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 80.7 ppm v/v d |
| $O_2$ | 5.9 % v/v d |
| $NO_x$ | 29.8 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Method #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **4-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:30-10:51** |
| **Source:** | **Boiler #10** | **Date:** | **05/04/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 10:30 | 78.9 | 5.9 | 30.0 |
| 2 | 10:31 | 78.7 | 5.9 | 29.9 |
| 3 | 10:32 | 78.4 | 5.9 | 29.9 |
| 4 | 10:33 | 78.1 | 5.9 | 29.8 |
| 5 | 10:34 | 78.0 | 6.0 | 29.7 |
| 6 | 10:35 | 76.8 | 6.0 | 29.7 |
| 7 | 10:36 | 78.3 | 6.0 | 29.7 |
| 8 | 10:37 | 78.1 | 5.9 | 29.6 |
| 9 | 10:38 | 77.8 | 5.9 | 29.8 |
| 10 | 10:39 | 79.9 | 5.9 | 29.5 |
| 11 | 10:40 | 80.6 | 5.9 | 29.3 |
| 12 | 10:41 | 81.4 | 5.9 | 29.6 |
| 13 | 10:42 | 79.5 | 5.9 | 29.9 |
| 14 | 10:43 | 80.0 | 6.0 | 30.0 |
| 15 | 10:44 | 80.7 | 5.9 | 29.9 |
| 16 | 10:45 | 80.9 | 5.9 | 29.9 |
| 17 | 10:46 | 80.0 | 5.9 | 30.0 |
| 18 | 10:47 | 81.6 | 5.9 | 30.0 |
| 19 | 10:48 | 81.0 | 5.9 | 29.9 |
| 20 | 10:49 | 81.8 | 5.9 | 29.8 |
| 21 | 10:50 | 81.4 | 5.9 | 29.9 |
| 22 | 10:51 | 82.4 | 5.9 | 29.7 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **79.74** | **5.92** | **29.80** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 4-COO2NOx
**Source :** Boiler #10 **Date:** 05/04/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.1 | 0.1 |
| 8:24 | 44.4 | 44.2 | -0.2 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:23 | 0 | 0.2 | 0.2 |
| 10:25 | 44.4 | 44.0 | -0.4 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:53 | 0 | 0.2 | 0.2 | 0.0 |
| 10:55 | 44.4 | 44.0 | -0.4 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:23 | 0.0 | 0.1 | 0.5 |
| 10:25 | 8.51 | 8.4 | -0.5 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:53 | 0.0 | 0.0 | 0.0 | -0.5 |
| 10:55 | 8.51 | 8.5 | 0.0 | 0.5 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 35 seconds |
| $O_2$ | 28 | 26 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 4-COO2NOx
**Source:** Boiler #10 **Date:** 05/04/10

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.2 | 0.2 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | From FCC on 5/3/10 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:23 | 0.0 | 0.3 | 0.3 |
| 10:27 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:53 | 0.0 | 0.4 | 0.4 | 0.1 |
| 10:57 | 51.5 | 51.3 | -0.2 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 34 seconds |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 79.74 ppm v/v d |
| $O_2$ | 5.92 % v/v d |
| NOx | 29.80 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 80.6 ppm v/v d |
| $O_2$ | 5.9 % v/v d |
| $NO_x$ | 29.8 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Method #3A, 7E & 10**

**Client:** CHS, Inc. - Laurel Refinery
**Location:** Laurel, Montana
**Source:** Boiler #10

**Run #:** 5-COO2NOx
**Time:** 11:00-11:21
**Date:** 05/04/10

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 11:00 | 82.3 | 5.8 | 30.0 |
| 2 | 11:01 | 80.2 | 5.8 | 30.0 |
| 3 | 11:02 | 80.0 | 5.8 | 29.9 |
| 4 | 11:03 | 81.4 | 5.9 | 29.9 |
| 5 | 11:04 | 81.2 | 5.9 | 30.0 |
| 6 | 11:05 | 81.6 | 5.8 | 29.8 |
| 7 | 11:06 | 80.2 | 5.9 | 29.9 |
| 8 | 11:07 | 80.9 | 5.9 | 29.9 |
| 9 | 11:08 | 80.7 | 5.8 | 29.7 |
| 10 | 11:09 | 82.4 | 5.8 | 29.8 |
| 11 | 11:10 | 81.4 | 5.8 | 29.9 |
| 12 | 11:11 | 81.4 | 5.8 | 30.0 |
| 13 | 11:12 | 79.7 | 5.8 | 30.0 |
| 14 | 11:13 | 81.5 | 5.8 | 30.0 |
| 15 | 11:14 | 79.6 | 5.8 | 29.9 |
| 16 | 11:15 | 81.0 | 5.8 | 29.9 |
| 17 | 11:16 | 80.8 | 5.8 | 30.0 |
| 18 | 11:17 | 82.4 | 5.8 | 29.9 |
| 19 | 11:18 | 81.7 | 5.8 | 30.0 |
| 20 | 11:19 | 79.6 | 5.8 | 30.0 |
| 21 | 11:20 | 81.0 | 5.7 | 29.8 |
| 22 | 11:21 | 80.0 | 5.8 | 30.0 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **80.95** | **5.81** | **29.92** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 5-COO2NOx
**Source :** Boiler #10 **Date:** 05/04/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.1 | 0.1 |
| 8:24 | 44.4 | 44.2 | -0.2 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:53 | 0 | 0.2 | 0.2 |
| 10:55 | 44.4 | 44.0 | -0.4 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:23 | 0 | 0.2 | 0.2 | 0.0 |
| 11:25 | 44.4 | 44.1 | -0.3 | 0.1 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:53 | 0.0 | 0.0 | 0.0 |
| 10:55 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:23 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11:25 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 35 seconds |
| $O_2$ | 28 | 26 seconds |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.2 | 0.2 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | From FCC on 5/3/10 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:53 | 0.0 | 0.4 | 0.4 |
| 10:57 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:23 | 0.0 | 0.4 | 0.4 | 0.0 |
| 11:27 | 51.5 | 51.3 | -0.2 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 34 seconds |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 80.95 ppm v/v d |
| $O_2$ | 5.81 % v/v d |
| NOx | 29.92 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 81.8 ppm v/v d |
| $O_2$ | 5.8 % v/v d |
| $NO_x$ | 29.9 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Method #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **6-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:30-11:51** |
| **Source:** | **Boiler #10** | **Date:** | **05/04/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 11:30 | 82.5 | 5.9 | 29.8 |
| 2 | 11:31 | 79.9 | 5.9 | 29.8 |
| 3 | 11:32 | 83.5 | 5.9 | 29.7 |
| 4 | 11:33 | 81.3 | 5.9 | 29.8 |
| 5 | 11:34 | 82.6 | 5.9 | 29.6 |
| 6 | 11:35 | 80.5 | 6.0 | 29.7 |
| 7 | 11:36 | 80.6 | 5.9 | 29.7 |
| 8 | 11:37 | 81.5 | 5.9 | 29.7 |
| 9 | 11:38 | 83.4 | 5.9 | 29.8 |
| 10 | 11:39 | 83.3 | 5.9 | 29.8 |
| 11 | 11:40 | 80.6 | 5.9 | 29.7 |
| 12 | 11:41 | 80.2 | 5.9 | 29.7 |
| 13 | 11:42 | 80.3 | 5.9 | 29.7 |
| 14 | 11:43 | 83.3 | 5.9 | 29.7 |
| 15 | 11:44 | 83.4 | 5.9 | 29.6 |
| 16 | 11:45 | 82.5 | 5.9 | 29.5 |
| 17 | 11:46 | 81.0 | 5.9 | 29.6 |
| 18 | 11:47 | 80.4 | 5.9 | 29.5 |
| 19 | 11:48 | 82.8 | 5.9 | 29.6 |
| 20 | 11:49 | 82.4 | 5.9 | 29.5 |
| 21 | 11:50 | 81.3 | 5.9 | 29.4 |
| 22 | 11:51 | 82.1 | 5.8 | 29.5 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **81.79** | **5.90** | **29.65** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 6-COO2NOx
**Source :** Boiler #10 **Date:** 05/04/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.1 | 0.1 |
| 8:24 | 44.4 | 44.2 | -0.2 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:23 | 0 | 0.2 | 0.2 |
| 11:25 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:53 | 0 | 0.3 | 0.3 | 0.1 |
| 11:55 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:23 | 0.0 | 0.0 | 0.0 |
| 11:25 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:53 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11:55 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 35 seconds |
| $O_2$ | 28 | 26 seconds |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.2 | 0.2 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | From FCC on 5/3/10 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:23 | 0.0 | 0.4 | 0.4 |
| 11:27 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:53 | 0.0 | 0.3 | 0.3 | -0.1 |
| 11:57 | 51.5 | 51.2 | -0.3 | -0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 34 seconds |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 81.79 ppm v/v d |
| $O_2$ | 5.90 % v/v d |
| NOx | 29.65 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 82.6 ppm v/v d |
| $O_2$ | 5.9 % v/v d |
| $NO_x$ | 29.6 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Method #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **7-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:00-12:21** |
| **Source:** | **Boiler #10** | **Date:** | **05/04/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 12:00 | 81.2 | 5.8 | 29.4 |
| 2 | 12:01 | 82.0 | 5.8 | 29.5 |
| 3 | 12:02 | 79.9 | 5.8 | 29.6 |
| 4 | 12:03 | 81.7 | 5.9 | 29.8 |
| 5 | 12:04 | 79.8 | 5.9 | 29.8 |
| 6 | 12:05 | 81.6 | 5.9 | 30.0 |
| 7 | 12:06 | 79.6 | 5.9 | 29.8 |
| 8 | 12:07 | 80.4 | 5.9 | 30.0 |
| 9 | 12:08 | 80.6 | 6.0 | 29.9 |
| 10 | 12:09 | 79.9 | 6.0 | 30.0 |
| 11 | 12:10 | 79.5 | 6.0 | 29.9 |
| 12 | 12:11 | 81.3 | 6.0 | 29.9 |
| 13 | 12:12 | 82.0 | 6.0 | 29.8 |
| 14 | 12:13 | 81.5 | 6.0 | 29.8 |
| 15 | 12:14 | 82.1 | 6.0 | 29.8 |
| 16 | 12:15 | 82.2 | 6.0 | 29.9 |
| 17 | 12:16 | 81.9 | 5.9 | 29.9 |
| 18 | 12:17 | 80.7 | 5.9 | 29.9 |
| 19 | 12:18 | 80.7 | 6.0 | 30.0 |
| 20 | 12:19 | 81.0 | 6.0 | 29.9 |
| 21 | 12:20 | 79.9 | 6.0 | 29.9 |
| 22 | 12:21 | 80.7 | 6.0 | 29.8 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **80.92** | **5.94** | **29.83** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 7-COO2NOx
**Source :** Boiler #10 **Date:** 05/04/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.1 | 0.1 |
| 8:24 | 44.4 | 44.2 | -0.2 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:53 | 0 | 0.3 | 0.3 |
| 11:55 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:23 | 0 | 0.3 | 0.3 | 0.0 |
| 12:25 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:53 | 0.0 | 0.0 | 0.0 |
| 11:55 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:23 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12:25 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 35 seconds |
| $O_2$ | 28 | 26 seconds |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) | |
|---|---|---|---|---|
| 8:21 | 0.0 | 0.2 | 0.2 | |
| 8:26 | 51.5 | 51.4 | -0.1 | |
| 8:30 | 100.7 | 100.3 | -0.4 | |
| 8:45 | 53.3 | 49.4 | From FCC on 5/3/10 | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:53 | 0.0 | 0.3 | 0.3 |
| 11:57 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:23 | 0.0 | 0.3 | 0.3 | 0.0 |
| 12:27 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 34 seconds |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 80.92 ppm v/v d |
| $O_2$ | 5.94 % v/v d |
| NOx | 29.83 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 81.7 ppm v/v d |
| $O_2$ | 5.9 % v/v d |
| $NO_x$ | 29.9 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Method #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **8-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:30-12:51** |
| **Source:** | **Boiler #10** | **Date:** | **05/04/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 12:30 | 82.7 | 5.9 | 29.6 |
| 2 | 12:31 | 81.5 | 5.9 | 29.7 |
| 3 | 12:32 | 82.5 | 6.0 | 29.7 |
| 4 | 12:33 | 82.1 | 6.0 | 29.8 |
| 5 | 12:34 | 82.0 | 5.9 | 29.5 |
| 6 | 12:35 | 82.7 | 6.0 | 29.6 |
| 7 | 12:36 | 82.9 | 6.0 | 29.6 |
| 8 | 12:37 | 80.8 | 6.0 | 29.5 |
| 9 | 12:38 | 82.5 | 6.0 | 29.6 |
| 10 | 12:39 | 82.9 | 6.0 | 29.5 |
| 11 | 12:40 | 82.6 | 6.0 | 29.4 |
| 12 | 12:41 | 81.5 | 5.9 | 29.5 |
| 13 | 12:42 | 83.2 | 5.9 | 29.5 |
| 14 | 12:43 | 81.2 | 5.9 | 29.6 |
| 15 | 12:44 | 82.6 | 5.9 | 29.7 |
| 16 | 12:45 | 81.9 | 5.8 | 29.5 |
| 17 | 12:46 | 80.6 | 5.9 | 29.6 |
| 18 | 12:47 | 82.9 | 5.8 | 29.5 |
| 19 | 12:48 | 82.5 | 5.9 | 29.7 |
| 20 | 12:49 | 82.0 | 5.8 | 29.8 |
| 21 | 12:50 | 80.6 | 5.8 | 29.8 |
| 22 | 12:51 | 80.9 | 5.8 | 29.7 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **82.05** | **5.91** | **29.61** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 8-COO2NOx
**Source :** Boiler #10 **Date:** 05/04/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.1 | 0.1 |
| 8:24 | 44.4 | 44.2 | -0.2 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:23 | 0 | 0.3 | 0.3 |
| 12:25 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:53 | 0 | 0.3 | 0.3 | 0.0 |
| 12:55 | 44.4 | 44.0 | -0.4 | -0.1 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:23 | 0.0 | 0.0 | 0.0 |
| 12:25 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:53 | 0.0 | 0.1 | 0.5 | 0.5 |
| 12:55 | 8.51 | 8.5 | 0.0 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| CO | 36 | 35 seconds |
| $O_2$ | 28 | 26 seconds |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.2 | 0.2 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | From FCC on 5/3/10 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:23 | 0.0 | 0.3 | 0.3 |
| 12:27 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:53 | 0.0 | 0.3 | 0.3 | 0.0 |
| 12:57 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 34 seconds |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 82.05 ppm v/v d |
| $O_2$ | 5.91 % v/v d |
| NOx | 29.61 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 83.0 ppm v/v d |
| $O_2$ | 5.9 % v/v d |
| $NO_x$ | 29.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Method #3A, 7E & 10**

**Client:** CHS, Inc. - Laurel Refinery
**Location:** Laurel, Montana
**Source:** Boiler #10

**Run #:** 9-COO2NOx
**Time:** 13:00-13:21
**Date:** 05/04/10

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 13:00 | 81.1 | 5.9 | 29.7 |
| 2 | 13:01 | 82.1 | 5.9 | 29.8 |
| 3 | 13:02 | 82.8 | 5.9 | 29.6 |
| 4 | 13:03 | 80.0 | 5.9 | 29.6 |
| 5 | 13:04 | 82.0 | 5.9 | 29.8 |
| 6 | 13:05 | 80.7 | 5.9 | 29.8 |
| 7 | 13:06 | 82.1 | 5.9 | 29.8 |
| 8 | 13:07 | 80.9 | 5.9 | 29.9 |
| 9 | 13:08 | 82.4 | 5.9 | 29.9 |
| 10 | 13:09 | 82.8 | 5.8 | 29.8 |
| 11 | 13:10 | 81.3 | 5.9 | 29.9 |
| 12 | 13:11 | 81.0 | 5.9 | 29.8 |
| 13 | 13:12 | 80.0 | 5.9 | 29.8 |
| 14 | 13:13 | 81.6 | 5.9 | 29.8 |
| 15 | 13:14 | 82.8 | 5.9 | 29.8 |
| 16 | 13:15 | 82.3 | 5.9 | 29.9 |
| 17 | 13:16 | 80.7 | 5.9 | 30.0 |
| 18 | 13:17 | 82.4 | 5.8 | 29.9 |
| 19 | 13:18 | 83.4 | 5.9 | 30.0 |
| 20 | 13:19 | 82.9 | 5.9 | 30.0 |
| 21 | 13:20 | 80.0 | 5.9 | 29.9 |
| 22 | 13:21 | 83.0 | 5.9 | 29.8 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **81.74** | **5.89** | **29.83** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 9-COO2NOx
**Source :** Boiler #10 **Date:** 05/04/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.1 | 0.1 |
| 8:24 | 44.4 | 44.2 | -0.2 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:53 | 0 | 0.3 | 0.3 |
| 12:55 | 44.4 | 44.0 | -0.4 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:23 | 0 | 0.3 | 0.3 | 0.0 |
| 13:25 | 44.4 | 44.0 | -0.4 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.0 | 0.0 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:53 | 0.0 | 0.1 | 0.5 |
| 12:55 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:23 | 0.0 | 0.1 | 0.5 | 0.0 |
| 13:25 | 8.51 | 8.5 | 0.0 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| CO | 36 | 35 seconds |
| $O_2$ | 28 | 26 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 9-COO2NOx
**Source:** Boiler #10 **Date:** 05/04/10

**Instrument Calibration Checks - continued**

$NO_x$ Instrument Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.2 | 0.2 |
| 8:26 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | From FCC on 5/3/10 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:53 | 0.0 | 0.3 | 0.3 |
| 12:57 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:23 | 0.0 | 0.3 | 0.3 | 0.0 |
| 13:27 | 51.5 | 51.2 | -0.3 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 34 seconds |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 81.74 ppm v/v d |
| $O_2$ | 5.89 % v/v d |
| NOx | 29.83 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 82.7 ppm v/v d |
| $O_2$ | 5.9 % v/v d |
| $NO_x$ | 29.9 ppm v/v d |

**CHS, Inc. - Laurel Refinery**
**Boiler #10**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/04/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 8:20 | 0.1 | 0.0 | 0.2 | Initial Calibrations/Tank IDS |
| 8:21 | 0.1 | 0.0 | 0.2 | **CO Tanks** |
| 8:22 | 0.1 | 0.0 | 0.2 | ET0003451 @ 44.4 ppm; Exp. 09-28-12 |
| 8:23 | 31.1 | 5.5 | 0.2 | ET0003462 @ 98.0 ppm; Exp. 09-28-12 |
| 8:24 | 44.2 | 8.5 | 0.2 | CO Instrument: CAI 200 |
| 8:25 | 6.5 | 2.0 | 32.6 | |
| 8:26 | 0.1 | 0.0 | 51.4 | **$O_2$ Tanks** |
| 8:27 | 71.3 | 16.1 | 7.4 | ET0003451 @ 8.51%; Exp. 09/28/12 |
| 8:28 | 97.6 | 20.4 | 0.2 | ET0003519 @ 20.5%; Exp. 06/19/12 |
| 8:29 | 14.2 | 3.1 | 68.3 | $O_2$ Instrument: Servomex 1400 |
| 8:30 | 0.1 | 0.0 | 100.3 | |
| 8:31 | 0.1 | 0.0 | 13.2 | |
| 8:32 | 0.1 | 0.0 | 0.2 | |
| 8:33 | 29.7 | 6.0 | 0.2 | $CO/O_2$ Response Time |
| 8:34 | 44.1 | 8.5 | 0.2 | |
| 8:35 | 7.0 | 1.3 | 0.2 | $CO/O_2$ Response Time |
| 8:36 | 0.2 | 0.1 | 0.2 | |
| 8:37 | 0.2 | 0.1 | 34.7 | $NO_x$ Response Time |
| 8:38 | 0.2 | 0.1 | 51.2 | |
| 8:39 | 0.2 | 0.1 | 10.4 | $NO_x$ Response Time |
| 8:40 | 0.2 | 0.1 | 0.3 | **$NO_x$ Tanks** |
| 8:41 | 0.2 | 0.1 | 0.3 | LL82176 @ 51.5 ppm; Exp. 10-19-11 |
| 8:42 | 0.2 | 0.0 | 0.3 | LL31587 @ 100.7 ppm; Exp. 08-11-10 |
| 8:43 | 0.2 | 0.0 | 0.3 | LL82188 @ 53.3 ppm; Exp. 10-29-11 |
| 8:44 | 0.2 | 0.0 | 0.3 | $NO_x$ Instrument: CAI 400 |
| 8:45 | 40.2 | 4.2 | 14.2 | |
| 8:46 | 78.4 | 6.1 | 29.8 | |
| 8:47 | 79.0 | 5.8 | 29.8 | |
| 8:48 | 77.8 | 5.9 | 29.8 | |
| 8:49 | 77.3 | 5.8 | 29.8 | |
| 8:50 | 78.7 | 6.1 | 29.8 | |
| 8:51 | 78.4 | 6.1 | 29.9 | |
| 8:52 | 77.5 | 6.1 | 29.6 | |
| 8:53 | 78.6 | 6.0 | 29.6 | |
| 8:54 | 78.9 | 6.0 | 29.9 | |
| 8:55 | 79.4 | 6.1 | 29.7 | |
| 8:56 | 79.4 | 6.0 | 29.8 | |
| 8:57 | 77.8 | 6.1 | 29.7 | |
| 8:58 | 78.2 | 6.0 | 29.7 | |
| 8:59 | 78.5 | 5.9 | 29.8 | |
| 9:00 | 78.9 | 5.8 | 29.9 | Start Run 1 |

**CHS, Inc. - Laurel Refinery**
**Boiler #10**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/04/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 9:01 | 78.8 | 6.1 | 29.7 | |
| 9:02 | 78.1 | 5.9 | 29.6 | |
| 9:03 | 78.1 | 6.1 | 29.8 | |
| 9:04 | 79.4 | 5.8 | 29.8 | |
| 9:05 | 78.6 | 6.1 | 29.6 | |
| 9:06 | 78.2 | 5.8 | 29.7 | |
| 9:07 | 79.1 | 5.9 | 29.9 | |
| 9:08 | 79.4 | 6.0 | 29.9 | |
| 9:09 | 77.7 | 5.8 | 29.8 | |
| 9:10 | 78.2 | 6.0 | 29.6 | |
| 9:11 | 77.9 | 6.1 | 29.7 | |
| 9:12 | 77.9 | 5.8 | 29.7 | |
| 9:13 | 79.3 | 6.0 | 29.8 | |
| 9:14 | 79.3 | 6.0 | 29.8 | |
| 9:15 | 78.6 | 6.0 | 29.8 | |
| 9:16 | 79.3 | 5.8 | 29.8 | |
| 9:17 | 79.4 | 6.1 | 29.7 | |
| 9:18 | 78.2 | 6.0 | 29.6 | |
| 9:19 | 78.6 | 6.0 | 29.8 | |
| 9:20 | 79.1 | 6.0 | 29.8 | |
| 9:21 | 78.6 | 5.9 | 29.9 | End Run 1 |
| 9:22 | 14.6 | 2.1 | 4.5 | |
| 9:23 | 0.3 | 0.1 | 0.3 | |
| 9:24 | 32.8 | 4.9 | 0.3 | |
| 9:25 | 44.1 | 8.5 | 0.3 | |
| 9:26 | 10.3 | 2.0 | 34.0 | |
| 9:27 | 0.3 | 0.1 | 51.2 | |
| 9:28 | 0.3 | 0.1 | 3.7 | |
| 9:29 | 28.4 | 3.1 | 17.4 | |
| 9:30 | 81.7 | 5.8 | 29.7 | Start Run 2 |
| 9:31 | 80.1 | 6.1 | 29.8 | |
| 9:32 | 80.8 | 5.9 | 29.8 | |
| 9:33 | 80.2 | 6.0 | 29.9 | |
| 9:34 | 81.4 | 6.1 | 29.6 | |
| 9:35 | 80.8 | 6.1 | 29.8 | |
| 9:36 | 80.9 | 6.0 | 29.6 | |
| 9:37 | 82.5 | 5.9 | 29.7 | |
| 9:38 | 82.6 | 6.0 | 29.7 | |
| 9:39 | 82.5 | 6.0 | 29.7 | |
| 9:40 | 81.1 | 6.0 | 29.8 | |
| 9:41 | 80.2 | 5.9 | 29.8 | |
| 9:42 | 81.5 | 5.9 | 29.6 | |

**CHS, Inc. - Laurel Refinery**
**Boiler #10**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/04/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 9:43 | 80.6 | 5.8 | 29.8 | |
| 9:44 | 81.7 | 5.9 | 29.8 | |
| 9:45 | 81.1 | 6.1 | 29.9 | |
| 9:46 | 78.4 | 6.1 | 29.7 | |
| 9:47 | 79.4 | 6.0 | 29.8 | |
| 9:48 | 79.8 | 6.0 | 29.8 | |
| 9:49 | 80.9 | 5.9 | 29.8 | |
| 9:50 | 79.9 | 5.9 | 29.7 | |
| 9:51 | 81.0 | 6.0 | 29.9 | End Run 2 |
| 9:52 | 21.1 | 1.8 | 5.7 | |
| 9:53 | 0.3 | 0.1 | 0.3 | |
| 9:54 | 36.1 | 5.8 | 0.3 | |
| 9:55 | 44.1 | 8.4 | 0.3 | |
| 9:56 | 6.3 | 2.1 | 30.6 | |
| 9:57 | 0.3 | 0.1 | 51.2 | |
| 9:58 | 0.3 | 0.1 | 10.4 | |
| 9:59 | 26.0 | 3.7 | 19.4 | |
| 10:00 | 79.5 | 5.9 | 29.8 | Start Run 3 |
| 10:01 | 80.6 | 5.8 | 29.6 | |
| 10:02 | 78.8 | 5.9 | 29.9 | |
| 10:03 | 80.4 | 5.8 | 29.7 | |
| 10:04 | 80.2 | 5.9 | 29.7 | |
| 10:05 | 80.5 | 5.9 | 29.7 | |
| 10:06 | 80.7 | 5.9 | 29.6 | |
| 10:07 | 78.8 | 5.9 | 29.7 | |
| 10:08 | 79.8 | 5.9 | 29.8 | |
| 10:09 | 80.3 | 5.8 | 29.7 | |
| 10:10 | 79.3 | 5.8 | 29.8 | |
| 10:11 | 79.0 | 5.8 | 29.9 | |
| 10:12 | 79.1 | 5.8 | 29.8 | |
| 10:13 | 79.3 | 5.9 | 29.8 | |
| 10:14 | 80.8 | 5.9 | 29.7 | |
| 10:15 | 78.9 | 5.9 | 29.8 | |
| 10:16 | 80.3 | 5.9 | 29.8 | |
| 10:17 | 79.0 | 5.9 | 29.7 | |
| 10:18 | 80.9 | 5.9 | 29.7 | |
| 10:19 | 80.7 | 5.9 | 29.7 | |
| 10:20 | 80.4 | 5.9 | 29.7 | |
| 10:21 | 80.5 | 5.8 | 29.7 | End Run 3 |
| 10:22 | 14.8 | 0.9 | 5.5 | |
| 10:23 | 0.2 | 0.1 | 0.3 | |
| 10:24 | 31.9 | 6.2 | 0.3 | |

**CHS, Inc. - Laurel Refinery**
**Boiler #10**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/04/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 10:25 | 44.0 | 8.4 | 0.3 | |
| 10:26 | 16.2 | 1.2 | 33.7 | |
| 10:27 | 0.3 | 0.1 | 51.3 | |
| 10:28 | 0.3 | 0.1 | 7.3 | |
| 10:29 | 31.7 | 4.1 | 20.2 | |
| 10:30 | 78.9 | 5.9 | 30.0 | Start Run 4 |
| 10:31 | 78.7 | 5.9 | 29.9 | |
| 10:32 | 78.4 | 5.9 | 29.9 | |
| 10:33 | 78.1 | 5.9 | 29.8 | |
| 10:34 | 78.0 | 6.0 | 29.7 | |
| 10:35 | 76.8 | 6.0 | 29.7 | |
| 10:36 | 78.3 | 6.0 | 29.7 | |
| 10:37 | 78.1 | 5.9 | 29.6 | |
| 10:38 | 77.8 | 5.9 | 29.8 | |
| 10:39 | 79.9 | 5.9 | 29.5 | |
| 10:40 | 80.6 | 5.9 | 29.3 | |
| 10:41 | 81.4 | 5.9 | 29.6 | |
| 10:42 | 79.5 | 5.9 | 29.9 | |
| 10:43 | 80.0 | 6.0 | 30.0 | |
| 10:44 | 80.7 | 5.9 | 29.9 | |
| 10:45 | 80.9 | 5.9 | 29.9 | |
| 10:46 | 80.0 | 5.9 | 30.0 | |
| 10:47 | 81.6 | 5.9 | 30.0 | |
| 10:48 | 81.0 | 5.9 | 29.9 | |
| 10:49 | 81.8 | 5.9 | 29.8 | |
| 10:50 | 81.4 | 5.9 | 29.9 | |
| 10:51 | 82.4 | 5.9 | 29.7 | End Run 4 |
| 10:52 | 16.2 | 1.7 | 4.9 | |
| 10:53 | 0.2 | 0.0 | 0.4 | |
| 10:54 | 30.7 | 5.1 | 0.4 | |
| 10:55 | 44.0 | 8.5 | 0.4 | |
| 10:56 | 11.4 | 2.0 | 36.1 | |
| 10:57 | 0.2 | 0.0 | 51.3 | |
| 10:58 | 0.2 | 0.0 | 6.8 | |
| 10:59 | 21.8 | 5.2 | 21.7 | |
| 11:00 | 82.3 | 5.8 | 30.0 | Start Run 5 |
| 11:01 | 80.2 | 5.8 | 30.0 | |
| 11:02 | 80.0 | 5.8 | 29.9 | |
| 11:03 | 81.4 | 5.9 | 29.9 | |
| 11:04 | 81.2 | 5.9 | 30.0 | |
| 11:05 | 81.6 | 5.8 | 29.8 | |
| 11:06 | 80.2 | 5.9 | 29.9 | |

**CHS, Inc. - Laurel Refinery**
**Boiler #10**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/04/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 11:07 | 80.9 | 5.9 | 29.9 | |
| 11:08 | 80.7 | 5.8 | 29.7 | |
| 11:09 | 82.4 | 5.8 | 29.8 | |
| 11:10 | 81.4 | 5.8 | 29.9 | |
| 11:11 | 81.4 | 5.8 | 30.0 | |
| 11:12 | 79.7 | 5.8 | 30.0 | |
| 11:13 | 81.5 | 5.8 | 30.0 | |
| 11:14 | 79.6 | 5.8 | 29.9 | |
| 11:15 | 81.0 | 5.8 | 29.9 | |
| 11:16 | 80.8 | 5.8 | 30.0 | |
| 11:17 | 82.4 | 5.8 | 29.9 | |
| 11:18 | 81.7 | 5.8 | 30.0 | |
| 11:19 | 79.6 | 5.8 | 30.0 | |
| 11:20 | 81.0 | 5.7 | 29.8 | |
| 11:21 | 80.0 | 5.8 | 30.0 | End Run 5 |
| 11:22 | 12.9 | 2.2 | 4.7 | |
| 11:23 | 0.2 | 0.0 | 0.4 | |
| 11:24 | 29.5 | 3.9 | 0.4 | |
| 11:25 | 44.1 | 8.5 | 0.3 | |
| 11:26 | 12.9 | 1.7 | 38.3 | |
| 11:27 | 0.3 | 0.0 | 51.3 | |
| 11:28 | 0.2 | 0.0 | 11.6 | |
| 11:29 | 32.6 | 3.1 | 22.8 | |
| 11:30 | 82.5 | 5.9 | 29.8 | Start Run 6 |
| 11:31 | 79.9 | 5.9 | 29.8 | |
| 11:32 | 83.5 | 5.9 | 29.7 | |
| 11:33 | 81.3 | 5.9 | 29.8 | |
| 11:34 | 82.6 | 5.9 | 29.6 | |
| 11:35 | 80.5 | 6.0 | 29.7 | |
| 11:36 | 80.6 | 5.9 | 29.7 | |
| 11:37 | 81.5 | 5.9 | 29.7 | |
| 11:38 | 83.4 | 5.9 | 29.8 | |
| 11:39 | 83.3 | 5.9 | 29.8 | |
| 11:40 | 80.6 | 5.9 | 29.7 | |
| 11:41 | 80.2 | 5.9 | 29.7 | |
| 11:42 | 80.3 | 5.9 | 29.7 | |
| 11:43 | 83.3 | 5.9 | 29.7 | |
| 11:44 | 83.4 | 5.9 | 29.6 | |
| 11:45 | 82.5 | 5.9 | 29.5 | |
| 11:46 | 81.0 | 5.9 | 29.6 | |
| 11:47 | 80.4 | 5.9 | 29.5 | |
| 11:48 | 82.8 | 5.9 | 29.6 | |

**CHS, Inc. - Laurel Refinery**
**Boiler #10**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/04/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 11:49 | 82.4 | 5.9 | 29.5 | |
| 11:50 | 81.3 | 5.9 | 29.4 | |
| 11:51 | 82.1 | 5.8 | 29.5 | End Run 6 |
| 11:52 | 16.7 | 0.8 | 5.8 | |
| 11:53 | 0.3 | 0.0 | 0.3 | |
| 11:54 | 31.6 | 4.8 | 0.3 | |
| 11:55 | 44.1 | 8.5 | 0.3 | |
| 11:56 | 5.8 | 3.3 | 33.7 | |
| 11:57 | 0.3 | 0.0 | 51.2 | |
| 11:58 | 0.3 | 0.0 | 4.9 | |
| 11:59 | 27.7 | 2.9 | 22.4 | |
| 12:00 | 81.2 | 5.8 | 29.4 | Start Run 7 |
| 12:01 | 82.0 | 5.8 | 29.5 | |
| 12:02 | 79.9 | 5.8 | 29.6 | |
| 12:03 | 81.7 | 5.9 | 29.8 | |
| 12:04 | 79.8 | 5.9 | 29.8 | |
| 12:05 | 81.6 | 5.9 | 30.0 | |
| 12:06 | 79.6 | 5.9 | 29.8 | |
| 12:07 | 80.4 | 5.9 | 30.0 | |
| 12:08 | 80.6 | 6.0 | 29.9 | |
| 12:09 | 79.9 | 6.0 | 30.0 | |
| 12:10 | 79.5 | 6.0 | 29.9 | |
| 12:11 | 81.3 | 6.0 | 29.9 | |
| 12:12 | 82.0 | 6.0 | 29.8 | |
| 12:13 | 81.5 | 6.0 | 29.8 | |
| 12:14 | 82.1 | 6.0 | 29.8 | |
| 12:15 | 82.2 | 6.0 | 29.9 | |
| 12:16 | 81.9 | 5.9 | 29.9 | |
| 12:17 | 80.7 | 5.9 | 29.9 | |
| 12:18 | 80.7 | 6.0 | 30.0 | |
| 12:19 | 81.0 | 6.0 | 29.9 | |
| 12:20 | 79.9 | 6.0 | 29.9 | |
| 12:21 | 80.7 | 6.0 | 29.8 | End Run 7 |
| 12:22 | 12.4 | 2.3 | 7.1 | |
| 12:23 | 0.3 | 0.0 | 0.3 | |
| 12:24 | 28.4 | 4.4 | 0.3 | |
| 12:25 | 44.1 | 8.5 | 0.3 | |
| 12:26 | 11.3 | 2.1 | 34.9 | |
| 12:27 | 0.3 | 0.0 | 51.2 | |
| 12:28 | 0.3 | 0.0 | 8.3 | |
| 12:29 | 28.5 | 2.7 | 18.6 | |
| 12:30 | 82.7 | 5.9 | 29.6 | Start Run 8 |

**CHS, Inc. - Laurel Refinery**
**Boiler #10**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/04/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 12:31 | 81.5 | 5.9 | 29.7 | |
| 12:32 | 82.5 | 6.0 | 29.7 | |
| 12:33 | 82.1 | 6.0 | 29.8 | |
| 12:34 | 82.0 | 5.9 | 29.5 | |
| 12:35 | 82.7 | 6.0 | 29.6 | |
| 12:36 | 82.9 | 6.0 | 29.6 | |
| 12:37 | 80.8 | 6.0 | 29.5 | |
| 12:38 | 82.5 | 6.0 | 29.6 | |
| 12:39 | 82.9 | 6.0 | 29.5 | |
| 12:40 | 82.6 | 6.0 | 29.4 | |
| 12:41 | 81.5 | 5.9 | 29.5 | |
| 12:42 | 83.2 | 5.9 | 29.5 | |
| 12:43 | 81.2 | 5.9 | 29.6 | |
| 12:44 | 82.6 | 5.9 | 29.7 | |
| 12:45 | 81.9 | 5.8 | 29.5 | |
| 12:46 | 80.6 | 5.9 | 29.6 | |
| 12:47 | 82.9 | 5.8 | 29.5 | |
| 12:48 | 82.5 | 5.9 | 29.7 | |
| 12:49 | 82.0 | 5.8 | 29.8 | |
| 12:50 | 80.6 | 5.8 | 29.8 | |
| 12:51 | 80.9 | 5.8 | 29.7 | End Run 8 |
| 12:52 | 16.3 | 1.5 | 11.4 | |
| 12:53 | 0.3 | 0.1 | 0.3 | |
| 12:54 | 32.7 | 5.8 | 0.3 | |
| 12:55 | 44.0 | 8.5 | 0.3 | |
| 12:56 | 12.1 | 2.4 | 30.1 | |
| 12:57 | 0.3 | 0.1 | 51.2 | |
| 12:58 | 0.3 | 0.1 | 6.9 | |
| 12:59 | 34.1 | 2.9 | 21.1 | |
| 13:00 | 81.1 | 5.9 | 29.7 | Start Run 9 |
| 13:01 | 82.1 | 5.9 | 29.8 | |
| 13:02 | 82.8 | 5.9 | 29.6 | |
| 13:03 | 80.0 | 5.9 | 29.6 | |
| 13:04 | 82.0 | 5.9 | 29.8 | |
| 13:05 | 80.7 | 5.9 | 29.8 | |
| 13:06 | 82.1 | 5.9 | 29.8 | |
| 13:07 | 80.9 | 5.9 | 29.9 | |
| 13:08 | 82.4 | 5.9 | 29.9 | |
| 13:09 | 82.8 | 5.8 | 29.8 | |
| 13:10 | 81.3 | 5.9 | 29.9 | |
| 13:11 | 81.0 | 5.9 | 29.8 | |
| 13:12 | 80.0 | 5.9 | 29.8 | |

**CHS, Inc. - Laurel Refinery**
**Boiler #10**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/04/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 13:13 | 81.6 | 5.9 | 29.8 | |
| 13:14 | 82.8 | 5.9 | 29.8 | |
| 13:15 | 82.3 | 5.9 | 29.9 | |
| 13:16 | 80.7 | 5.9 | 30.0 | |
| 13:17 | 82.4 | 5.8 | 29.9 | |
| 13:18 | 83.4 | 5.9 | 30.0 | |
| 13:19 | 82.9 | 5.9 | 30.0 | |
| 13:20 | 80.0 | 5.9 | 29.9 | |
| 13:21 | 83.0 | 5.9 | 29.8 | End Run 9 |
| 13:22 | 14.2 | 3.1 | 6.0 | |
| 13:23 | 0.3 | 0.1 | 0.3 | |
| 13:24 | 30.8 | 4.7 | 0.3 | |
| 13:25 | 44.0 | 8.5 | 0.3 | |
| 13:26 | 11.1 | 3.1 | 35.8 | |
| 13:27 | 0.3 | 0.1 | 51.2 | |
| 13:28 | 0.3 | 0.1 | 8.6 | |
| 13:29 | 0.3 | 0.1 | 0.3 | |
| 13:30 | 0.3 | 0.1 | 0.3 | |
| 13:31 | 0.3 | 0.1 | 0.3 | |
| 13:32 | 0.3 | 0.1 | 0.3 | |
| 13:33 | 0.3 | 0.0 | 0.3 | |
| 13:34 | 0.3 | 0.0 | 0.3 | |
| 13:35 | 0.3 | 0.0 | 0.3 | |
| 13:36 | 0.3 | 0.0 | 0.3 | |

# $NO_x$ EXAMPLE CALCULATIONS

| | |
|---|---|
| COMPANY NAME: CHS | SPECIES: NO X |
| PLANT LOCATION: Laurel, MT | TEST DATE: 5/5/10 |
| SOURCE TESTED: B-12 | |

**Calculate the "Calibration Corrected $NO_x$ Value", $C_{GAS}$ - EPA Reference Method #7E**

$C_{GAS}$ = $(C_{Mean} - C_O)[C_{MA}/(C_M - C_O)]$

$C_{GAS}$ = corrected gas concentration, ppm v/v dry

$C_{Mean}$ = average gas ppm from analyzer

$C_{Mean}$ = 20.11

$C_O$ = average of initial and final (post) system bias calibration check for zero calibration gas, ppm

$C_O$ = 0.2

$C_{MA}$ = actual concentration of upscale calibration gas, ppm

$C_{MA}$ = 44.4

$C_M$ = average of initial and final (post) system bias calibration check for upscale calibration gas, ppm

$C_M$ = 44.1

$C_{GAS}$ = (20.11 $C_{Mean}$ - 0.2 $C_O$)[44.4 $C_{MA}$/(44.1 $C_M$ - 0.2 $C_O$)]

= 20.1

WorldDrive01:\Forms\Forms\NOx Cal Corrected & Fd1.wpd
Revised 07/16/07 jmf

# $NO_x$ EXAMPLE CALCULATIONS

| | |
|---|---|
| COMPANY NAME: CHS | RUN: 1 CO/NOX/O2 |
| PLANT LOCATION: Laurel, MT. | TEST DATE: 5/3/10 |
| SOURCE TESTED: B-12 | |

## Calculate the "Calibration Corrected $NO_x$ Value", $C_{GAS}$ - EPA Reference Method #7E

$C_{GAS}$ = $(C_{Mean} - C_O)[C_{MA}/(C_M - C_O)]$

$C_{GAS}$ = corrected gas concentration, ppm v/v dry

$C_{Mean}$ = average gas ppm from analyzer

$C_{Mean}$ = _____

$C_O$ = average of initial and final (post) system bias calibration check for zero calibration gas, ppm

$C_O$ = _____

$C_{MA}$ = actual concentration of upscale calibration gas, ppm

$C_{MA}$ = _____

$C_M$ = average of initial and final (post) system bias calibration check for upscale calibration gas, ppm

$C_M$ = _____

$C_{GAS}$ = (_____$C_{Mean}$ - _____$C_O$)[_____$C_{MA}$/(_____$C_M$ - _____$C_O$)]

= _____

## $F_d$ Calculations - EPA Reference Method #19

Oxygen based F factor dry basis.

$E = C_d F_d[20.9 / (20.9 - \%O_2)]$

Where:

E = emission rate in lbs/mmBtu

$C_d$ = concentration in lbs/scf
To convert from ppm v/v dry to lbs/scf multiply ppm by $1.194 \times 10^{-7}$

$F_d$ = fuel factor on a dry basis
= 8,608 scf/mmBtu for **natural / fuel** gas as **supplied / calculated.**

<u>$NO_x$ Example:</u>

E = (20.1 ppm v/v dry)($1.194 \times 10^{-7}$)(8,608 scf/mmBtu )[20.9 / (20.9 - 2.7 $\%O_2$)]

= .024 lbs/mmBtu

EEMC

# $O_2$ EXAMPLE CALCULATION

COMPANY NAME: CHS
PLANT LOCATION: Laurel, MT.
SOURCE TESTED: B-12

RUN: 1 00/02/40X
TEST DATE: 5/5/10

## Calculate the "Calibration Corrected $O_2$ Value", $C_{GAS}$ - EPA Reference Method #3A

$C_{GAS}$ = $(C_{Mean} - C_O)[C_{MA}/(C_M - C_O)]$

$C_{GAS}$ = corrected gas concentration, $O_2$ % v/v dry

$C_{Mean}$ = average gas % from analyzer

$C_{Mean}$ = 2.75

$C_O$ = average of initial and final (post) system bias calibration check for zero calibration gas, %

$C_O$ = 0.1

$C_{MA}$ = actual concentration of upscale calibration gas, %

$C_{MA}$ = 8.51

$C_M$ = average of initial and final (post) system bias calibration check for upscale calibration gas, %

$C_M$ = 8.5

$C_{GAS}$ = (2.75 $C_{Mean}$ - 0.1 $C_O$)[8.51 $C_{MA}$/(8.5 $C_M$ - 0.1 $C_O$)]

= 2.7

# CO EXAMPLE CALCULATION

COMPANY NAME: CHS
PLANT LOCATION: Laurel, MT
SOURCE TESTED: B-12

RUN: 1-CO/4X/02
TEST DATE: 5/5/10

**Calculate the "Calibration Corrected CO Value", $C_{GAS}$ - EPA Reference Method #10**

$C_{GAS}$ = $(C_{Mean} - C_O)[C_{MA}/(C_M - C_O)]$
$C_{GAS}$ = corrected gas concentration, $O_2$ % v/v dry

$C_{Mean}$ = average gas % from analyzer
$C_{Mean}$ = 1.00

$C_O$ = average of initial and final (post) system bias calibration check for zero calibration gas, %
$C_O$ = 0.2

$C_{MA}$ = actual concentration of upscale calibration gas, %
$C_{MA}$ = 44.4

$C_M$ = average of initial and final (post) system bias calibration check for upscale calibration gas, %
$C_M$ = 44.1

$C_{GAS}$ = (1.00 $C_{Mean}$ - 0.2 $C_O$)[44.4 $C_{MA}$/(44.1 $C_M$ - 0.2 $C_O$)]
= 0.8

WorldDrive01:Forms/Forms/O2Calc1.wpd
Revised 07/16/07 jmf

# 3% $O_2$ EXAMPLE CALCULATIONS

| | |
|---|---|
| COMPANY NAME: CHS | SPECIES: CO |
| PLANT LOCATION: Laurel, MT | TEST DATE: |
| SOURCE TESTED: RB-12 | |

**Calculate the species Concentration to 3% $O_2$,**

Correction factor for 7% Oxygen($F_{O2}$):

$F_{O2}$ = [(17.9 )/(20.9 - $\%O_2$)]

C = Species concentration

$C_{7\%O2}$ = ($F_{O2}$) (C)

Run # 1 CO/NOx/O2

$F_{O2}$ = [(17.9 ) / (20.9 - 2.7 $\%O_2$ )] = .984

$C_{7\%O2}$ = (.984 $F_{O2}$) (.8 C) = 0.8 (.787) ppmvd

Run # _____

$F_{O2}$ = [(17.9 ) / (20.9 - _____ $\%O_2$ )] = _____

$C_{7\%O2}$ = (_____ $F_{O2}$) (_____ C) = _____

WorldDrive01:\Forms\Forms\SO2 0% O2 Corrected.wpd
Revised 07/16/07 jmf

# MASS FLOW
# EXAMPLE CALCULATIONS

COMPANY NAME: CHS
PLANT LOCATION: Laurel, MT
SOURCE TESTED: B-12

Run #: 1 CO/NOX/O2
TEST DATE: 5/5/10

**Definitions:**

PPH based on MW (Molecular Weight)

Gas Flow (GF) units are awcfm, sdcfh, or what is compatible to concentration.

Concentration units are ppm v/v dry or wet, compatible to gas flow.

Volume/Mole, V/M = (359 cu.ft./lb-mole @ STP) $\frac{\text{Ts °A}}{492°A}$ $\frac{29.92Hg}{Ps"Hg}$

Ts °A = Temperature Stack, degrees Absolute

Ps "Hg = Pressure Stack, inches mercury

pph = $(60x10^{-6})$ (MW/(V/M)) (Gas Flow) (Concentration)

**PPH Basis (Species=** NOX **, MW=** 46 **)**

NO X

**V/M** = (359 cu.ft./lb-mole @ STP) $\frac{744 \text{ Ts °A}}{492°A}$ $\frac{29.92Hg}{26.542 Ps"Hg}$ = 611.970

$(60x10^{-6})$ (46 MW) / (611.970 V/M) ) (45,193.0 GF) (20.1 ppmv/v) = 4.10 **PPH**

**PPH Basis (Species=** CO **, MW=** 28 **)**

CO

**V/M** = (359 cu.ft./lb-mole @ STP) $\frac{744 \text{ Ts °A}}{492°A}$ $\frac{29.92Hg}{(26.542 Ps"Hg)}$ = 611.970

$(60x10^{-6})$ (28 MW) / (611.970 V/M) ) (45,193.0 GF) 0.8 ppmv/v) = 0.10 **PPH**

**PPH Basis (Species=** _____ **, MW=** _____ **)**

**V/M** = (359 cu.ft./lb-mole @ STP) $\frac{\text{Ts °A}}{492°A}$ $\frac{29.92Hg}{(\quad Ps"Hg)}$ = _____

$(60x10^{-6})$ ( ( ____ MW) / ( _____ V/M) ) ( _____ GF) ( _____ ppmv/v) = _____ **PPH**

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **1-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:15-10:36** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 10:15 | 1.2 | 2.8 | 19.6 |
| 2 | 10:16 | 1.1 | 2.7 | 19.3 |
| 3 | 10:17 | 1.0 | 2.7 | 21.2 |
| 4 | 10:18 | 0.9 | 2.8 | 20.5 |
| 5 | 10:19 | 1.0 | 2.8 | 20.1 |
| 6 | 10:20 | 1.0 | 2.8 | 19.3 |
| 7 | 10:21 | 1.0 | 2.6 | 19.4 |
| 8 | 10:22 | 1.0 | 2.7 | 20.1 |
| 9 | 10:23 | 1.2 | 2.6 | 20.5 |
| 10 | 10:24 | 0.9 | 2.6 | 19.9 |
| 11 | 10:25 | 1.0 | 2.7 | 20.2 |
| 12 | 10:26 | 1.2 | 2.6 | 19.2 |
| 13 | 10:27 | 1.1 | 2.8 | 19.6 |
| 14 | 10:28 | 0.9 | 2.9 | 20.7 |
| 15 | 10:29 | 0.9 | 2.8 | 21.0 |
| 16 | 10:30 | 0.8 | 2.8 | 20.9 |
| 17 | 10:31 | 1.1 | 3.1 | 20.2 |
| 18 | 10:32 | 1.0 | 2.7 | 20.1 |
| 19 | 10:33 | 1.1 | 2.6 | 20.7 |
| 20 | 10:34 | 1.0 | 2.9 | 19.9 |
| 21 | 10:35 | 1.0 | 2.8 | 19.9 |
| 22 | 10:36 | 0.7 | 2.8 | 20.1 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **1.00** | **2.75** | **20.11** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 1-COO2NOx
**Source :** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0 | 0.2 | 0.2 |
| 8:47 | 44.4 | 44.2 | -0.2 |
| 8:51 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:01 | 0 | 0.2 | 0.2 |
| 8:59 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:38 | 0 | 0.2 | 0.2 | 0.0 |
| 10:40 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0.0 | 0.0 | 0.0 |
| 8:47 | 8.51 | 8.5 | 0.0 |
| 8:51 | 20.5 | 20.5 | 0.0 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:01 | 0.0 | 0.1 | 0.5 |
| 8:59 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:38 | 0.0 | 0.1 | 0.5 | 0.0 |
| 10:40 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 33 seconds |
| $O_2$ | 29 | 27 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 1-COO2NOx
**Source:** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:45 | 0.0 | 0.2 | 0.2 |
| 8:50 | 51.5 | 51.3 | -0.2 |
| 8:54 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | (from 5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:06 | 0.0 | 0.2 | 0.2 |
| 9:04 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:38 | 0.0 | 0.2 | 0.2 | 0.0 |
| 10:42 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High | |
|---|---|---|---|
| $NO_x$ | 37 | 35 | seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.52 | "Hg |
| Static Pressure | 0.30 | "$H_2O$ |
| Ps | 26.542 | "Hg |
| Gas Flow | 45,193.0 | adcfm |
| Avg. Stack Temp, Ts | 284 | °F |
| | 744 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 611.970 | ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.1 PPH |
| $NO_x$ | 4.10 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 1.00 ppm v/v d |
| $O_2$ | 2.75 % v/v d |
| NOx | 20.11 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.8 ppm v/v d |
| $O_2$ | 2.7 % v/v d |
| $NO_x$ | 20.1 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.8 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **2-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:45-11:06** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 10:45 | 0.8 | 2.8 | 20.3 |
| 2 | 10:46 | 0.9 | 2.7 | 19.0 |
| 3 | 10:47 | 0.8 | 2.7 | 20.6 |
| 4 | 10:48 | 1.0 | 2.6 | 19.7 |
| 5 | 10:49 | 0.7 | 2.7 | 20.8 |
| 6 | 10:50 | 1.0 | 2.7 | 20.1 |
| 7 | 10:51 | 0.8 | 2.7 | 19.7 |
| 8 | 10:52 | 0.8 | 2.7 | 20.7 |
| 9 | 10:53 | 0.7 | 2.6 | 19.2 |
| 10 | 10:54 | 0.9 | 2.7 | 19.3 |
| 11 | 10:55 | 0.8 | 2.7 | 20.7 |
| 12 | 10:56 | 1.0 | 2.6 | 20.9 |
| 13 | 10:57 | 0.8 | 2.6 | 19.6 |
| 14 | 10:58 | 0.8 | 2.6 | 19.5 |
| 15 | 10:59 | 0.8 | 2.6 | 20.5 |
| 16 | 11:00 | 0.8 | 2.9 | 19.1 |
| 17 | 11:01 | 0.9 | 2.8 | 19.2 |
| 18 | 11:02 | 0.8 | 2.6 | 19.4 |
| 19 | 11:03 | 0.9 | 2.5 | 19.9 |
| 20 | 11:04 | 0.9 | 2.8 | 19.0 |
| 21 | 11:05 | 0.8 | 2.6 | 20.5 |
| 22 | 11:06 | 0.9 | 2.8 | 20.4 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.85** | **2.68** | **19.91** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 2-COO2NOx
**Source :** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0 | 0.2 | 0.2 |
| 8:47 | 44.4 | 44.2 | -0.2 |
| 8:51 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:38 | 0 | 0.2 | 0.2 |
| 10:40 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:08 | 0 | 0.2 | 0.2 | 0.0 |
| 11:10 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0.0 | 0.0 | 0.0 |
| 8:47 | 8.51 | 8.5 | 0.0 |
| 8:51 | 20.5 | 20.5 | 0.0 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:38 | 0.0 | 0.1 | 0.5 |
| 10:40 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:08 | 0.0 | 0.1 | 0.5 | 0.0 |
| 11:10 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 33 seconds |
| $O_2$ | 29 | 27 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 2-COO2NOx
**Source:** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:45 | 0.0 | 0.2 | 0.2 |
| 8:50 | 51.5 | 51.3 | -0.2 |
| 8:54 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | (from 5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:38 | 0.0 | 0.2 | 0.2 |
| 10:42 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:08 | 0.0 | 0.2 | 0.2 | 0.0 |
| 11:12 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 35 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.52 | "Hg |
| Static Pressure | 0.30 | "$H_2O$ |
| Ps | 26.542 | "Hg |
| Gas Flow | 45,028.1 | adcfm |
| Avg. Stack Temp, Ts | 287 | °F |
| | 747 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 614.438 | ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.1 PPH |
| $NO_x$ | 4.03 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.85 ppm v/v d |
| $O_2$ | 2.68 % v/v d |
| NOx | 19.91 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.7 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 19.9 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **3-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:15-11:36** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 11:15 | 0.8 | 2.7 | 19.6 |
| 2 | 11:16 | 0.8 | 2.7 | 19.7 |
| 3 | 11:17 | 0.9 | 2.6 | 20.3 |
| 4 | 11:18 | 0.7 | 2.6 | 19.0 |
| 5 | 11:19 | 0.9 | 2.7 | 19.5 |
| 6 | 11:20 | 0.9 | 2.7 | 19.8 |
| 7 | 11:21 | 0.8 | 2.8 | 19.5 |
| 8 | 11:22 | 0.9 | 2.7 | 20.6 |
| 9 | 11:23 | 0.7 | 2.5 | 19.9 |
| 10 | 11:24 | 0.9 | 2.6 | 20.8 |
| 11 | 11:25 | 0.7 | 2.5 | 19.6 |
| 12 | 11:26 | 1.0 | 2.7 | 19.9 |
| 13 | 11:27 | 1.0 | 2.7 | 20.0 |
| 14 | 11:28 | 0.8 | 2.6 | 20.1 |
| 15 | 11:29 | 1.0 | 2.7 | 20.1 |
| 16 | 11:30 | 0.8 | 2.7 | 20.9 |
| 17 | 11:31 | 0.8 | 2.5 | 20.7 |
| 18 | 11:32 | 0.9 | 2.6 | 20.3 |
| 19 | 11:33 | 0.8 | 2.7 | 19.1 |
| 20 | 11:34 | 1.0 | 2.7 | 19.2 |
| 21 | 11:35 | 1.0 | 2.5 | 20.8 |
| 22 | 11:36 | 0.9 | 2.7 | 19.4 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.86** | **2.65** | **19.95** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 3-COO2NOx
**Source :** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0 | 0.2 | 0.2 |
| 8:47 | 44.4 | 44.2 | -0.2 |
| 8:51 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:08 | 0 | 0.2 | 0.2 |
| 11:10 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:38 | 0 | 0.2 | 0.2 | 0.0 |
| 11:40 | 44.4 | 44.2 | -0.2 | 0.1 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0.0 | 0.0 | 0.0 |
| 8:47 | 8.51 | 8.5 | 0.0 |
| 8:51 | 20.5 | 20.5 | 0.0 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:08 | 0.0 | 0.1 | 0.5 |
| 11:10 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:38 | 0.0 | 0.1 | 0.5 | 0.0 |
| 11:40 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 33 seconds |
| $O_2$ | 29 | 27 seconds |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:45 | 0.0 | 0.2 | 0.2 |
| 8:50 | 51.5 | 51.3 | -0.2 |
| 8:54 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | (from 5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:08 | 0.0 | 0.2 | 0.2 |
| 11:12 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:38 | 0.0 | 0.2 | 0.2 | 0.0 |
| 11:42 | 51.5 | 51.3 | -0.2 | 0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 35 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.52 | "Hg |
| Static Pressure | 0.30 | "$H_2O$ |
| Ps | 26.542 | "Hg |
| Gas Flow | 45,103.2 | adcfm |
| Avg. Stack Temp, Ts | 285 | °F |
| | 745 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 612.793 | ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.1 PPH |
| $NO_x$ | 4.04 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.86 ppm v/v d |
| $O_2$ | 2.65 % v/v d |
| NOx | 19.95 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.7 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 19.9 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **4-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:45-12:06** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 11:45 | 1.1 | 2.6 | 20.9 |
| 2 | 11:46 | 0.8 | 2.5 | 20.2 |
| 3 | 11:47 | 1.0 | 2.6 | 19.2 |
| 4 | 11:48 | 0.7 | 2.6 | 19.2 |
| 5 | 11:49 | 0.8 | 2.7 | 19.1 |
| 6 | 11:50 | 0.9 | 2.7 | 21.0 |
| 7 | 11:51 | 0.9 | 2.6 | 19.4 |
| 8 | 11:52 | 0.9 | 2.7 | 20.4 |
| 9 | 11:53 | 0.9 | 2.7 | 20.0 |
| 10 | 11:54 | 1.1 | 2.6 | 20.1 |
| 11 | 11:55 | 0.9 | 2.7 | 19.9 |
| 12 | 11:56 | 1.0 | 2.8 | 20.6 |
| 13 | 11:57 | 1.0 | 2.6 | 21.1 |
| 14 | 11:58 | 0.9 | 2.7 | 21.3 |
| 15 | 11:59 | 1.1 | 2.7 | 21.0 |
| 16 | 12:00 | 0.7 | 2.6 | 19.2 |
| 17 | 12:01 | 0.8 | 2.7 | 19.5 |
| 18 | 12:02 | 1.0 | 2.8 | 19.1 |
| 19 | 12:03 | 1.0 | 2.7 | 19.4 |
| 20 | 12:04 | 0.9 | 2.7 | 19.3 |
| 21 | 12:05 | 1.0 | 2.6 | 19.6 |
| 22 | 12:06 | 1.0 | 2.9 | 19.7 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.93** | **2.67** | **19.96** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 4-COO2NOx
**Source :** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0 | 0.2 | 0.2 |
| 8:47 | 44.4 | 44.2 | -0.2 |
| 8:51 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:38 | 0 | 0.2 | 0.2 |
| 11:40 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:08 | 0 | 0.1 | 0.1 | -0.1 |
| 12:10 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0.0 | 0.0 | 0.0 |
| 8:47 | 8.51 | 8.5 | 0.0 |
| 8:51 | 20.5 | 20.5 | 0.0 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:38 | 0.0 | 0.1 | 0.5 |
| 11:40 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:08 | 0.0 | 0.1 | 0.5 | 0.0 |
| 12:10 | 8.51 | 8.4 | -0.5 | -0.5 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 33 seconds |
| $O_2$ | 29 | 27 seconds |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **5-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:15-12:36** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 12:15 | 0.9 | 2.7 | 20.2 |
| 2 | 12:16 | 0.9 | 2.6 | 19.5 |
| 3 | 12:17 | 0.7 | 2.6 | 20.4 |
| 4 | 12:18 | 0.7 | 2.8 | 19.9 |
| 5 | 12:19 | 0.7 | 2.6 | 19.6 |
| 6 | 12:20 | 1.0 | 2.7 | 20.8 |
| 7 | 12:21 | 0.8 | 2.8 | 20.3 |
| 8 | 12:22 | 0.9 | 2.6 | 20.2 |
| 9 | 12:23 | 0.9 | 2.7 | 20.4 |
| 10 | 12:24 | 0.8 | 2.6 | 19.9 |
| 11 | 12:25 | 0.8 | 2.7 | 21.1 |
| 12 | 12:26 | 0.8 | 2.8 | 20.2 |
| 13 | 12:27 | 0.9 | 2.6 | 19.3 |
| 14 | 12:28 | 0.9 | 2.6 | 21.2 |
| 15 | 12:29 | 0.9 | 2.6 | 19.4 |
| 16 | 12:30 | 0.8 | 2.7 | 19.5 |
| 17 | 12:31 | 1.0 | 2.7 | 20.0 |
| 18 | 12:32 | 0.8 | 2.7 | 20.8 |
| 19 | 12:33 | 0.9 | 2.7 | 19.4 |
| 20 | 12:34 | 0.9 | 2.7 | 20.1 |
| 21 | 12:35 | 0.7 | 2.7 | 19.5 |
| 22 | 12:36 | 0.8 | 2.7 | 19.7 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.84** | **2.68** | **20.06** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 5-COO2NOx
**Source :** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0 | 0.2 | 0.2 |
| 8:47 | 44.4 | 44.2 | -0.2 |
| 8:51 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:08 | 0 | 0.1 | 0.1 |
| 12:10 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:38 | 0 | 0.1 | 0.1 | 0.0 |
| 12:40 | 44.4 | 44.1 | -0.3 | -0.1 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0.0 | 0.0 | 0.0 |
| 8:47 | 8.51 | 8.5 | 0.0 |
| 8:51 | 20.5 | 20.5 | 0.0 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:08 | 0.0 | 0.1 | 0.5 |
| 12:10 | 8.51 | 8.4 | -0.5 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:38 | 0.0 | 0.0 | 0.0 | -0.5 |
| 12:40 | 8.51 | 8.4 | -0.5 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 33 seconds |
| $O_2$ | 29 | 27 seconds |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **5-COO2NOx** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) | |
|---|---|---|---|---|
| 8:45 | 0.0 | 0.2 | 0.2 | |
| 8:50 | 51.5 | 51.3 | -0.2 | |
| 8:54 | 100.7 | 100.3 | -0.4 | |
| 8:45 | 53.3 | 49.4 | (from 5/3/10 FCC logger) | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:08 | 0.0 | 0.3 | 0.3 |
| 12:12 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:38 | 0.0 | 0.3 | 0.3 | 0.0 |
| 12:42 | 51.5 | 51.3 | -0.2 | 0.0 |

| **Instrument Response Times:** | Zero | High | |
|---|---|---|---|
| $NO_x$ | 37 | 35 | seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.52 | "Hg |
| Static Pressure | 0.30 | "$H_2O$ |
| Ps | 26.542 | "Hg |
| Gas Flow | 45,068.8 | adcfm |
| Avg. Stack Temp, Ts | 287 | °F |
| | 747 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 614.438 | ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.1 PPH |
| $NO_x$ | 4.05 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.84 ppm v/v d |
| $O_2$ | 2.68 % v/v d |
| NOx | 20.06 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.7 ppm v/v d |
| $O_2$ | 2.7 % v/v d |
| $NO_x$ | 20.0 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **6-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:45-13:06** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 12:45 | 0.6 | 2.6 | 20.1 |
| 2 | 12:46 | 0.9 | 2.6 | 19.7 |
| 3 | 12:47 | 0.6 | 2.7 | 20.5 |
| 4 | 12:48 | 0.8 | 2.6 | 18.9 |
| 5 | 12:49 | 0.9 | 2.7 | 19.5 |
| 6 | 12:50 | 0.6 | 2.9 | 20.4 |
| 7 | 12:51 | 0.6 | 2.7 | 18.6 |
| 8 | 12:52 | 0.6 | 2.7 | 18.6 |
| 9 | 12:53 | 0.9 | 2.5 | 20.2 |
| 10 | 12:54 | 0.9 | 2.5 | 19.5 |
| 11 | 12:55 | 0.6 | 2.6 | 19.7 |
| 12 | 12:56 | 0.9 | 2.6 | 19.5 |
| 13 | 12:57 | 0.6 | 2.8 | 18.8 |
| 14 | 12:58 | 0.7 | 2.6 | 20.1 |
| 15 | 12:59 | 0.6 | 2.6 | 19.3 |
| 16 | 13:00 | 0.8 | 2.8 | 20.6 |
| 17 | 13:01 | 1.0 | 2.7 | 19.2 |
| 18 | 13:02 | 0.7 | 2.8 | 19.3 |
| 19 | 13:03 | 0.8 | 2.8 | 20.0 |
| 20 | 13:04 | 0.7 | 2.5 | 19.0 |
| 21 | 13:05 | 0.6 | 2.6 | 19.7 |
| 22 | 13:06 | 0.6 | 2.8 | 18.9 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.73** | **2.67** | **19.55** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 6-COO2NOx
**Source :** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0 | 0.2 | 0.2 |
| 8:47 | 44.4 | 44.2 | -0.2 |
| 8:51 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:38 | 0 | 0.1 | 0.1 |
| 12:40 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:08 | 0 | 0.2 | 0.2 | 0.1 |
| 13:10 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0.0 | 0.0 | 0.0 |
| 8:47 | 8.51 | 8.5 | 0.0 |
| 8:51 | 20.5 | 20.5 | 0.0 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:38 | 0.0 | 0.0 | 0.0 |
| 12:40 | 8.51 | 8.4 | -0.5 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:08 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13:10 | 8.51 | 8.4 | -0.5 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 33 seconds |
| $O_2$ | 29 | 27 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 6-COO2NOx
**Source:** Boiler 12 **Date:** 05/05/10

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:45 | 0.0 | 0.2 | 0.2 |
| 8:50 | 51.5 | 51.3 | -0.2 |
| 8:54 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | (from 5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:38 | 0.0 | 0.3 | 0.3 |
| 12:42 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:08 | 0.0 | 0.3 | 0.3 | 0.0 |
| 13:12 | 51.5 | 51.3 | -0.2 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 35 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.52 | "Hg |
| Static Pressure | 0.30 | "$H_2O$ |
| Ps | 26.542 | "Hg |
| Gas Flow | 45,185.8 | adcfm |
| Avg. Stack Temp, Ts | 285 | °F |
| | 745 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 612.793 | ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.1 PPH |
| $NO_x$ | 3.95 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.73 ppm v/v d |
| $O_2$ | 2.67 % v/v d |
| NOx | 19.55 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.6 ppm v/v d |
| $O_2$ | 2.7 % v/v d |
| $NO_x$ | 19.4 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.6 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **7-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:15-13:36** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 13:15 | 1.0 | 2.7 | 19.3 |
| 2 | 13:16 | 1.1 | 2.6 | 19.8 |
| 3 | 13:17 | 1.1 | 2.6 | 20.1 |
| 4 | 13:18 | 0.8 | 2.7 | 20.8 |
| 5 | 13:19 | 1.1 | 2.8 | 20.5 |
| 6 | 13:20 | 1.0 | 2.6 | 20.0 |
| 7 | 13:21 | 1.0 | 2.7 | 19.0 |
| 8 | 13:22 | 0.8 | 2.8 | 20.5 |
| 9 | 13:23 | 0.7 | 2.9 | 20.5 |
| 10 | 13:24 | 0.8 | 2.6 | 18.8 |
| 11 | 13:25 | 1.1 | 2.6 | 19.1 |
| 12 | 13:26 | 0.7 | 2.6 | 19.4 |
| 13 | 13:27 | 1.0 | 2.8 | 19.6 |
| 14 | 13:28 | 0.7 | 2.8 | 20.7 |
| 15 | 13:29 | 0.9 | 2.8 | 20.5 |
| 16 | 13:30 | 0.8 | 2.7 | 19.6 |
| 17 | 13:31 | 0.7 | 2.7 | 20.0 |
| 18 | 13:32 | 0.8 | 2.7 | 20.8 |
| 19 | 13:33 | 0.9 | 2.6 | 19.2 |
| 20 | 13:34 | 0.7 | 2.6 | 20.2 |
| 21 | 13:35 | 0.9 | 2.7 | 19.1 |
| 22 | 13:36 | 1.1 | 2.7 | 19.9 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.90** | **2.70** | **19.88** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 7-COO2NOx
**Source :** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0 | 0.2 | 0.2 |
| 8:47 | 44.4 | 44.2 | -0.2 |
| 8:51 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 13:08 | 0 | 0.2 | 0.2 |
| 13:10 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:38 | 0 | 0.2 | 0.2 | 0.0 |
| 13:40 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0.0 | 0.0 | 0.0 |
| 8:47 | 8.51 | 8.5 | 0.0 |
| 8:51 | 20.5 | 20.5 | 0.0 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 13:08 | 0.0 | 0.0 | 0.0 |
| 13:10 | 8.51 | 8.4 | -0.5 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:38 | 0.0 | 0.1 | 0.5 | 0.5 |
| 13:40 | 8.51 | 8.5 | 0.0 | 0.5 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 33 seconds |
| $O_2$ | 29 | 27 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 7-COO2NOx
**Source:** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:45 | 0.0 | 0.2 | 0.2 |
| 8:50 | 51.5 | 51.3 | -0.2 |
| 8:54 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | (from 5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 13:08 | 0.0 | 0.3 | 0.3 |
| 13:12 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:38 | 0.0 | 0.3 | 0.3 | 0.0 |
| 13:42 | 51.5 | 51.2 | -0.3 | -0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 35 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.52 | "Hg |
| Static Pressure | 0.30 | "$H_2O$ |
| Ps | 26.542 | "Hg |
| Gas Flow | 45,203.7 | adcfm |
| Avg. Stack Temp, Ts | 283 | °F |
| | 743 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole | | |
| Act Conditions | 611.148 | ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.1 PPH |
| $NO_x$ | 4.04 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.90 ppm v/v d |
| $O_2$ | 2.70 % v/v d |
| NOx | 19.88 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.7 ppm v/v d |
| $O_2$ | 2.7 % v/v d |
| $NO_x$ | 19.8 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **8-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:45-14:06** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 13:45 | 0.6 | 2.8 | 19.7 |
| 2 | 13:46 | 0.9 | 2.9 | 19.3 |
| 3 | 13:47 | 0.7 | 2.6 | 19.4 |
| 4 | 13:48 | 0.8 | 2.7 | 19.1 |
| 5 | 13:49 | 0.8 | 2.6 | 19.3 |
| 6 | 13:50 | 0.8 | 2.7 | 20.1 |
| 7 | 13:51 | 0.7 | 2.7 | 19.4 |
| 8 | 13:52 | 0.7 | 2.6 | 19.2 |
| 9 | 13:53 | 0.8 | 2.8 | 19.7 |
| 10 | 13:54 | 0.7 | 2.9 | 18.7 |
| 11 | 13:55 | 1.0 | 3.1 | 20.0 |
| 12 | 13:56 | 0.9 | 3.0 | 19.1 |
| 13 | 13:57 | 1.0 | 2.6 | 20.0 |
| 14 | 13:58 | 0.8 | 2.6 | 18.7 |
| 15 | 13:59 | 0.9 | 2.7 | 18.8 |
| 16 | 14:00 | 0.7 | 2.7 | 19.3 |
| 17 | 14:01 | 0.8 | 2.8 | 18.8 |
| 18 | 14:02 | 0.7 | 3.1 | 19.8 |
| 19 | 14:03 | 0.7 | 2.5 | 20.7 |
| 20 | 14:04 | 0.7 | 2.8 | 19.7 |
| 21 | 14:05 | 1.0 | 2.8 | 19.4 |
| 22 | 14:06 | 0.7 | 2.7 | 19.0 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.79** | **2.76** | **19.42** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 8-COO2NOx
**Source :** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0 | 0.2 | 0.2 |
| 8:47 | 44.4 | 44.2 | -0.2 |
| 8:51 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 13:38 | 0 | 0.2 | 0.2 |
| 13:40 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 14:08 | 0 | 0.2 | 0.2 | 0.0 |
| 14:10 | 44.4 | 44.2 | -0.2 | 0.1 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0.0 | 0.0 | 0.0 |
| 8:47 | 8.51 | 8.5 | 0.0 |
| 8:51 | 20.5 | 20.5 | 0.0 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 13:38 | 0.0 | 0.1 | 0.5 |
| 13:40 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 14:08 | 0.0 | 0.1 | 0.5 | 0.0 |
| 14:10 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 33 seconds |
| $O_2$ | 29 | 27 seconds |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **8-COO2NOx** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:45 | 0.0 | 0.2 | 0.2 |
| 8:50 | 51.5 | 51.3 | -0.2 |
| 8:54 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | (from 5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 13:38 | 0.0 | 0.3 | 0.3 |
| 13:42 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 14:08 | 0.0 | 0.2 | 0.2 | -0.1 |
| 14:12 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 35 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.52 | "Hg |
| Static Pressure | 0.30 | "$H_2O$ |
| Ps | 26.542 | "Hg |
| Gas Flow | 44,970.6 | adcfm |
| Avg. Stack Temp, Ts | 284 | °F |
| | 744 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 611.970 | ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.1 PPH |
| $NO_x$ | 3.93 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.79 ppm v/v d |
| $O_2$ | 2.76 % v/v d |
| NOx | 19.42 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.6 ppm v/v d |
| $O_2$ | 2.7 % v/v d |
| $NO_x$ | 19.4 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **9-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **14:15-14:36** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 14:15 | 0.9 | 2.7 | 19.8 |
| 2 | 14:16 | 0.9 | 2.8 | 19.0 |
| 3 | 14:17 | 0.9 | 2.8 | 20.5 |
| 4 | 14:18 | 1.0 | 2.6 | 19.6 |
| 5 | 14:19 | 1.1 | 2.6 | 18.8 |
| 6 | 14:20 | 1.1 | 2.7 | 18.5 |
| 7 | 14:21 | 1.1 | 2.7 | 19.5 |
| 8 | 14:22 | 1.1 | 2.7 | 19.5 |
| 9 | 14:23 | 0.9 | 2.6 | 19.3 |
| 10 | 14:24 | 1.2 | 2.6 | 18.4 |
| 11 | 14:25 | 1.2 | 2.7 | 19.8 |
| 12 | 14:26 | 1.2 | 2.7 | 20.2 |
| 13 | 14:27 | 1.2 | 2.7 | 20.4 |
| 14 | 14:28 | 1.0 | 2.7 | 19.7 |
| 15 | 14:29 | 1.2 | 2.7 | 19.4 |
| 16 | 14:30 | 1.1 | 2.6 | 18.6 |
| 17 | 14:31 | 0.9 | 2.7 | 20.5 |
| 18 | 14:32 | 0.9 | 2.7 | 19.0 |
| 19 | 14:33 | 1.0 | 2.7 | 20.5 |
| 20 | 14:34 | 1.1 | 2.7 | 19.3 |
| 21 | 14:35 | 1.2 | 2.7 | 19.1 |
| 22 | 14:36 | 1.1 | 2.7 | 19.3 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **1.06** | **2.69** | **19.49** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 9-COO2NOx
**Source :** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0 | 0.2 | 0.2 |
| 8:47 | 44.4 | 44.2 | -0.2 |
| 8:51 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 14:08 | 0 | 0.2 | 0.2 |
| 14:10 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 14:38 | 0 | 0.2 | 0.2 | 0.0 |
| 14:40 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:44 | 0.0 | 0.0 | 0.0 |
| 8:47 | 8.51 | 8.5 | 0.0 |
| 8:51 | 20.5 | 20.5 | 0.0 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 14:08 | 0.0 | 0.1 | 0.5 |
| 14:10 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 14:38 | 0.0 | 0.1 | 0.5 | 0.0 |
| 14:40 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 36 | 33 seconds |
| $O_2$ | 29 | 27 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 9-COO2NOx
**Source:** Boiler 12 **Date:** 05/05/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:45 | 0.0 | 0.2 | 0.2 |
| 8:50 | 51.5 | 51.3 | -0.2 |
| 8:54 | 100.7 | 100.3 | -0.4 |
| 8:45 | 53.3 | 49.4 | (from 5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 14:08 | 0.0 | 0.2 | 0.2 |
| 14:12 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 14:38 | 0.0 | 0.2 | 0.2 | 0.0 |
| 14:42 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 37 | 35 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.52 "Hg |
| Static Pressure | 0.30 "$H_2O$ |
| Ps | 26.542 "Hg |
| Gas Flow | 45,022.3 adcfm |
| Avg. Stack Temp, Ts | 281 °F |
| | 741 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole Act Conditions | 609.503 ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.1 PPH |
| $NO_x$ | 3.98 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 1.06 ppm v/v d |
| $O_2$ | 2.69 % v/v d |
| NOx | 19.49 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.9 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 19.5 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.9 ppm v/v d |
| $NO_x$ | 22.3 ppm v/v d |

**CHS, Inc. - Laurel Refinery**
**Boiler 12**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/05/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 8:20 | 0.2 | 0.0 | 0.2 | Initial Calibrations/Tank IDS |
| 8:21 | 0.2 | 0.0 | 0.2 | **$O_2$ Tanks** |
| 8:22 | 0.2 | 0.0 | 0.2 | ET0003451 @ 8.51%; Exp. 09/28/12 |
| 8:23 | 0.2 | 0.0 | 0.2 | ET0003519 @ 20.5%; Exp. 06/19/12 |
| 8:24 | 0.2 | 0.0 | 0.2 | $O_2$ Instrument: Servomex 1400 |
| 8:25 | 0.2 | 0.0 | 0.2 | **$NO_x$ Tanks** |
| 8:26 | 0.2 | 0.0 | 0.2 | LL82176 @ 51.5 ppm; Exp. 10-19-11 |
| 8:27 | 0.2 | 0.0 | 0.2 | LL31587 @ 100.7 ppm; Exp. 08-11-10 |
| 8:28 | 0.2 | 0.0 | 0.2 | LL82188 @ 53.3 ppm; Exp. 10-29-11 |
| 8:29 | 0.2 | 0.0 | 0.2 | $NO_x$ Instrument: CAI 400 |
| 8:30 | 0.2 | 0.0 | 0.2 | **CO Tanks** |
| 8:31 | 0.2 | 0.0 | 0.2 | ET0003451 @ 44.4 ppm; Exp. 09-28-12 |
| 8:32 | 0.2 | 0.0 | 0.2 | ET0003462 @ 98.0 ppm; Exp. 09-28-12 |
| 8:33 | 0.2 | 0.0 | 0.2 | CO Instrument: CAI 200 |
| 8:34 | 0.2 | 0.0 | 0.2 | |
| 8:35 | 0.2 | 0.0 | 0.2 | |
| 8:36 | 0.2 | 0.0 | 0.2 | |
| 8:37 | 0.2 | 0.0 | 0.2 | |
| 8:38 | 0.2 | 0.0 | 0.2 | |
| 8:39 | 0.2 | 0.0 | 0.2 | |
| 8:40 | 0.2 | 0.0 | 0.2 | |
| 8:41 | 0.2 | 0.0 | 0.2 | |
| 8:42 | 0.2 | 0.0 | 0.2 | |
| 8:43 | 0.2 | 0.0 | 0.2 | |
| 8:44 | 0.2 | 0.0 | 0.2 | |
| 8:45 | 0.2 | 0.0 | 0.2 | |
| 8:46 | 30.4 | 4.5 | 0.2 | |
| 8:47 | 44.2 | 8.5 | 0.2 | |
| 8:48 | 11.2 | 2.1 | 0.2 | |
| 8:49 | 0.2 | 0.0 | 27.5 | |
| 8:50 | 65.9 | 16.2 | 51.3 | |
| 8:51 | 97.6 | 20.5 | 12.1 | |
| 8:52 | 14.7 | 3.7 | 0.2 | |
| 8:53 | 0.2 | 0.0 | 71.4 | |
| 8:54 | 0.2 | 0.0 | 100.3 | |
| 8:55 | 0.2 | 0.0 | 15.5 | |
| 8:56 | 0.2 | 0.0 | 0.2 | |
| 8:57 | 0.2 | 0.0 | 0.2 | |
| 8:58 | 32.6 | 5.1 | 0.2 | $CO/O_2$ Response Time |
| 8:59 | 44.1 | 8.5 | 0.2 | |
| 9:00 | 6.8 | 1.6 | 0.2 | $CO/O_2$ Response Time |

**CHS, Inc. - Laurel Refinery**
**Boiler 12**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/05/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 9:01 | 0.2 | 0.1 | 0.2 | |
| 9:02 | 0.2 | 0.1 | 0.2 | |
| 9:03 | 0.2 | 0.1 | 33.6 | $NO_x$ Response Time |
| 9:04 | 0.2 | 0.1 | 51.2 | |
| 9:05 | 0.2 | 0.0 | 14.1 | $NO_x$ Response Time |
| 9:06 | 0.2 | 0.0 | 0.2 | |
| 9:07 | 0.2 | 0.0 | 0.2 | |
| 9:08 | 0.2 | 0.0 | 0.2 | |
| 9:09 | 0.2 | 0.0 | 0.2 | |
| 9:10 | 0.2 | 0.0 | 0.2 | |
| 9:11 | 0.2 | 0.0 | 0.2 | |
| 9:12 | 0.2 | 0.0 | 0.2 | |
| 9:13 | 0.2 | 0.0 | 0.2 | |
| 9:14 | 0.2 | 0.0 | 0.2 | |
| 9:15 | 0.2 | 0.0 | 0.2 | |
| 9:16 | 0.2 | 0.0 | 0.2 | |
| 9:17 | 0.2 | 0.0 | 0.2 | |
| 9:18 | 0.2 | 0.0 | 0.2 | |
| 9:19 | 0.2 | 0.0 | 0.2 | |
| 9:20 | 0.2 | 0.0 | 0.2 | |
| 9:21 | 0.2 | 0.0 | 0.2 | |
| 9:22 | 0.2 | 0.0 | 0.2 | |
| 9:23 | 0.2 | 0.0 | 0.2 | |
| 9:24 | 0.2 | 0.0 | 0.2 | |
| 9:25 | 0.2 | 0.0 | 0.2 | |
| 9:26 | 0.2 | 0.0 | 0.2 | |
| 9:27 | 0.2 | 0.0 | 0.2 | |
| 9:28 | 0.2 | 0.0 | 0.2 | |
| 9:29 | 0.2 | 0.0 | 0.2 | |
| 9:30 | 0.2 | 0.0 | 0.2 | |
| 9:31 | 0.2 | 0.0 | 0.2 | |
| 9:32 | 0.2 | 0.0 | 0.2 | |
| 9:33 | 0.2 | 0.0 | 0.2 | |
| 9:34 | 0.2 | 0.0 | 0.2 | |
| 9:35 | 0.2 | 0.0 | 0.2 | |
| 9:36 | 0.2 | 0.0 | 0.2 | |
| 9:37 | 0.2 | 0.0 | 0.2 | |
| 9:38 | 0.4 | 2.0 | 6.9 | |
| 9:39 | 1.1 | 2.8 | 20.3 | |
| 9:40 | 1.1 | 2.8 | 20.7 | |
| 9:41 | 1.2 | 2.9 | 19.8 | |
| 9:42 | 1.0 | 3.0 | 20.8 | |

**CHS, Inc. - Laurel Refinery**
**Boiler 12**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/05/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 9:43 | 1.2 | 2.9 | 19.6 | |
| 9:44 | 0.9 | 2.7 | 20.8 | |
| 9:45 | 0.9 | 3.0 | 19.9 | |
| 9:46 | 0.9 | 2.8 | 19.3 | |
| 9:47 | 0.8 | 3.0 | 20.9 | |
| 9:48 | 0.8 | 2.9 | 20.6 | |
| 9:49 | 1.0 | 2.7 | 19.9 | |
| 9:50 | 0.8 | 2.9 | 20.8 | |
| 9:51 | 0.8 | 3.0 | 20.3 | |
| 9:52 | 1.1 | 2.7 | 19.4 | |
| 9:53 | 1.1 | 2.7 | 20.0 | |
| 9:54 | 1.0 | 2.9 | 20.0 | |
| 9:55 | 0.8 | 2.9 | 20.8 | |
| 9:56 | 1.0 | 2.8 | 20.8 | |
| 9:57 | 1.2 | 2.7 | 19.7 | |
| 9:58 | 1.1 | 2.9 | 20.6 | |
| 9:59 | 0.9 | 3.0 | 19.7 | |
| 10:00 | 0.8 | 3.0 | 20.6 | |
| 10:01 | 0.8 | 2.9 | 19.2 | |
| 10:02 | 0.9 | 3.0 | 20.4 | |
| 10:03 | 0.9 | 2.8 | 20.9 | |
| 10:04 | 0.8 | 2.8 | 19.7 | |
| 10:05 | 1.0 | 2.8 | 20.2 | |
| 10:06 | 0.8 | 2.7 | 20.4 | |
| 10:07 | 1.1 | 2.9 | 20.8 | |
| 10:08 | 1.2 | 3.0 | 19.7 | |
| 10:09 | 0.9 | 2.8 | 20.4 | |
| 10:10 | 0.8 | 2.7 | 19.2 | |
| 10:11 | 1.1 | 2.7 | 20.8 | |
| 10:12 | 1.0 | 2.9 | 20.4 | |
| 10:13 | 1.0 | 3.0 | 20.0 | |
| 10:14 | 0.9 | 2.7 | 20.1 | |
| 10:15 | 1.2 | 2.8 | 19.6 | Start Run 1 |
| 10:16 | 1.1 | 2.7 | 19.3 | |
| 10:17 | 1.0 | 2.7 | 21.2 | |
| 10:18 | 0.9 | 2.8 | 20.5 | |
| 10:19 | 1.0 | 2.8 | 20.1 | |
| 10:20 | 1.0 | 2.8 | 19.3 | |
| 10:21 | 1.0 | 2.6 | 19.4 | |
| 10:22 | 1.0 | 2.7 | 20.1 | |
| 10:23 | 1.2 | 2.6 | 20.5 | |
| 10:24 | 0.9 | 2.6 | 19.9 | |

**CHS, Inc. - Laurel Refinery**
**Boiler 12**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/05/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 10:25 | 1.0 | 2.7 | 20.2 | |
| 10:26 | 1.2 | 2.6 | 19.2 | |
| 10:27 | 1.1 | 2.8 | 19.6 | |
| 10:28 | 0.9 | 2.9 | 20.7 | |
| 10:29 | 0.9 | 2.8 | 21.0 | |
| 10:30 | 0.8 | 2.8 | 20.9 | |
| 10:31 | 1.1 | 3.1 | 20.2 | |
| 10:32 | 1.0 | 2.7 | 20.1 | |
| 10:33 | 1.1 | 2.6 | 20.7 | |
| 10:34 | 1.0 | 2.9 | 19.9 | |
| 10:35 | 1.0 | 2.8 | 19.9 | |
| 10:36 | 0.7 | 2.8 | 20.1 | End Run 1 |
| 10:37 | 0.3 | 0.5 | 4.7 | |
| 10:38 | 0.2 | 0.1 | 0.2 | |
| 10:39 | 35.1 | 5.7 | 0.2 | |
| 10:40 | 44.1 | 8.5 | 0.2 | |
| 10:41 | 12.1 | 2.1 | 37.2 | |
| 10:42 | 0.2 | 0.1 | 51.2 | |
| 10:43 | 0.2 | 0.1 | 6.9 | |
| 10:44 | 0.4 | 1.0 | 15.2 | |
| 10:45 | 0.8 | 2.8 | 20.3 | Start Run 2 |
| 10:46 | 0.9 | 2.7 | 19.0 | |
| 10:47 | 0.8 | 2.7 | 20.6 | |
| 10:48 | 1.0 | 2.6 | 19.7 | |
| 10:49 | 0.7 | 2.7 | 20.8 | |
| 10:50 | 1.0 | 2.7 | 20.1 | |
| 10:51 | 0.8 | 2.7 | 19.7 | |
| 10:52 | 0.8 | 2.7 | 20.7 | |
| 10:53 | 0.7 | 2.6 | 19.2 | |
| 10:54 | 0.9 | 2.7 | 19.3 | |
| 10:55 | 0.8 | 2.7 | 20.7 | |
| 10:56 | 1.0 | 2.6 | 20.9 | |
| 10:57 | 0.8 | 2.6 | 19.6 | |
| 10:58 | 0.8 | 2.6 | 19.5 | |
| 10:59 | 0.8 | 2.6 | 20.5 | |
| 11:00 | 0.8 | 2.9 | 19.1 | |
| 11:01 | 0.9 | 2.8 | 19.2 | |
| 11:02 | 0.8 | 2.6 | 19.4 | |
| 11:03 | 0.9 | 2.5 | 19.9 | |
| 11:04 | 0.9 | 2.8 | 19.0 | |
| 11:05 | 0.8 | 2.6 | 20.5 | |
| 11:06 | 0.9 | 2.8 | 20.4 | End Run 2 |

**CHS, Inc. - Laurel Refinery**
**Boiler 12**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/05/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 11:07 | 0.3 | 0.5 | 4.4 | |
| 11:08 | 0.2 | 0.1 | 0.2 | |
| 11:09 | 30.6 | 5.9 | 0.2 | |
| 11:10 | 44.1 | 8.5 | 0.2 | |
| 11:11 | 9.4 | 1.1 | 36.1 | |
| 11:12 | 0.2 | 0.1 | 51.2 | |
| 11:13 | 0.2 | 0.1 | 7.4 | |
| 11:14 | 0.6 | 0.8 | 17.3 | |
| 11:15 | 0.8 | 2.7 | 19.6 | Start Run 3 |
| 11:16 | 0.8 | 2.7 | 19.7 | |
| 11:17 | 0.9 | 2.6 | 20.3 | |
| 11:18 | 0.7 | 2.6 | 19.0 | |
| 11:19 | 0.9 | 2.7 | 19.5 | |
| 11:20 | 0.9 | 2.7 | 19.8 | |
| 11:21 | 0.8 | 2.8 | 19.5 | |
| 11:22 | 0.9 | 2.7 | 20.6 | |
| 11:23 | 0.7 | 2.5 | 19.9 | |
| 11:24 | 0.9 | 2.6 | 20.8 | |
| 11:25 | 0.7 | 2.5 | 19.6 | |
| 11:26 | 1.0 | 2.7 | 19.9 | |
| 11:27 | 1.0 | 2.7 | 20.0 | |
| 11:28 | 0.8 | 2.6 | 20.1 | |
| 11:29 | 1.0 | 2.7 | 20.1 | |
| 11:30 | 0.8 | 2.7 | 20.9 | |
| 11:31 | 0.8 | 2.5 | 20.7 | |
| 11:32 | 0.9 | 2.6 | 20.3 | |
| 11:33 | 0.8 | 2.7 | 19.1 | |
| 11:34 | 1.0 | 2.7 | 19.2 | |
| 11:35 | 1.0 | 2.5 | 20.8 | |
| 11:36 | 0.9 | 2.7 | 19.4 | End Run 3 |
| 11:37 | 0.5 | 0.4 | 5.3 | |
| 11:38 | 0.2 | 0.1 | 0.2 | |
| 11:39 | 30.7 | 5.1 | 0.2 | |
| 11:40 | 44.2 | 8.5 | 0.2 | |
| 11:41 | 10.2 | 2.0 | 28.8 | |
| 11:42 | 0.2 | 0.1 | 51.3 | |
| 11:43 | 0.2 | 0.1 | 8.3 | |
| 11:44 | 0.6 | 2.1 | 16.1 | |
| 11:45 | 1.1 | 2.6 | 20.9 | Start Run 4 |
| 11:46 | 0.8 | 2.5 | 20.2 | |
| 11:47 | 1.0 | 2.6 | 19.2 | |
| 11:48 | 0.7 | 2.6 | 19.2 | |

**CHS, Inc. - Laurel Refinery**
**Boiler 12**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/05/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 11:49 | 0.8 | 2.7 | 19.1 | |
| 11:50 | 0.9 | 2.7 | 21.0 | |
| 11:51 | 0.9 | 2.6 | 19.4 | |
| 11:52 | 0.9 | 2.7 | 20.4 | |
| 11:53 | 0.9 | 2.7 | 20.0 | |
| 11:54 | 1.1 | 2.6 | 20.1 | |
| 11:55 | 0.9 | 2.7 | 19.9 | |
| 11:56 | 1.0 | 2.8 | 20.6 | |
| 11:57 | 1.0 | 2.6 | 21.1 | |
| 11:58 | 0.9 | 2.7 | 21.3 | |
| 11:59 | 1.1 | 2.7 | 21.0 | |
| 12:00 | 0.7 | 2.6 | 19.2 | |
| 12:01 | 0.8 | 2.7 | 19.5 | |
| 12:02 | 1.0 | 2.8 | 19.1 | |
| 12:03 | 1.0 | 2.7 | 19.4 | |
| 12:04 | 0.9 | 2.7 | 19.3 | |
| 12:05 | 1.0 | 2.6 | 19.6 | |
| 12:06 | 1.0 | 2.9 | 19.7 | End Run 4 |
| 12:07 | 0.3 | 0.5 | 6.6 | |
| 12:08 | 0.1 | 0.1 | 0.3 | |
| 12:09 | 37.2 | 5.6 | 0.3 | |
| 12:10 | 44.2 | 8.4 | 0.2 | |
| 12:11 | 9.6 | 1.3 | 33.9 | |
| 12:12 | 0.2 | 0.1 | 51.3 | |
| 12:13 | 0.1 | 0.1 | 7.4 | |
| 12:14 | 0.6 | 1.9 | 18.3 | |
| 12:15 | 0.9 | 2.7 | 20.2 | Start Run 5 |
| 12:16 | 0.9 | 2.6 | 19.5 | |
| 12:17 | 0.7 | 2.6 | 20.4 | |
| 12:18 | 0.7 | 2.8 | 19.9 | |
| 12:19 | 0.7 | 2.6 | 19.6 | |
| 12:20 | 1.0 | 2.7 | 20.8 | |
| 12:21 | 0.8 | 2.8 | 20.3 | |
| 12:22 | 0.9 | 2.6 | 20.2 | |
| 12:23 | 0.9 | 2.7 | 20.4 | |
| 12:24 | 0.8 | 2.6 | 19.9 | |
| 12:25 | 0.8 | 2.7 | 21.1 | |
| 12:26 | 0.8 | 2.8 | 20.2 | |
| 12:27 | 0.9 | 2.6 | 19.3 | |
| 12:28 | 0.9 | 2.6 | 21.2 | |
| 12:29 | 0.9 | 2.6 | 19.4 | |
| 12:30 | 0.8 | 2.7 | 19.5 | |

**CHS, Inc. - Laurel Refinery**
**Boiler 12**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/05/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 12:31 | 1.0 | 2.7 | 20.0 | |
| 12:32 | 0.8 | 2.7 | 20.8 | |
| 12:33 | 0.9 | 2.7 | 19.4 | |
| 12:34 | 0.9 | 2.7 | 20.1 | |
| 12:35 | 0.7 | 2.7 | 19.5 | |
| 12:36 | 0.8 | 2.7 | 19.7 | End Run 5 |
| 12:37 | 0.4 | 0.3 | 4.6 | |
| 12:38 | 0.1 | 0.0 | 0.3 | |
| 12:39 | 30.4 | 6.4 | 0.3 | |
| 12:40 | 44.1 | 8.4 | 0.3 | |
| 12:41 | 9.4 | 2.2 | 40.2 | |
| 12:42 | 0.2 | 0.0 | 51.3 | |
| 12:43 | 0.1 | 0.0 | 6.9 | |
| 12:44 | 0.5 | 2.1 | 14.8 | |
| 12:45 | 0.6 | 2.6 | 20.1 | Start Run 6 |
| 12:46 | 0.9 | 2.6 | 19.7 | |
| 12:47 | 0.6 | 2.7 | 20.5 | |
| 12:48 | 0.8 | 2.6 | 18.9 | |
| 12:49 | 0.9 | 2.7 | 19.5 | |
| 12:50 | 0.6 | 2.9 | 20.4 | |
| 12:51 | 0.6 | 2.7 | 18.6 | |
| 12:52 | 0.6 | 2.7 | 18.6 | |
| 12:53 | 0.9 | 2.5 | 20.2 | |
| 12:54 | 0.9 | 2.5 | 19.5 | |
| 12:55 | 0.6 | 2.6 | 19.7 | |
| 12:56 | 0.9 | 2.6 | 19.5 | |
| 12:57 | 0.6 | 2.8 | 18.8 | |
| 12:58 | 0.7 | 2.6 | 20.1 | |
| 12:59 | 0.6 | 2.6 | 19.3 | |
| 13:00 | 0.8 | 2.8 | 20.6 | |
| 13:01 | 1.0 | 2.7 | 19.2 | |
| 13:02 | 0.7 | 2.8 | 19.3 | |
| 13:03 | 0.8 | 2.8 | 20.0 | |
| 13:04 | 0.7 | 2.5 | 19.0 | |
| 13:05 | 0.6 | 2.6 | 19.7 | |
| 13:06 | 0.6 | 2.8 | 18.9 | End Run 6 |
| 13:07 | 0.3 | 0.7 | 2.9 | |
| 13:08 | 0.2 | 0.0 | 0.3 | |
| 13:09 | 27.5 | 3.9 | 0.3 | |
| 13:10 | 44.1 | 8.4 | 0.2 | |
| 13:11 | 7.7 | 2.3 | 32.8 | |
| 13:12 | 0.2 | 0.0 | 51.3 | |

**CHS, Inc. - Laurel Refinery**
**Boiler 12**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/05/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 13:13 | 0.2 | 0.0 | 5.8 | |
| 13:14 | 0.6 | 1.7 | 17.7 | |
| 13:15 | 1.0 | 2.7 | 19.3 | Start Run 7 |
| 13:16 | 1.1 | 2.6 | 19.8 | |
| 13:17 | 1.1 | 2.6 | 20.1 | |
| 13:18 | 0.8 | 2.7 | 20.8 | |
| 13:19 | 1.1 | 2.8 | 20.5 | |
| 13:20 | 1.0 | 2.6 | 20.0 | |
| 13:21 | 1.0 | 2.7 | 19.0 | |
| 13:22 | 0.8 | 2.8 | 20.5 | |
| 13:23 | 0.7 | 2.9 | 20.5 | |
| 13:24 | 0.8 | 2.6 | 18.8 | |
| 13:25 | 1.1 | 2.6 | 19.1 | |
| 13:26 | 0.7 | 2.6 | 19.4 | |
| 13:27 | 1.0 | 2.8 | 19.6 | |
| 13:28 | 0.7 | 2.8 | 20.7 | |
| 13:29 | 0.9 | 2.8 | 20.5 | |
| 13:30 | 0.8 | 2.7 | 19.6 | |
| 13:31 | 0.7 | 2.7 | 20.0 | |
| 13:32 | 0.8 | 2.7 | 20.8 | |
| 13:33 | 0.9 | 2.6 | 19.2 | |
| 13:34 | 0.7 | 2.6 | 20.2 | |
| 13:35 | 0.9 | 2.7 | 19.1 | |
| 13:36 | 1.1 | 2.7 | 19.9 | End Run 7 |
| 13:37 | 0.4 | 0.5 | 4.7 | |
| 13:38 | 0.2 | 0.1 | 0.3 | |
| 13:39 | 33.8 | 4.7 | 0.3 | |
| 13:40 | 44.1 | 8.5 | 0.3 | |
| 13:41 | 12.0 | 1.2 | 31.2 | |
| 13:42 | 0.2 | 0.1 | 51.2 | |
| 13:43 | 0.2 | 0.1 | 10.5 | |
| 13:44 | 0.4 | 2.1 | 18.2 | |
| 13:45 | 0.6 | 2.8 | 19.7 | Start Run 8 |
| 13:46 | 0.9 | 2.9 | 19.3 | |
| 13:47 | 0.7 | 2.6 | 19.4 | |
| 13:48 | 0.8 | 2.7 | 19.1 | |
| 13:49 | 0.8 | 2.6 | 19.3 | |
| 13:50 | 0.8 | 2.7 | 20.1 | |
| 13:51 | 0.7 | 2.7 | 19.4 | |
| 13:52 | 0.7 | 2.6 | 19.2 | |
| 13:53 | 0.8 | 2.8 | 19.7 | |
| 13:54 | 0.7 | 2.9 | 18.7 | |

**CHS, Inc. - Laurel Refinery**
**Boiler 12**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/05/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 13:55 | 1.0 | 3.1 | 20.0 | |
| 13:56 | 0.9 | 3.0 | 19.1 | |
| 13:57 | 1.0 | 2.6 | 20.0 | |
| 13:58 | 0.8 | 2.6 | 18.7 | |
| 13:59 | 0.9 | 2.7 | 18.8 | |
| 14:00 | 0.7 | 2.7 | 19.3 | |
| 14:01 | 0.8 | 2.8 | 18.8 | |
| 14:02 | 0.7 | 3.1 | 19.8 | |
| 14:03 | 0.7 | 2.5 | 20.7 | |
| 14:04 | 0.7 | 2.8 | 19.7 | |
| 14:05 | 1.0 | 2.8 | 19.4 | |
| 14:06 | 0.7 | 2.7 | 19.0 | End Run 8 |
| 14:07 | 0.5 | 0.6 | 6.5 | |
| 14:08 | 0.2 | 0.1 | 0.2 | |
| 14:09 | 35.1 | 6.3 | 0.2 | |
| 14:10 | 44.2 | 8.5 | 0.2 | |
| 14:11 | 6.9 | 3.1 | 38.4 | |
| 14:12 | 0.2 | 0.1 | 51.2 | |
| 14:13 | 0.2 | 0.1 | 6.0 | |
| 14:14 | 0.7 | 1.8 | 17.4 | |
| 14:15 | 0.9 | 2.7 | 19.8 | Start Run 9 |
| 14:16 | 0.9 | 2.8 | 19.0 | |
| 14:17 | 0.9 | 2.8 | 20.5 | |
| 14:18 | 1.0 | 2.6 | 19.6 | |
| 14:19 | 1.1 | 2.6 | 18.8 | |
| 14:20 | 1.1 | 2.7 | 18.5 | |
| 14:21 | 1.1 | 2.7 | 19.5 | |
| 14:22 | 1.1 | 2.7 | 19.5 | |
| 14:23 | 0.9 | 2.6 | 19.3 | |
| 14:24 | 1.2 | 2.6 | 18.4 | |
| 14:25 | 1.2 | 2.7 | 19.8 | |
| 14:26 | 1.2 | 2.7 | 20.2 | |
| 14:27 | 1.2 | 2.7 | 20.4 | |
| 14:28 | 1.0 | 2.7 | 19.7 | |
| 14:29 | 1.2 | 2.7 | 19.4 | |
| 14:30 | 1.1 | 2.6 | 18.6 | |
| 14:31 | 0.9 | 2.7 | 20.5 | |
| 14:32 | 0.9 | 2.7 | 19.0 | |
| 14:33 | 1.0 | 2.7 | 20.5 | |
| 14:34 | 1.1 | 2.7 | 19.3 | |
| 14:35 | 1.2 | 2.7 | 19.1 | |
| 14:36 | 1.1 | 2.7 | 19.3 | End Run 9 |

**CHS, Inc. - Laurel Refinery**
**Boiler 12**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/05/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 14:37 | 0.4 | 0.6 | 5.8 | |
| 14:38 | 0.2 | 0.1 | 0.2 | |
| 14:39 | 30.7 | 5.1 | 0.2 | |
| 14:40 | 44.2 | 8.5 | 0.2 | |
| 14:41 | 5.7 | 2.0 | 35.0 | |
| 14:42 | 0.2 | 0.1 | 51.2 | |
| 14:43 | 0.2 | 0.1 | 11.6 | |
| 14:44 | 0.2 | 0.1 | 0.2 | |

# EPA METHODS # 1 - 4
# GAS FLOW / MOISTURE
# EXAMPLE CALCULATION

COMPANY NAME: CHS
PLANT LOCATION: Laurel, Montana
SOURCE TESTED: B-12
TEST DATE: 5/5/10
RUN #: 1 G F

Pm"Hg = 26.52 Pb"Hg + (2.12 ΔH "$H_2O$/13.6) = 26.676 Pm"Hg ③

Ps"Hg = 26.52 Pb"Hg + (0.30 Static "$H_2O$/13.6) = 26.542 Ps"Hg ③

1) Vm(std) = (15.670 Vm)(17.65)(.98 Y) (26.676 Pm"Hg / 524. Tm°A) = 13.939 dscf ③ ② ①

2) Vw(std) = (0.04707)(56.0 ml) = 2.636 scf ③

3) Bws = (2.636 scf) / (2.636 scf + 13.939 dscf) = .1590 Bws x 100 = 15.9 %$H_2O$ ③ ②

4) Vm(actual) = (____ Y)(____ Vm)(____ Ts°A)(____ Pm"Hg) / (1- ____ Bws)(____ Tm°A)(____ Ps"Hg) = ____ awcf ① ③ ③

5) Md = 0.44(10.3 %$CO_2$) + 0.32(2.7 %$O_2$) + 0.28(86.5 %$N_2$+%CO) = 29.84 lb/lb mole ① ① ① ②

6) Ms = (29.84 lb/lb mole)(1-.1590 Bws) + (18 x .1590 Bws) = 27.96 lb/lb mole ②

.8410

7a) Area = (3.1416)(4.75 dia ft./2)² = 17.721 sq.ft. ③ ③

7b) Area = (____ ft.)(____ ft.) = ____ sq.ft. ③ ③ ③

8) Vs = (85.49)(.84 cp)(Avg SQRT .7029 ΔP)( 744 Ts°A / (26.542 Ps"Hg)(27.96 lb/lb mole)) = 50.54 fps ② ②

9a) AWCFM = (50.54 fps)(17.721 sq.ft)(60sec/min) = 53,737.2 awcfm ①

9b) ADCFM = (53,737.2 awcfm)(1 - .1590 Bws) = 45,193.0 adcfm ①

.8410

10a)

Qsw = 3600(50.54 fps)(17.721 sq.ft)(528°A / 744. Ts°A)(26.542 Ps"Hg / 29.92 "Hg) = 2,029,826.9 wscf/hr ①

10b)

Qsd = (1 - .1590 Bws)(2,029,826.9 wscf/hr) = 1,707,084.4 dcsf/hr ①

.8410

WorldDrive01:\Forms\Forms\Hand Calc 1-4.wpd

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **1-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:15-1036** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 864.330 | 0.48 | 2.12 | 64 | 284 | 0.6928 |
| 2 | 14 | | 0.53 | 2.12 | 64 | 284 | 0.7280 |
| 3 | 21 | | 0.46 | 2.12 | 65 | 284 | 0.6782 |
| 4 | | 880.000 | 0.53 | | | 283 | 0.7280 |
| 5 | | | 0.45 | | | 284 | 0.6708 |
| 6 | | | 0.43 | | | 283 | 0.6557 |
| 7 | | | 0.52 | | | 284 | 0.7211 |
| 8 | | | 0.55 | | | 284 | 0.7416 |
| 1 | | | 0.49 | | | 284 | 0.7000 |
| 2 | | | 0.54 | | | 284 | 0.7348 |
| 3 | | | 0.45 | | | 284 | 0.6708 |
| 4 | | | 0.55 | | | 284 | 0.7416 |
| 5 | | | 0.47 | | | 283 | 0.6856 |
| 6 | | | 0.42 | | | 283 | 0.6481 |
| 7 | | | 0.51 | | | 283 | 0.7141 |
| 8 | | | 0.54 | | | 283 | 0.7348 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.52 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.670 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 56.0 ml | | |

Method 3A
%$O_2$ Average 2.7 %v dry
Orsat
%$CO_2$ Average 10.8 %v dry

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **1-GF** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.7029 "$H_2O$ |
| Avg Meter Temp. (Tm) | 64 °F | Avg Stack Temp. (Ts) | 284 °F |
| Avg Meter Temp. (Tm) | 524 °A (°R) | Avg Stack Temp. (Ts) | 744 °A (°R) |
| Pressure Meter (Pm) | 26.676 "Hg | Pressure Stack (Ps) | 26.542 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.939 dscf | Velocity (Vs) | 50.54 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 26.323 awcf | Volume (actual conditions) | 53,737.2 awcfm |
| Volume Water | | | 45,193.0 adcfm |
| Vapor, Vw(std) | 2.636 scf | Volume (std. conditions) | 2,029,826.9 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 33,830.4 wscfm |
| Moisture (Bws) | 0.1590 | | 1,707,084.4 dscf/hr |
| Percent Moisture | 15.90 %v | | 28,451.4 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.84 lb/lb-mole | | |
| Wet (Ms) | 27.96 lb/lb-mole | | |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 2-GF
**Source:** Boiler 12 **Date:** 05/05/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.7033 "$H_2O$ |
| Avg Meter Temp. (Tm) | 65 °F | Avg Stack Temp. (Ts) | 287 °F |
| Avg Meter Temp. (Tm) | 525 °A (°R) | Avg Stack Temp. (Ts) | 747 °A (°R) |
| Pressure Meter (Pm) | 26.676 "Hg | Pressure Stack (Ps) | 26.542 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.744 dscf | Velocity (Vs) | 50.76 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 26.268 awcf | Volume (actual conditions) | 53,971.1 awcfm |
| Volume Water | | | 45,028.1 adcfm |
| Vapor, Vw(std) | 2.730 scf | Volume (std. conditions) | 2,030,475.3 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 33,841.3 wscfm |
| Moisture (Bws) | 0.1657 | | 1,694,025.5 dscf/hr |
| Percent Moisture | 16.57 %v | | 28,233.8 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.82 lb/lb-mole | | |
| Wet (Ms) | 27.86 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: Boiler 12
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #:
DATE: 5/5/10
START TIME: 1015
END TIME: 1036

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.52 BAROMETRIC PRESSURE ("Hg)

- 1.28 PITOT
- .98 METER BOX
- .94 Y FACTOR
- ± .30 STATIC PRESSURE ("H2O)

- NOZZLE # 21
- NOZZLE DIA.
- T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 14 POST
- TRAIN LEAK TEST, ($ft^3$/min) 000 PRE .002 POST
- STACK DIMENSIONS

TEST TIME

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 864.330 | | | | | | | | | |
| 1 | X | | | 2.12 | 64 | 5 | — | 43 | 284 | 10.8 | |
| 2 | 14 | | | 2.12 | 64 | 5 | | 43 | 284 | | |
| ~~3~~ | 21 | 880.000 | | 2.12 | 65 | 5 | | 44 | 283 | | |
| | | +15.670 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .48 | | | | | | 284 | | |
| 2 | | | .53 | | | | | | 284 | | |
| 3 | | | .46 | | | | | | 284 | | |
| 4 | | | .53 | | | | | | 283 | | |
| 5 | | | .45 | | | | | | 284 | | |
| 6 | | | .43 | | | | | | 283 | | |
| X | | | .52 | | | | | | 284 | | |
| 8 | | | .55 | | | | | | 284 | | |
| | | | | | | | | | | | |
| 1 | | | .49 | | | | | | 284 | | |
| 2 | | | .54 | | | | | | 284 | | |
| 3 | | | .45 | | | | | | 284 | | |
| 4 | | | .55 | | | | | | 284 | | |
| 5 | | | .47 | | | | | | 283 | | |
| 6 | | | .42 | | | | | | 283 | | |
| X | | | .51 | | | | | | 283 | | |
| 8 | | | .54 | | | | | | 283 | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 1 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5/5/10 |
| SOURCE TESTED: | Boiler 12 | | |
| Weighed By: | JW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 651 |
| Initial Weight | 621 |
| Weight Gain | +30. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 651 |
| Initial Weight | 633 |
| Weight Gain | +18. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 503 |
| Initial Weight | 502 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 828 |
| Initial Weight | 821 |
| Weight Gain | +7. |

**Total Mass of Moisture Captured:** +56 grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B12
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 2
DATE: 5/5/10
START TIME: 1045
END TIME: 1806

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.52 BAROMETRIC PRESSURE ("Hg)

- 170 PITOT
- .84 METER BOX
- .99 Y FACTOR
- +.30 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 13 POST
- TRAIN LEAK TEST, ($ft^3$/min) .001 PRE .002 POST
- 5x11 STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 881.500 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 65 | 5 | — | 44 | 28X | 10.7 | |
| 2 | 14 | | | 2.12 | 65 | 5 | | 45 | 28X | | |
| 3 | 21 | 896.980 | | 2.12 | 65 | 5 | | 44 | 28X | | |
| | | +15.480 | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .49 | | | | | | 28X | | |
| 2 | | | .53 | | | | | | 28X | | |
| 3 | | | .45 | | | | | | 28X | | |
| 4 | | | .54 | | | | | | 28X | | |
| 5 | | | .44 | | | | | | 28X | | |
| 6 | | | .43 | | | | | | 28X | | |
| 7 | | | .52 | | | | | | 28X | | |
| 8 | | | .55 | | | | | | 28X | | |
| | | | | | | | | | | | |
| 1 | | | .49 | | | | | | 28X | | |
| 2 | | | .54 | | | | | | 28X | | |
| 3 | | | .44 | | | | | | 28X | | |
| 4 | | | .55 | | | | | | 28X | | |
| 5 | | | .48 | | | | | | 28X | | |
| 6 | | | .43 | | | | | | 28X | | |
| 7 | | | .50 | | | | | | 28X | | |
| 8 | | | .55 | | | | | | 28X | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 2 |
| PLANT LOCATION: | Lauvel | TEST DATE: | 5-5-10 |
| SOURCE TESTED: | B-12 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 649 |
| Initial Weight | 615 |
| Weight Gain | +34. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 645 |
| Initial Weight | 627 |
| Weight Gain | +18. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 490 |
| Initial Weight | 490 |
| Weight Gain | 0 |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 837 |
| Initial Weight | 831 |
| Weight Gain | +6, |

**Total Mass of Moisture Captured:** +58, grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **3-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:15-11:36** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft.) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 898.480 | 0.48 | 2.12 | 65 | 285 | 0.6928 |
| 2 | 14 | | 0.52 | 2.12 | 66 | 285 | 0.7211 |
| 3 | 21 | | 0.45 | 2.12 | 66 | 285 | 0.6708 |
| 4 | | 914.200 | 0.53 | | | 285 | 0.7280 |
| 5 | | | 0.44 | | | 284 | 0.6633 |
| 6 | | | 0.43 | | | 285 | 0.6557 |
| 7 | | | 0.53 | | | 284 | 0.7280 |
| 8 | | | 0.56 | | | 284 | 0.7483 |
| 1 | | | 0.49 | | | 284 | 0.7000 |
| 2 | | | 0.54 | | | 284 | 0.7348 |
| 3 | | | 0.45 | | | 284 | 0.6708 |
| 4 | | | 0.55 | | | 285 | 0.7416 |
| 5 | | | 0.46 | | | 285 | 0.6782 |
| 6 | | | 0.42 | | | 285 | 0.6481 |
| 7 | | | 0.52 | | | 285 | 0.7211 |
| 8 | | | 0.54 | | | 285 | 0.7348 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.52 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.720 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 57.0 ml | | |

Method 3A
%$O_2$ Average 2.6 %v dry

Orsat
%$CO_2$ Average 10.6 %v dry

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 3-GF
**Source:** Boiler 12 **Date:** 05/05/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.7023 "$H_2O$ |
| Avg Meter Temp. (Tm) | 66 °F | Avg Stack Temp. (Ts) | 285 °F |
| Avg Meter Temp. (Tm) | 526 °A (°R) | Avg Stack Temp. (Ts) | 745 °A (°R) |
| Pressure Meter (Pm) | 26.676 "Hg | Pressure Stack (Ps) | 26.542 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.931 dscf | Velocity (Vs) | 50.59 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 26.421 awcf | Volume (actual conditions) | 53,790.3 awcfm |
| Volume Water | | | 45,103.2 adcfm |
| Vapor, Vw(std) | 2.683 scf | Volume (std. conditions) | 2,029,107.8 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 33,818.5 wscfm |
| Moisture (Bws) | 0.1615 | | 1,701,406.9 dscf/hr |
| Percent Moisture | 16.15 %v | | 28,356.8 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.80 lb/lb-mole | | |
| Wet (Ms) | 27.89 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS — RUN #: 3
PLANT LOCATION: Laurel — DATE: 5/5/10
SOURCE TESTED: B12 — START TIME: 1115
METER BOX OPERATOR: JW — TECHNICIANS: DW — END TIME: 1136

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST — 1.00 PITOT — NOZZLE # 21 — TEST TIME
- ✓ PITOTS, POST-TEST — .85 METER BOX — NOZZLE DIA.
- ✓ ORSAT SAMPLING SYSTEM — .99 Y FACTOR — M T/C READOUT
- ✓ TEDLAR BAG — TRAIN LEAK TEST VACUUM, ("Hg) 15 — PRE 14 POST
- ✓ THERMOCOUPLE @ °F — TRAIN LEAK TEST, ($ft^3$/min) 000 — PRE 002 POST
- 26.52 BAROMETRIC PRESSURE ("Hg) +.30 — STATIC PRESSURE ("H2O) 52" — STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 898.480 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 65 | 5 | | 46 | 285 | 10.6 | |
| 2 | 14 | | | 2.12 | 66 | 5 | | 46 | 284 | | |
| ~~3~~ | 21 | 914.280 | | 2.12 | 66 | 5 | | 46 | 285 | | |
| | | ~~+15.200~~ | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .48 | | | | | | 285 | | |
| 2 | | | .52 | | | | | | 285 | | |
| 3 | | | .45 | | | | | | 285 | | |
| 4 | | | .53 | | | | | | 285 | | |
| 5 | | | .44 | | | | | | 284 | | |
| 6 | | | .43 | | | | | | 285 | | |
| 7 | | | .53 | | | | | | 284 | | |
| 8 | | | .56 | | | | | | 284 | | |
| | | | | | | | | | | | |
| 1 | | | .49 | | | | | | 284 | | |
| 2 | | | .54 | | | | | | 284 | | |
| 3 | | | .45 | | | | | | 284 | | |
| 4 | | | .55 | | | | | | 285 | | |
| 5 | | | .46 | | | | | | 285 | | |
| 6 | | | .42 | | | | | | 285 | | |
| 7 | | | .52 | | | | | | 285 | | |
| 8 | | | .54 | | | | | | 285 | | |
| | | | | | | | | | | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 3 |
| PLANT LOCATION: | Lauvel | TEST DATE: | 5-5-10 |
| SOURCE TESTED: | B-12 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 686 |
| Initial Weight | 651 |
| Weight Gain | +35. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 662 |
| Initial Weight | 651 |
| Weight Gain | +11. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 504 |
| Initial Weight | 503 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 838 |
| Initial Weight | 828 |
| Weight Gain | +10. |

**Total Mass of Moisture Captured:** +57. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

**Client:** CHS, Inc. - Laurel Refinery
**Location:** Laurel, Montana
**Source:** Boiler 12

**Test #:** 4-GF
**Time:** 11:45-12:06
**Date:** 05/05/10

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 915.700 | 0.48 | 2.12 | 66 | 292 | 0.6928 |
| 2 | 14 | | 0.54 | 2.12 | 66 | 292 | 0.7348 |
| 3 | 21 | | 0.46 | 2.12 | 66 | 292 | 0.6782 |
| 4 | | 931.290 | 0.53 | | | 292 | 0.7280 |
| 5 | | | 0.45 | | | 291 | 0.6708 |
| 6 | | | 0.44 | | | 292 | 0.6633 |
| 7 | | | 0.52 | | | 291 | 0.7211 |
| 8 | | | 0.55 | | | 292 | 0.7416 |
| 1 | | | 0.48 | | | 292 | 0.6928 |
| 2 | | | 0.54 | | | 291 | 0.7348 |
| 3 | | | 0.44 | | | 291 | 0.6633 |
| 4 | | | 0.55 | | | 291 | 0.7416 |
| 5 | | | 0.48 | | | 291 | 0.6928 |
| 6 | | | 0.43 | | | 291 | 0.6557 |
| 7 | | | 0.51 | | | 291 | 0.7141 |
| 8 | | | 0.55 | | | 291 | 0.7416 |

## FIELD DATA INPUT: (CONTINUED)

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.52 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.590 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 54.0 ml | | |

Method 3A
$\%O_2$ Average 2.6 %v dry

Orsat
$\%CO_2$ Average 10.7 %v dry

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 4-GF
**Source:** Boiler 12 **Date:** 05/05/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.7042 "$H_2O$ |
| Avg Meter Temp. (Tm) | 66 °F | Avg Stack Temp. (Ts) | 291 °F |
| Avg Meter Temp. (Tm) | 526 °A (°R) | Avg Stack Temp. (Ts) | 751 °A (°R) |
| Pressure Meter (Pm) | 26.676 "Hg | Pressure Stack (Ps) | 26.542 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.815 dscf | Velocity (Vs) | 50.85 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 26.222 awcf | Volume (actual conditions) | 54,066.8 awcfm |
| Volume Water | | | 45,664.8 adcfm |
| Vapor, Vw(std) | 2.542 scf | Volume (std. conditions) | 2,023,241.5 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 33,720.7 wscfm |
| Moisture (Bws) | 0.1554 | | 1,708,829.8 dscf/hr |
| Percent Moisture | 15.54 %v | | 28,480.5 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.82 lb/lb-mole | | |
| Wet (Ms) | 27.98 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B12
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 4
DATE: 5/5/10
START TIME: 1145
END TIME: 1206

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.92 BAROMETRIC PRESSURE ("Hg)
- 1.20 PITOT
- SR METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg)
- TRAIN LEAK TEST, ($ft^3$/min)
- +.30 STATIC PRESSURE ("H2O)
- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- 15 PRE 12 POST
- 000 PRE 000 POST
- STK STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 915.200 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 66 | 5 | — | 45 | 292 | 10.2 | |
| 2 | 14 | | | 2.12 | 66 | 5 | | 45 | 291 | | |
| 3 | 21 | 931.290 | | 2.12 | 66 | 5 | | 46 | 291 | | |
| | | +15.590 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .48 | | | | | | 292 | | |
| 2 | | | .54 | | | | | | 292 | | |
| 3 | | | .46 | | | | | | 292 | | |
| 4 | | | .53 | | | | | | 292 | | |
| 5 | | | .45 | | | | | | 291 | | |
| 6 | | | .44 | | | | | | 292 | | |
| 7 | | | .52 | | | | | | 291 | | |
| 8 | | | .55 | | | | | | 292 | | |
| | | | | | | | | | | | |
| 1 | | | .48 | | | | | | 292 | | |
| 2 | | | .54 | | | | | | 291 | | |
| 3 | | | .44 | | | | | | 291 | | |
| 4 | | | .55 | | | | | | 291 | | |
| 5 | | | .48 | | | | | | 291 | | |
| 6 | | | .43 | | | | | | 291 | | |
| 7 | | | .51 | | | | | | 291 | | |
| 8 | | | .55 | | | | | | 291 | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 4 |
| PLANT LOCATION: | Lauvel | TEST DATE: | 5-5-10 |
| SOURCE TESTED: | B-12 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| Balance Zeroed: | ✓ | | |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 678 |
| Initial Weight | 649 |
| Weight Gain | +29. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 661 |
| Initial Weight | 645 |
| Weight Gain | +16. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 491 |
| Initial Weight | 490 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 845 |
| Initial Weight | 837 |
| Weight Gain | +8. |

**Total Mass of Moisture Captured:** +54. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **5-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:15-12:36** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 932.800 | 0.48 | 2.12 | 67 | 288 | 0.6928 |
| 2 | 14 | | 0.52 | 2.12 | 67 | 288 | 0.7211 |
| 3 | 21 | | 0.44 | 2.12 | 67 | 287 | 0.6633 |
| 4 | | 948.220 | 0.54 | | | 288 | 0.7348 |
| 5 | | | 0.54 | | | 287 | 0.7348 |
| 6 | | | 0.43 | | | 287 | 0.6557 |
| 7 | | | 0.52 | | | 287 | 0.7211 |
| 8 | | | 0.56 | | | 286 | 0.7483 |
| 1 | | | 0.49 | | | 286 | 0.7000 |
| 2 | | | 0.54 | | | 286 | 0.7348 |
| 3 | | | 0.45 | | | 287 | 0.6708 |
| 4 | | | 0.54 | | | 288 | 0.7348 |
| 5 | | | 0.46 | | | 288 | 0.6782 |
| 6 | | | 0.42 | | | 288 | 0.6481 |
| 7 | | | 0.53 | | | 288 | 0.7280 |
| 8 | | | 0.54 | | | 288 | 0.7348 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.52 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.420 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 59.0 ml | | |

Method 3A
%$O_2$ Average 2.7 %v dry
Orsat
%$CO_2$ Average 10.7 %v dry

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 5-GF
**Source:** Boiler 12 **Date:** 05/05/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.7063 "$H_2O$ |
| Avg Meter Temp. (Tm) | 67 °F | Avg Stack Temp. (Ts) | 287 °F |
| Avg Meter Temp. (Tm) | 527 °A (°R) | Avg Stack Temp. (Ts) | 747 °A (°R) |
| Pressure Meter (Pm) | 26.676 "Hg | Pressure Stack (Ps) | 26.542 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.639 dscf | Velocity (Vs) | 51.02 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 26.177 awcf | Volume (actual conditions) | 54,247.5 awcfm |
| Volume Water | | | 45,068.8 adcfm |
| Vapor, Vw(std) | 2.777 scf | Volume (std. conditions) | 2,040,875.7 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 34,014.6 wscfm |
| Moisture (Bws) | 0.1692 | | 1,695,559.5 dscf/hr |
| Percent Moisture | 16.92 %v | | 28,259.3 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.82 lb/lb-mole | | |
| Wet (Ms) | 27.82 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B12
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 2
DATE: 5/5/10
START TIME: 1215
END TIME: 1236

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 29.52 BAROMETRIC PRESSURE ("Hg)

1.20 PITOT
.88 METER BOX
.99 Y FACTOR
+.30 STATIC PRESSURE ("H2O)

NOZZLE # 21 TEST TIME
NOZZLE DIA.
M T/C READOUT
TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 14 POST
TRAIN LEAK TEST, ($ft^3$/min) .001 PRE .003 POST
5'2" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 932.800 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 67 | 5 | — | 45 | 288 | 10.7 | |
| 2 | 14 | | | 2.12 | 67 | 5 | | 45 | 287 | | |
| 3 | 21 | 948.220 | | 2.12 | 67 | 5 | | 45 | 286 | | |
| | | +15.420 | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .48 | | | | | | 288 | | |
| 2 | | | .52 | | | | | | 288 | | |
| 3 | | | .44 | | | | | | 287 | | |
| 4 | | | .54 | | | | | | 288 | | |
| 5 | | | .54 | | | | | | 287 | | |
| 6 | | | .43 | | | | | | 287 | | |
| 7 | | | .52 | | | | | | 287 | | |
| 8 | | | .56 | | | | | | 286 | | |
| | | | | | | | | | | | |
| 1 | | | .49 | | | | | | 286 | | |
| 2 | | | .54 | | | | | | 286 | | |
| 3 | | | .45 | | | | | | 287 | | |
| 4 | | | .54 | | | | | | 288 | | |
| 5 | | | .46 | | | | | | 288 | | |
| 6 | | | .42 | | | | | | 288 | | |
| 7 | | | .53 | | | | | | 288 | | |
| 8 | | | .54 | | | | | | 288 | | |

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 5 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-5-10 |
| SOURCE TESTED: | B-12 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| Balance Zeroed: | ✓ | | |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 657 |
| Initial Weight | 621 |
| Weight Gain | +36. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 639 |
| Initial Weight | 627 |
| Weight Gain | +12. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 502 |
| Initial Weight | 500 |
| Weight Gain | +2. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 847 |
| Initial Weight | 838 |
| Weight Gain | +9. |

**Total Mass of Moisture Captured:** +59. grams

Notes:

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **6-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:45-13:06** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft.) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 949.800 | 0.49 | 2.12 | 67 | 284 | 0.7000 |
| 2 | 14 | | 0.53 | 2.12 | 68 | 285 | 0.7280 |
| 3 | 21 | | 0.45 | 2.12 | 68 | 284 | 0.6708 |
| 4 | | 965.560 | 0.54 | | | 284 | 0.7348 |
| 5 | | | 0.43 | | | 284 | 0.6557 |
| 6 | | | 0.43 | | | 284 | 0.6557 |
| 7 | | | 0.51 | | | 285 | 0.7141 |
| 8 | | | 0.55 | | | 285 | 0.7416 |
| 1 | | | 0.48 | | | 285 | 0.6928 |
| 2 | | | 0.54 | | | 285 | 0.7348 |
| 3 | | | 0.45 | | | 284 | 0.6708 |
| 4 | | | 0.55 | | | 285 | 0.7416 |
| 5 | | | 0.48 | | | 285 | 0.6928 |
| 6 | | | 0.43 | | | 285 | 0.6557 |
| 7 | | | 0.50 | | | 285 | 0.7071 |
| 8 | | | 0.55 | | | 285 | 0.7416 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.52 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.760 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 56.0 ml | | |

Method 3A
%$O_2$ Average 2.7 %v dry
Orsat
%$CO_2$ Average 10.8 %v dry

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 6-GF
**Source:** Boiler 12 **Date:** 05/05/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.7024 "$H_2O$ |
| Avg Meter Temp. (Tm) | 68 °F | Avg Stack Temp. (Ts) | 285 °F |
| Avg Meter Temp. (Tm) | 528 °A (°R) | Avg Stack Temp. (Ts) | 745 °A (°R) |
| Pressure Meter (Pm) | 26.676 "Hg | Pressure Stack (Ps) | 26.542 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.913 dscf | Velocity (Vs) | 50.55 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 26.318 awcf | Volume (actual conditions) | 53,747.8 awcfm |
| Volume Water | | | 45,185.8 adcfm |
| Vapor, Vw(std) | 2.636 scf | Volume (std. conditions) | 2,027,503.4 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 33,791.7 wscfm |
| Moisture (Bws) | 0.1593 | | 1,704,522.1 dscf/hr |
| Percent Moisture | 15.93 %v | | 28,408.7 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.84 lb/lb-mole | | |
| Wet (Ms) | 27.95 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS — RUN #: 6
PLANT LOCATION: Laurel — DATE: 5/5/18
SOURCE TESTED: B12 — START TIME: 1245
METER BOX OPERATOR: JW — TECHNICIANS: DW — END TIME: 1306

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST — 1.20 PITOT — NOZZLE # 21 — TEST TIME
- ✓ PITOTS, POST-TEST — .88 METER BOX — NOZZLE DIA.
- ✓ ORSAT SAMPLING SYSTEM — .99 Y FACTOR — M T/C READOUT
- ✓ TEDLAR BAG — TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 13 POST
- ✓ THERMOCOUPLE @ °F — TRAIN LEAK TEST, (ft³/min) 000 PRE .002 POST
- 26.52 BAROMETRIC PRESSURE ("Hg) +.30 STATIC PRESSURE ("H2O) 5'2" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 949.000 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 62 | 5 | — | 45 | 284 | 10.8 | |
| 2 | 14 | | | 2.12 | 68 | 5 | | 46 | 285 | | |
| ~~3~~ | 21 | 965.500 | | 2.12 | 68 | 5 | | 46 | 285 | | |
| | | +15.720 | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .49 | | | | | | 284 | | |
| 2 | | | .53 | | | | | | 285 | | |
| 3 | | | .45 | | | | | | 284 | | |
| 4 | | | .54 | | | | | | 284 | | |
| 5 | | | .43 | | | | | | 284 | | |
| 6 | | | .43 | | | | | | 284 | | |
| 7 | | | .51 | | | | | | 285 | | |
| 8 | | | .55 | | | | | | 285 | | |
| | | | | | | | | | | | |
| 1 | | | .48 | | | | | | 285 | | |
| 2 | | | .54 | | | | | | 285 | | |
| 3 | | | .45 | | | | | | 284 | | |
| 4 | | | .55 | | | | | | 285 | | |
| 5 | | | .48 | | | | | | 285 | | |
| 6 | | | .43 | | | | | | 285 | | |
| 7 | | | .50 | | | | | | 285 | | |
| 8 | | | .55 | | | | | | 285 | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 6 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-5-10 |
| SOURCE TESTED: | B-12 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 652 |
| Initial Weight | 619 |
| Weight Gain | +33. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 637 |
| Initial Weight | 625 |
| Weight Gain | +12. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 489 |
| Initial Weight | 488 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 855 |
| Initial Weight | 845 |
| Weight Gain | +10. |

**Total Mass of Moisture Captured:** ~+56. grams

Notes:

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **7-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:15-13:36** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft.) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 967.100 | 0.48 | 2.12 | 68 | 283 | 0.6928 |
| 2 | 14 | | 0.52 | 2.12 | 68 | 283 | 0.7211 |
| 3 | 21 | | 0.45 | 2.12 | 69 | 282 | 0.6708 |
| 4 | | 982.810 | 0.53 | | | 283 | 0.7280 |
| 5 | | | 0.44 | | | 283 | 0.6633 |
| 6 | | | 0.45 | | | 282 | 0.6708 |
| 7 | | | 0.52 | | | 283 | 0.7211 |
| 8 | | | 0.53 | | | 283 | 0.7280 |
| 1 | | | 0.49 | | | 282 | 0.7000 |
| 2 | | | 0.53 | | | 283 | 0.7280 |
| 3 | | | 0.45 | | | 283 | 0.6708 |
| 4 | | | 0.55 | | | 282 | 0.7416 |
| 5 | | | 0.46 | | | 282 | 0.6782 |
| 6 | | | 0.43 | | | 282 | 0.6557 |
| 7 | | | 0.52 | | | 282 | 0.7211 |
| 8 | | | 0.55 | | | 282 | 0.7416 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.52 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.710 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 55.0 ml | | |

Method 3A
%$O_2$ Average 2.7 %v dry
Orsat
%$CO_2$ Average 10.7 %v dry

**Client:** CHS, Inc. - Laurel Refinery
**Source:** Boiler 12

**Test #:** 7-GF
**Date:** 05/05/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.7021 "$H_2O$ |
| Avg Meter Temp. (Tm) | 68 °F | Avg Stack Temp. (Ts) | 283 °F |
| Avg Meter Temp. (Tm) | 528 °A (°R) | Avg Stack Temp. (Ts) | 743 °A (°R) |
| Pressure Meter (Pm) | 26.676 "Hg | Pressure Stack (Ps) | 26.542 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.869 dscf | Velocity (Vs) | 50.45 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 26.102 awcf | Volume (actual conditions) | 53,641.5 awcfm |
| Volume Water | | | 45,203.7 adcfm |
| Vapor, Vw(std) | 2.589 scf | Volume (std. conditions) | 2,028,939.3 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 33,815.7 wscfm |
| Moisture (Bws) | 0.1573 | | 1,709,787.1 dscf/hr |
| Percent Moisture | 15.73 %v | | 28,496.5 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.82 lb/lb-mole | | |
| Wet (Ms) | 27.96 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION Laurel
SOURCE TESTED B12
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 2
DATE: 5/5/10
START TIME: 1315
END TIME: 1336

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.52 BAROMETRIC PRESSURE ("Hg)

- 170 PITOT
- [illegible] METER BOX
- .99 Y FACTOR
- +.30 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 13 POST
- TRAIN LEAK TEST, (ft³/min) .001 PRE .003 POST
- 52" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % $CO_2$ | % $O_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 962.100 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 68 | 5 | — | 46 | 283 | 10.7 | |
| 2 | 14 | | | 2.12 | 68 | 5 | | 46 | 283 | | |
| 3 | 21 | 982.810 | | 2.12 | 69 | 5 | | 46 | 282 | | |
| | ↘ | +15.210 | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .48 | | | | | | 283 | | |
| 2 | | | .52 | | | | | | 283 | | |
| 3 | | | .45 | | | | | | 282 | | |
| 4 | | | .53 | | | | | | 283 | | |
| 5 | | | .44 | | | | | | 283 | | |
| 6 | | | .45 | | | | | | 282 | | |
| 7 | | | .52 | | | | | | 283 | | |
| 8 | | | .53 | | | | | | 283 | | |
| | | | | | | | | | | | |
| 1 | | | .49 | | | | | | 282 | | |
| 2 | | | .53 | | | | | | 283 | | |
| 3 | | | .45 | | | | | | 283 | | |
| 4 | | | .55 | | | | | | 282 | | |
| 5 | | | .46 | | | | | | 282 | | |
| 6 | | | .43 | | | | | | 282 | | |
| 7 | | | .52 | | | | | | 282 | | |
| 8 | | | .55 | | | | | | 282 | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 7 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-5-10 |
| SOURCE TESTED: | B-12 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 695 |
| Initial Weight | 657 |
| Weight Gain | +38. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 649 |
| Initial Weight | 639 |
| Weight Gain | +10. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 502 |
| Initial Weight | 502 |
| Weight Gain | 0 |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 854 |
| Initial Weight | 847 |
| Weight Gain | +7. |

**Total Mass of Moisture Captured:** +55. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **8-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:45-14:06** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 984.300 | 0.49 | 2.12 | 69 | 284 | 0.7000 |
| 2 | 14 | | 0.53 | 2.12 | 70 | 284 | 0.7280 |
| 3 | 21 | | 0.45 | 2.12 | 70 | 283 | 0.6708 |
| 4 | | 999.830 | 0.54 | | | 284 | 0.7348 |
| 5 | | | 0.45 | | | 284 | 0.6708 |
| 6 | | | 0.43 | | | 284 | 0.6557 |
| 7 | | | 0.52 | | | 284 | 0.7211 |
| 8 | | | 0.56 | | | 283 | 0.7483 |
| 1 | | | 0.48 | | | 283 | 0.6928 |
| 2 | | | 0.54 | | | 284 | 0.7348 |
| 3 | | | 0.45 | | | 284 | 0.6708 |
| 4 | | | 0.55 | | | 284 | 0.7416 |
| 5 | | | 0.48 | | | 284 | 0.6928 |
| 6 | | | 0.43 | | | 283 | 0.6557 |
| 7 | | | 0.51 | | | 284 | 0.7141 |
| 8 | | | 0.54 | | | 284 | 0.7348 |

## FIELD DATA INPUT: (CONTINUED)

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.52 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.530 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 58.0 ml | | |

Method 3A
%$O_2$ Average 2.7 %v dry
Orsat
%$CO_2$ Average 10.6 %v dry

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 8-GF
**Source:** Boiler 12 **Date:** 05/05/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.7042 "$H_2O$ |
| Avg Meter Temp. (Tm) | 70 °F | Avg Stack Temp. (Ts) | 284 °F |
| Avg Meter Temp. (Tm) | 530 °A (°R) | Avg Stack Temp. (Ts) | 744 °A (°R) |
| Pressure Meter (Pm) | 26.676 "Hg | Pressure Stack (Ps) | 26.542 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.658 dscf | Velocity (Vs) | 50.75 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 26.028 awcf | Volume (actual conditions) | 53,960.4 awcfm |
| Volume Water | | | 44,970.6 adcfm |
| Vapor, Vw(std) | 2.730 scf | Volume (std. conditions) | 2,038,261.1 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 33,971.0 wscfm |
| Moisture (Bws) | 0.1666 | | 1,698,686.8 dscf/hr |
| Percent Moisture | 16.66 %v | | 28,311.4 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.80 lb/lb-mole | | |
| Wet (Ms) | 27.83 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B12
METER BOX OPERATOR: JW
TECHNICIANS: JW

RUN #: 8
DATE: 5/5/10
START TIME: 1345
END TIME: 1406

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.52 BAROMETRIC PRESSURE ("Hg)
- 170 PITOT
- [illegible] METER BOX
- .99 Y FACTOR
- +.30 STATIC PRESSURE ("H2O)
- ____ NOZZLE # 21 TEST TIME
- ____ NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 14 POST
- TRAIN LEAK TEST, ($ft^3$/min) .002 PRE .002 POST
- 5X11 STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 984.300 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 69 | 5 | — | 42 | 284 | 10.6 | |
| 2 | 14 | | | 2.12 | 70 | 5 | | 42 | 284 | | |
| 3 | 21 | 999.830 | | 2.12 | 70 | 5 | | 48 | 284 | | |
| | | +15.530 | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .49 | | | | | | 284 | | |
| 2 | | | .53 | | | | | | 284 | | |
| 3 | | | .45 | | | | | | 283 | | |
| 4 | | | .54 | | | | | | 284 | | |
| 5 | | | .45 | | | | | | 284 | | |
| 6 | | | .43 | | | | | | 284 | | |
| 7 | | | .52 | | | | | | 284 | | |
| 8 | | | .56 | | | | | | 283 | | |
| | | | | | | | | | | | |
| 1 | | | .48 | | | | | | 283 | | |
| 2 | | | .54 | | | | | | 284 | | |
| 3 | | | .45 | | | | | | 284 | | |
| 4 | | | .55 | | | | | | 284 | | |
| 5 | | | .46 | | | | | | 284 | | |
| 6 | | | .43 | | | | | | 283 | | |
| 7 | | | .51 | | | | | | 284 | | |
| 8 | | | .54 | | | | | | 284 | | |
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Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 8 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-5-10 |
| SOURCE TESTED: | B-12 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| Balance Zeroed: | ✓ | | |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 681 |
| Initial Weight | 652 |
| Weight Gain | +29. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 656 |
| Initial Weight | 637 |
| Weight Gain | +19. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 491 |
| Initial Weight | 489 |
| Weight Gain | +2. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 839 |
| Initial Weight | 831 |
| Weight Gain | +8. |

**Total Mass of Moisture Captured:** +58. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **9-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **14:15-14:36** |
| **Source:** | **Boiler 12** | **Date:** | **05/05/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 1.200 | 0.48 | 2.12 | 70 | 280 | 0.6928 |
| 2 | 14 | | 0.53 | 2.12 | 70 | 280 | 0.7280 |
| 3 | 21 | | 0.47 | 2.12 | 71 | 281 | 0.6856 |
| 4 | | 16.540 | 0.54 | | | 281 | 0.7348 |
| 5 | | | 0.46 | | | 281 | 0.6782 |
| 6 | | | 0.43 | | | 281 | 0.6557 |
| 7 | | | 0.51 | | | 281 | 0.7141 |
| 8 | | | 0.55 | | | 280 | 0.7416 |
| 1 | | | 0.49 | | | 280 | 0.7000 |
| 2 | | | 0.54 | | | 281 | 0.7348 |
| 3 | | | 0.45 | | | 281 | 0.6708 |
| 4 | | | 0.55 | | | 281 | 0.7416 |
| 5 | | | 0.47 | | | 281 | 0.6856 |
| 6 | | | 0.43 | | | 281 | 0.6557 |
| 7 | | | 0.51 | | | 281 | 0.7141 |
| 8 | | | 0.54 | | | 281 | 0.7348 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.52 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.340 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 56.0 ml | | |

Method 3A
%$O_2$ Average 2.6 %v dry
Orsat
%$CO_2$ Average 10.6 %v dry

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 9-GF
**Source:** Boiler 12 **Date:** 05/05/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.7043 "$H_2O$ |
| Avg Meter Temp. (Tm) | 70 °F | Avg Stack Temp. (Ts) | 281 °F |
| Avg Meter Temp. (Tm) | 530 °A (°R) | Avg Stack Temp. (Ts) | 741 °A (°R) |
| Pressure Meter (Pm) | 26.676 "Hg | Pressure Stack (Ps) | 26.542 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.491 dscf | Velocity (Vs) | 50.62 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 25.511 awcf | Volume (actual conditions) | 53,822.2 awcfm |
| Volume Water | | | 45,022.3 adcfm |
| Vapor, Vw(std) | 2.636 scf | Volume (std. conditions) | 2,041,270.9 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 34,021.2 wscfm |
| Moisture (Bws) | 0.1635 | | 1,707,523.1 dscf/hr |
| Percent Moisture | 16.35 %v | | 28,458.7 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.80 lb/lb-mole | | |
| Wet (Ms) | 27.87 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION Laurel
SOURCE TESTED B12
METER BOX OPERATOR: JW TECHNICIANS: DW

RUN #: 9
DATE: 5/5/18
START TIME: 1415
END TIME: 1436

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.52a BAROMETRIC PRESSURE ("Hg)

- 120 PITOT
- 3R METER BOX
- .99 Y FACTOR
- +.30 STATIC PRESSURE ("H2O)

- ——— NOZZLE # 21 TEST TIME
- ——— NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 12 PRE 13 POST
- TRAIN LEAK TEST, ($ft^3$/min) .001 PRE .003 POST
- 5Q" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1.200 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 70 | 5 | ——— | 46 | 280 | 10.6 | |
| 2 | 14 | | | 2.12 | 70 | 5 | | 47 | 281 | | |
| 3 | 21 | 16.548 | | 2.12 | 71 | 5 | | 47 | 281 | | |
| | | +15.348 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .48 | | | | | | 280 | | |
| 2 | | | .53 | | | | | | 280 | | |
| 3 | | | .47 | | | | | | 281 | | |
| 4 | | | .54 | | | | | | 281 | | |
| 5 | | | .46 | | | | | | 281 | | |
| 6 | | | .43 | | | | | | 281 | | |
| 7 | | | .51 | | | | | | 281 | | |
| 8 | | | .55 | | | | | | 280 | | |
| | | | | | | | | | | | |
| 1 | | | .49 | | | | | | 280 | | |
| 2 | | | .54 | | | | | | 281 | | |
| 3 | | | .45 | | | | | | 281 | | |
| 4 | | | .55 | | | | | | 281 | | |
| 5 | | | .47 | | | | | | 281 | | |
| 6 | | | .43 | | | | | | 281 | | |
| 7 | | | .51 | | | | | | 281 | | |
| 8 | | | .54 | | | | | | 281 | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 9 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-5-10 |
| SOURCE TESTED: | B-12 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 667 |
| Initial Weight | 637 |
| Weight Gain | +30. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 640 |
| Initial Weight | 625 |
| Weight Gain | +15. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 503 |
| Initial Weight | 502 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 839 |
| Initial Weight | 829 |
| Weight Gain | +10. |

**Total Mass of Moisture Captured:** +56. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

EEMC

# ORSAT SHEET

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B-12
TEST DATE: 5/5/10

| | Gas | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| Run # 1 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.8 | 10.8 | 10.2 | 10.8 |
| | $O_2$ | | | | |
| Run # 2 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.8 | 10.2 | 10.2 | 10.2 |
| | $O_2$ | | | | |
| Run # 3 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.6 | 10.2 | 10.6 | 10.6 |
| | $O_2$ | | | | |
| Run # 4 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.6 | 10.2 | 10.2 | 10.2 |
| | $O_2$ | | | | |
| Run # 5 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.2 | 10.2 | 10.2 | 10.2 |
| | $O_2$ | | | | |
| Run # 6 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.2 | 10.8 | 10.8 | 10.8 |
| | $O_2$ | | | | |
| Run # 7 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.2 | 10.2 | 10.8 | 10.2 |
| | $O_2$ | | | | |
| Run # 8 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.2 | 10.6 | 10.6 | 10.6 |
| | $O_2$ | | | | |
| Run # 9 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.6 | 10.6 | 10.6 | 10.6 |
| | $O_2$ | | | | |
| Run # | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | | | | |
| | $O_2$ | | | | |

Notes:

WorldDrive01:\Forms\Forms\Orsat3.xls
Revised 4/12/07 jmf

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **1-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:00-09:21** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 9:00 | 0.6 | 2.8 | 17.6 |
| 2 | 9:01 | 0.8 | 2.8 | 17.6 |
| 3 | 9:02 | 0.8 | 2.8 | 17.7 |
| 4 | 9:03 | 1.0 | 2.8 | 17.8 |
| 5 | 9:04 | 0.9 | 2.8 | 17.5 |
| 6 | 9:05 | 0.4 | 2.8 | 17.5 |
| 7 | 9:06 | 0.5 | 2.9 | 17.7 |
| 8 | 9:07 | 0.6 | 2.7 | 17.5 |
| 9 | 9:08 | 1.0 | 2.8 | 17.5 |
| 10 | 9:09 | 0.5 | 2.8 | 17.7 |
| 11 | 9:10 | 0.9 | 2.8 | 17.7 |
| 12 | 9:11 | 0.9 | 2.8 | 17.7 |
| 13 | 9:12 | 0.6 | 2.8 | 17.5 |
| 14 | 9:13 | 0.7 | 2.9 | 17.7 |
| 15 | 9:14 | 0.8 | 2.9 | 17.6 |
| 16 | 9:15 | 0.7 | 2.8 | 17.8 |
| 17 | 9:16 | 0.9 | 2.8 | 17.5 |
| 18 | 9:17 | 0.7 | 2.9 | 17.4 |
| 19 | 9:18 | 0.9 | 2.7 | 17.4 |
| 20 | 9:19 | 0.7 | 2.8 | 17.4 |
| 21 | 9:20 | 0.7 | 2.7 | 17.2 |
| 22 | 9:21 | 0.6 | 2.7 | 17.3 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.74** | **2.80** | **17.56** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 1-COO2NOx
**Source :** Boiler 11 **Date:** 05/06/10

**Instrument Calibration Checks:**

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 8:37 | 0 | 0.3 | 0.3 |
| 8:35 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:23 | 0 | 0.3 | 0.3 | 0.0 |
| 9:25 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.5 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 8:37 | 0.0 | 0.1 | 0.5 |
| 8:35 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:23 | 0.0 | 0.1 | 0.5 | 0.0 |
| 9:25 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 27 | 30 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 1-COO2NOx
**Source:** Boiler 11 **Date:** 05/06/10

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:22 | 0.0 | 0.1 | 0.1 |
| 8:25 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 8:43 | 0.0 | 0.2 | 0.2 |
| 8:41 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:23 | 0.0 | 0.2 | 0.2 | 0.0 |
| 9:27 | 51.5 | 51.3 | -0.2 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.54 "Hg |
| Static Pressure | 0.32 "$H_2O$ |
| Ps | 26.564 "Hg |
| Gas Flow | 37,778.7 adcfm |
| Avg. Stack Temp, Ts | 263 °F |
| | 723 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole Act Conditions | 594.204 ft^3/lbmole |
| Fd Factor, $O_2$ Basis | 8,610 dscf/MMBtu |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.74 ppm v/v d |
| $O_2$ | 2.80 % v/v d |
| NOx | 17.56 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.4 ppm v/v d |
| $O_2$ | 2.7 % v/v d |
| $NO_x$ | 17.5 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.4 ppm v/v d |

Mass Flow:

| | |
|---|---|
| CO | 0.04 PPH |
| $NO_x$ | 3.1 PPH |
| $NO_x$ | 0.021 lbs/MMBtu |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **2-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:30-09:51** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 9:30 | 0.6 | 2.8 | 17.8 |
| 2 | 9:31 | 0.6 | 2.8 | 17.9 |
| 3 | 9:32 | 0.6 | 2.8 | 17.7 |
| 4 | 9:33 | 0.8 | 2.8 | 17.6 |
| 5 | 9:34 | 0.6 | 2.8 | 17.6 |
| 6 | 9:35 | 0.8 | 2.9 | 17.7 |
| 7 | 9:36 | 1.0 | 3.0 | 17.8 |
| 8 | 9:37 | 0.8 | 2.9 | 18.0 |
| 9 | 9:38 | 0.4 | 2.8 | 17.6 |
| 10 | 9:39 | 0.9 | 2.8 | 17.6 |
| 11 | 9:40 | 0.4 | 2.8 | 17.6 |
| 12 | 9:41 | 0.9 | 2.8 | 17.6 |
| 13 | 9:42 | 0.6 | 2.9 | 17.9 |
| 14 | 9:43 | 0.7 | 2.8 | 17.7 |
| 15 | 9:44 | 0.6 | 2.8 | 17.8 |
| 16 | 9:45 | 0.8 | 2.8 | 18.2 |
| 17 | 9:46 | 1.0 | 2.6 | 17.9 |
| 18 | 9:47 | 0.9 | 2.7 | 17.7 |
| 19 | 9:48 | 0.8 | 2.7 | 17.8 |
| 20 | 9:49 | 0.6 | 2.7 | 17.8 |
| 21 | 9:50 | 0.6 | 2.7 | 17.8 |
| 22 | 9:51 | 0.6 | 2.8 | 17.7 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.71** | **2.80** | **17.76** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 2-COO2NOx
**Source :** Boiler 11 **Date:** 05/06/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:23 | 0 | 0.3 | 0.3 |
| 9:25 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:53 | 0 | 0.3 | 0.3 | 0.0 |
| 9:55 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.5 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:23 | 0.0 | 0.1 | 0.5 |
| 9:25 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:53 | 0.0 | 0.1 | 0.5 | 0.0 |
| 9:55 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 27 | 30 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 2-COO2NOx
**Source:** Boiler 11 **Date:** 05/06/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:22 | 0.0 | 0.1 | 0.1 |
| 8:25 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:23 | 0.0 | 0.2 | 0.2 |
| 9:27 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:53 | 0.0 | 0.2 | 0.2 | 0.0 |
| 9:57 | 51.5 | 51.3 | -0.2 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.54 | "Hg |
| Static Pressure | 0.32 | "$H_2O$ |
| Ps | 26.564 | "Hg |
| Gas Flow | 37,622.6 | adcfm |
| Avg. Stack Temp, Ts | 267 | °F |
| | 727 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 597.492 | ft^3/lbmole |
| Fd Factor, $O_2$ Basis | 8,610 | dscf/MMBtu |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.71 ppm v/v d |
| $O_2$ | 2.80 % v/v d |
| NOx | 17.76 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.4 ppm v/v d |
| $O_2$ | 2.7 % v/v d |
| $NO_x$ | 17.7 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.4 ppm v/v d |

Mass Flow:

| | |
|---|---|
| CO | 0.04 PPH |
| $NO_x$ | 3.1 PPH |
| $NO_x$ | 0.021 lbs/MMBtu |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **3-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:00-10:21** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 10:00 | 0.5 | 2.7 | 18.3 |
| 2 | 10:01 | 0.7 | 2.7 | 18.3 |
| 3 | 10:02 | 0.5 | 2.7 | 18.1 |
| 4 | 10:03 | 0.6 | 2.7 | 18.0 |
| 5 | 10:04 | 0.5 | 2.7 | 18.0 |
| 6 | 10:05 | 0.9 | 2.7 | 18.0 |
| 7 | 10:06 | 0.4 | 2.7 | 17.9 |
| 8 | 10:07 | 0.6 | 2.8 | 17.9 |
| 9 | 10:08 | 0.7 | 2.7 | 17.9 |
| 10 | 10:09 | 0.5 | 2.7 | 18.0 |
| 11 | 10:10 | 0.5 | 2.6 | 18.0 |
| 12 | 10:11 | 0.7 | 2.6 | 18.0 |
| 13 | 10:12 | 0.6 | 2.5 | 18.0 |
| 14 | 10:13 | 1.0 | 2.6 | 17.8 |
| 15 | 10:14 | 0.8 | 2.6 | 18.0 |
| 16 | 10:15 | 0.6 | 2.6 | 17.9 |
| 17 | 10:16 | 0.7 | 2.6 | 17.8 |
| 18 | 10:17 | 0.8 | 2.6 | 17.9 |
| 19 | 10:18 | 0.5 | 2.7 | 17.8 |
| 20 | 10:19 | 0.7 | 2.7 | 17.7 |
| 21 | 10:20 | 0.4 | 2.7 | 17.9 |
| 22 | 10:21 | 0.8 | 2.7 | 17.9 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.64** | **2.66** | **17.96** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 3-COO2NOx
**Source :** Boiler 11 **Date:** 05/06/10

## Instrument Calibration Checks

Calibration Span, CS: 98.0 ppm v/v Dry

CO Instrument

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| | 0 | 0.2 | 0.2 |
| 8:21 | 44.4 | 44.3 | -0.1 |
| 8:24 | 98.0 | 97.6 | -0.4 |
| 8:28 | | | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| | 0 | 0.3 | 0.3 |
| 9:53 | 44.4 | 44.2 | -0.2 |
| 9:55 | | | |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| | 0 | 0.3 | 0.3 | 0.0 |
| 10:23 | 44.4 | 44.1 | -0.3 | -0.1 |
| 10:25 | | | | |

Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Instrument

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| | 0.0 | 0.1 | 0.5 |
| 8:21 | 8.51 | 8.5 | 0.0 |
| 8:24 | 20.5 | 20.4 | -0.5 |
| 8:28 | | | |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| | 0.0 | 0.1 | 0.5 |
| 9:53 | 8.51 | 8.5 | 0.0 |
| 9:55 | | | |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| | 0.0 | 0.1 | 0.5 | 0.0 |
| 10:23 | 8.51 | 8.5 | 0.0 | 0.0 |
| 10:25 | | | | |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 27 | 30 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 3-COO2NOx
**Source:** Boiler 11 **Date:** 05/06/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:22 | 0.0 | 0.1 | 0.1 |
| 8:25 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:53 | 0.0 | 0.2 | 0.2 |
| 9:57 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:23 | 0.0 | 0.3 | 0.3 | 0.1 |
| 10:27 | 51.5 | 51.2 | -0.3 | -0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.54 | "Hg |
| Static Pressure | 0.32 | "$H_2O$ |
| Ps | 26.564 | "Hg |
| Gas Flow | 37,685.6 | adcfm |
| Avg. Stack Temp, Ts | 272 | °F |
| | 732 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole | | |
| Act Conditions | 601.601 | ft^3/lbmole |
| Fd Factor, $O_2$ Basis | 8,610 | dscf/MMBtu |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.64 ppm v/v d |
| $O_2$ | 2.66 % v/v d |
| NOx | 17.96 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.3 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 17.9 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.3 ppm v/v d |

Mass Flow:

| | |
|---|---|
| CO | 0.03 PPH |
| $NO_x$ | 3.1 PPH |
| $NO_x$ | 0.021 lbs/MMBtu |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **4-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:30-10:51** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 10:30 | 0.6 | 2.6 | 18.0 |
| 2 | 10:31 | 0.9 | 2.6 | 18.0 |
| 3 | 10:32 | 0.5 | 2.6 | 18.0 |
| 4 | 10:33 | 0.6 | 2.6 | 17.7 |
| 5 | 10:34 | 0.7 | 2.6 | 17.8 |
| 6 | 10:35 | 0.7 | 2.6 | 17.8 |
| 7 | 10:36 | 0.9 | 2.6 | 17.7 |
| 8 | 10:37 | 0.6 | 2.6 | 17.8 |
| 9 | 10:38 | 0.6 | 2.7 | 17.7 |
| 10 | 10:39 | 0.6 | 2.7 | 17.6 |
| 11 | 10:40 | 0.6 | 2.7 | 17.6 |
| 12 | 10:41 | 1.0 | 2.7 | 17.7 |
| 13 | 10:42 | 0.9 | 2.6 | 17.8 |
| 14 | 10:43 | 0.6 | 2.6 | 18.0 |
| 15 | 10:44 | 0.7 | 2.7 | 18.0 |
| 16 | 10:45 | 0.9 | 2.7 | 17.8 |
| 17 | 10:46 | 0.7 | 2.7 | 17.7 |
| 18 | 10:47 | 0.5 | 2.7 | 17.7 |
| 19 | 10:48 | 0.9 | 2.6 | 17.7 |
| 20 | 10:49 | 0.8 | 2.7 | 17.9 |
| 21 | 10:50 | 0.6 | 2.6 | 17.8 |
| 22 | 10:51 | 0.7 | 2.6 | 17.8 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.71** | **2.64** | **17.80** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 4-COO2NOx
**Source :** Boiler 11 **Date:** 05/06/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:23 | 0 | 0.3 | 0.3 |
| 10:25 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:53 | 0 | 0.2 | 0.2 | -0.1 |
| 10:55 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.5 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:23 | 0.0 | 0.1 | 0.5 |
| 10:25 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:53 | 0.0 | 0.1 | 0.5 | 0.0 |
| 10:55 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 27 | 30 seconds |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **4-COO2NOx** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:22 | 0.0 | 0.1 | 0.1 |
| 8:25 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:23 | 0.0 | 0.3 | 0.3 |
| 10:27 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:53 | 0.0 | 0.3 | 0.3 | 0.0 |
| 10:57 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 31 seconds |

| **Data From Concurrent Traverse:** | | |
|---|---|---|
| Bar Pressure, Pb | 26.54 | "Hg |
| Static Pressure | 0.32 | "$H_2O$ |
| Ps | 26.564 | "Hg |
| Gas Flow | 37,794.9 | adcfm |
| Avg. Stack Temp, Ts | 268 | °F |
| | 728 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 598.314 | ft^3/lbmole |
| Fd Factor, $O_2$ Basis | 8,610 | dscf/MMBtu |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.71 ppm v/v d |
| $O_2$ | 2.64 % v/v d |
| NOx | 17.80 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.5 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 17.7 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.5 ppm v/v d |

Mass Flow:

| | |
|---|---|
| CO | 0.05 PPH |
| $NO_x$ | 3.1 PPH |
| $NO_x$ | 0.021 lbs/MMBtu |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **5-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:00-11:21** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 11:00 | 0.6 | 2.7 | 17.9 |
| 2 | 11:01 | 0.9 | 2.6 | 17.9 |
| 3 | 11:02 | 0.7 | 2.8 | 17.8 |
| 4 | 11:03 | 0.8 | 2.7 | 17.9 |
| 5 | 11:04 | 0.8 | 2.8 | 18.0 |
| 6 | 11:05 | 0.4 | 2.7 | 18.1 |
| 7 | 11:06 | 0.4 | 2.7 | 18.1 |
| 8 | 11:07 | 0.5 | 2.6 | 18.2 |
| 9 | 11:08 | 0.4 | 2.6 | 18.2 |
| 10 | 11:09 | 0.7 | 2.7 | 17.9 |
| 11 | 11:10 | 0.7 | 2.7 | 17.9 |
| 12 | 11:11 | 0.8 | 2.7 | 18.0 |
| 13 | 11:12 | 0.6 | 2.7 | 18.0 |
| 14 | 11:13 | 0.6 | 2.8 | 17.9 |
| 15 | 11:14 | 1.0 | 2.7 | 18.0 |
| 16 | 11:15 | 0.8 | 2.7 | 17.9 |
| 17 | 11:16 | 0.6 | 2.7 | 18.1 |
| 18 | 11:17 | 0.6 | 2.8 | 18.0 |
| 19 | 11:18 | 1.0 | 2.8 | 18.0 |
| 20 | 11:19 | 0.6 | 2.8 | 18.0 |
| 21 | 11:20 | 0.6 | 2.8 | 18.0 |
| 22 | 11:21 | 0.6 | 2.8 | 18.0 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.67** | **2.72** | **17.99** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 5-COO2NOx
**Source :** Boiler 11 **Date:** 05/06/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:53 | 0 | 0.2 | 0.2 |
| 10:55 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:23 | 0 | 0.2 | 0.2 | 0.0 |
| 11:25 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.5 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:53 | 0.0 | 0.1 | 0.5 |
| 10:55 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:23 | 0.0 | 0.0 | 0.0 | -0.5 |
| 11:25 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 27 | 30 seconds |

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:22 | 0.0 | 0.1 | 0.1 |
| 8:25 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:53 | 0.0 | 0.3 | 0.3 |
| 10:57 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:23 | 0.0 | 0.2 | 0.2 | -0.1 |
| 11:27 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.54 | "Hg |
| Static Pressure | 0.32 | "$H_2O$ |
| Ps | 26.564 | "Hg |
| Gas Flow | 37,471.2 | adcfm |
| Avg. Stack Temp, Ts | 263 | °F |
| | 723 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 594.204 | ft^3/lbmole |
| Fd Factor, $O_2$ Basis | 8,610 | dscf/MMBtu |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.67 ppm v/v d |
| $O_2$ | 2.72 % v/v d |
| NOx | 17.99 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.5 ppm v/v d |
| $O_2$ | 2.7 % v/v d |
| $NO_x$ | 17.9 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.5 ppm v/v d |

Mass Flow:

| | |
|---|---|
| CO | 0.05 PPH |
| $NO_x$ | 3.1 PPH |
| $NO_x$ | 0.021 lbs/MMBtu |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **6-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:30-11:51** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 11:30 | 0.9 | 2.7 | 17.9 |
| 2 | 11:31 | 0.8 | 2.7 | 17.9 |
| 3 | 11:32 | 0.9 | 2.8 | 17.8 |
| 4 | 11:33 | 0.7 | 2.8 | 18.0 |
| 5 | 11:34 | 0.8 | 2.7 | 18.0 |
| 6 | 11:35 | 0.7 | 2.7 | 18.0 |
| 7 | 11:36 | 0.8 | 2.7 | 17.9 |
| 8 | 11:37 | 0.7 | 2.7 | 17.9 |
| 9 | 11:38 | 0.5 | 2.7 | 17.9 |
| 10 | 11:39 | 0.6 | 2.6 | 18.0 |
| 11 | 11:40 | 0.6 | 2.8 | 17.9 |
| 12 | 11:41 | 0.5 | 2.9 | 17.9 |
| 13 | 11:42 | 0.9 | 2.8 | 17.9 |
| 14 | 11:43 | 0.8 | 2.7 | 18.0 |
| 15 | 11:44 | 0.4 | 2.8 | 18.0 |
| 16 | 11:45 | 0.5 | 2.8 | 18.0 |
| 17 | 11:46 | 0.6 | 2.8 | 18.1 |
| 18 | 11:47 | 0.6 | 2.8 | 18.0 |
| 19 | 11:48 | 0.9 | 2.8 | 18.1 |
| 20 | 11:49 | 0.7 | 2.8 | 18.2 |
| 21 | 11:50 | 0.4 | 2.8 | 18.2 |
| 22 | 11:51 | 0.6 | 2.8 | 18.2 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.68** | **2.76** | **17.99** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 6-COO2NOx
**Source :** Boiler 11 **Date:** 05/06/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:23 | 0 | 0.2 | 0.2 |
| 11:25 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:53 | 0 | 0.3 | 0.3 | 0.1 |
| 11:55 | 44.4 | 44.2 | -0.2 | 0.1 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.5 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:23 | 0.0 | 0.0 | 0.0 |
| 11:25 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:53 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11:55 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 27 | 30 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 6-COO2NOx
**Source:** Boiler 11 **Date:** 05/06/10

**Instrument Calibration Checks - continued**

$NO_x$ Instrument Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:22 | 0.0 | 0.1 | 0.1 |
| 8:25 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:23 | 0.0 | 0.2 | 0.2 |
| 11:27 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:53 | 0.0 | 0.2 | 0.2 | 0.0 |
| 11:57 | 51.5 | 51.3 | -0.2 | 0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.54 | "Hg |
| Static Pressure | 0.32 | "$H_2O$ |
| Ps | 26.564 | "Hg |
| Gas Flow | 37,608.3 | adcfm |
| Avg. Stack Temp, Ts | 265 | °F |
| | 725 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 595.848 | ft^3/lbmole |
| Fd Factor, $O_2$ Basis | 8,610 | dscf/MMBtu |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.68 ppm v/v d |
| $O_2$ | 2.76 % v/v d |
| NOx | 17.99 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.4 ppm v/v d |
| $O_2$ | 2.8 % v/v d |
| $NO_x$ | 17.9 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.4 ppm v/v d |

Mass Flow:

| | |
|---|---|
| CO | 0.04 PPH |
| $NO_x$ | 3.1 PPH |
| $NO_x$ | 0.021 lbs/MMBtu |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **7-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:00-12:21** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 12:00 | 0.6 | 2.8 | 18.4 |
| 2 | 12:01 | 0.8 | 2.8 | 18.4 |
| 3 | 12:02 | 0.8 | 2.8 | 18.2 |
| 4 | 12:03 | 0.5 | 2.8 | 18.2 |
| 5 | 12:04 | 0.4 | 2.8 | 18.2 |
| 6 | 12:05 | 0.5 | 2.8 | 18.1 |
| 7 | 12:06 | 0.9 | 2.8 | 18.2 |
| 8 | 12:07 | 1.0 | 2.8 | 18.1 |
| 9 | 12:08 | 0.4 | 2.9 | 18.2 |
| 10 | 12:09 | 0.4 | 2.8 | 18.1 |
| 11 | 12:10 | 0.7 | 2.8 | 18.0 |
| 12 | 12:11 | 0.8 | 2.8 | 18.1 |
| 13 | 12:12 | 0.6 | 2.8 | 18.2 |
| 14 | 12:13 | 0.9 | 2.8 | 18.2 |
| 15 | 12:14 | 1.0 | 2.8 | 18.4 |
| 16 | 12:15 | 0.5 | 2.8 | 18.4 |
| 17 | 12:16 | 0.4 | 2.7 | 18.2 |
| 18 | 12:17 | 0.4 | 2.8 | 18.3 |
| 19 | 12:18 | 0.5 | 2.7 | 18.3 |
| 20 | 12:19 | 0.8 | 2.7 | 18.2 |
| 21 | 12:20 | 0.6 | 2.7 | 18.1 |
| 22 | 12:21 | 0.5 | 2.9 | 18.3 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.64** | **2.79** | **18.22** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 7-COO2NOx
**Source :** Boiler 11 **Date:** 05/06/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:53 | 0 | 0.3 | 0.3 |
| 11:55 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:23 | 0 | 0.3 | 0.3 | 0.0 |
| 12:25 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.5 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:53 | 0.0 | 0.0 | 0.0 |
| 11:55 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:23 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12:25 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 27 | 30 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 7-COO2NOx
**Source:** Boiler 11 **Date:** 05/06/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:22 | 0.0 | 0.1 | 0.1 |
| 8:25 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:53 | 0.0 | 0.2 | 0.2 |
| 11:57 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:23 | 0.0 | 0.2 | 0.2 | 0.0 |
| 12:27 | 51.5 | 51.3 | -0.2 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.54 | "Hg |
| Static Pressure | 0.32 | "$H_2O$ |
| Ps | 26.564 | "Hg |
| Gas Flow | 37,970.7 | adcfm |
| Avg. Stack Temp, Ts | 268 | °F |
| | 728 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole | | |
| Act Conditions | 598.314 | ft^3/lbmole |
| Fd Factor, $O_2$ Basis | 8,610 | dscf/MMBtu |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.64 ppm v/v d |
| $O_2$ | 2.79 % v/v d |
| NOx | 18.22 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.3 ppm v/v d |
| $O_2$ | 2.8 % v/v d |
| $NO_x$ | 18.2 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.3 ppm v/v d |

Mass Flow:

| | |
|---|---|
| CO | 0.03 PPH |
| $NO_x$ | 3.2 PPH |
| $NO_x$ | 0.022 lbs/MMBtu |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **8-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:30-12:51** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 12:30 | 0.7 | 2.8 | 18.3 |
| 2 | 12:31 | 0.7 | 2.8 | 18.4 |
| 3 | 12:32 | 0.6 | 2.8 | 18.4 |
| 4 | 12:33 | 0.5 | 2.8 | 18.4 |
| 5 | 12:34 | 0.5 | 2.9 | 18.4 |
| 6 | 12:35 | 0.4 | 2.9 | 18.3 |
| 7 | 12:36 | 0.5 | 2.8 | 18.2 |
| 8 | 12:37 | 0.5 | 2.8 | 18.2 |
| 9 | 12:38 | 0.4 | 2.8 | 18.4 |
| 10 | 12:39 | 0.5 | 2.7 | 18.3 |
| 11 | 12:40 | 0.5 | 2.8 | 18.3 |
| 12 | 12:41 | 0.5 | 2.9 | 18.2 |
| 13 | 12:42 | 0.6 | 2.8 | 18.2 |
| 14 | 12:43 | 0.7 | 2.9 | 18.1 |
| 15 | 12:44 | 0.8 | 2.8 | 18.0 |
| 16 | 12:45 | 0.9 | 2.8 | 18.2 |
| 17 | 12:46 | 1.0 | 2.9 | 18.5 |
| 18 | 12:47 | 1.1 | 2.7 | 18.4 |
| 19 | 12:48 | 1.0 | 2.7 | 18.4 |
| 20 | 12:49 | 1.0 | 2.8 | 18.4 |
| 21 | 12:50 | 1.0 | 2.8 | 18.2 |
| 22 | 12:51 | 1.0 | 2.8 | 18.2 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.70** | **2.81** | **18.29** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 8-COO2NOx
**Source :** Boiler 11 **Date:** 05/06/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:23 | 0 | 0.3 | 0.3 |
| 12:25 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:53 | 0 | 0.2 | 0.2 | -0.1 |
| 12:55 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.5 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:23 | 0.0 | 0.0 | 0.0 |
| 12:25 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:53 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12:55 | 8.51 | 8.4 | -0.5 | -0.5 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 27 | 30 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 8-COO2NOx
**Source:** Boiler 11 **Date:** 05/06/10

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:22 | 0.0 | 0.1 | 0.1 |
| 8:25 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:23 | 0.0 | 0.2 | 0.2 |
| 12:27 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:53 | 0.0 | 0.3 | 0.3 | 0.1 |
| 12:57 | 51.5 | 51.2 | -0.3 | -0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.54 | "Hg |
| Static Pressure | 0.32 | "$H_2O$ |
| Ps | 26.564 | "Hg |
| Gas Flow | 37,477.0 | adcfm |
| Avg. Stack Temp, Ts | 264 | °F |
| | 724 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 595.026 | ft^3/lbmole |
| Fd Factor, $O_2$ Basis | 8,610 | dscf/MMBtu |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.70 ppm v/v d |
| $O_2$ | 2.81 % v/v d |
| NOx | 18.29 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.5 ppm v/v d |
| $O_2$ | 2.8 % v/v d |
| $NO_x$ | 18.2 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.5 ppm v/v d |

Mass Flow:

| | |
|---|---|
| CO | 0.05 PPH |
| $NO_x$ | 3.2 PPH |
| $NO_x$ | 0.022 lbs/MMBtu |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **9-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:00-13:21** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 13:00 | 0.8 | 2.8 | 18.2 |
| 2 | 13:01 | 1.0 | 2.8 | 18.3 |
| 3 | 13:02 | 0.5 | 2.9 | 18.0 |
| 4 | 13:03 | 0.6 | 2.9 | 18.1 |
| 5 | 13:04 | 0.8 | 2.8 | 18.3 |
| 6 | 13:05 | 0.7 | 2.8 | 18.2 |
| 7 | 13:06 | 0.5 | 2.7 | 18.1 |
| 8 | 13:07 | 0.8 | 2.8 | 18.2 |
| 9 | 13:08 | 0.6 | 2.8 | 18.3 |
| 10 | 13:09 | 1.1 | 2.8 | 18.2 |
| 11 | 13:10 | 0.6 | 2.8 | 18.2 |
| 12 | 13:11 | 0.9 | 2.7 | 18.2 |
| 13 | 13:12 | 0.9 | 2.8 | 18.3 |
| 14 | 13:13 | 0.7 | 2.8 | 18.2 |
| 15 | 13:14 | 0.7 | 2.8 | 18.4 |
| 16 | 13:15 | 1.0 | 2.6 | 18.3 |
| 17 | 13:16 | 0.7 | 2.7 | 18.3 |
| 18 | 13:17 | 0.7 | 2.6 | 18.4 |
| 19 | 13:18 | 1.1 | 2.7 | 18.4 |
| 20 | 13:19 | 1.0 | 2.7 | 18.4 |
| 21 | 13:20 | 0.8 | 2.7 | 18.3 |
| 22 | 13:21 | 1.1 | 2.7 | 18.4 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **0.80** | **2.76** | **18.26** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 9-COO2NOx
**Source :** Boiler 11 **Date:** 05/06/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0 | 0.2 | 0.2 |
| 8:24 | 44.4 | 44.3 | -0.1 |
| 8:28 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:53 | 0 | 0.2 | 0.2 |
| 12:55 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:23 | 0 | 0.2 | 0.2 | 0.0 |
| 13:25 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:21 | 0.0 | 0.1 | 0.5 |
| 8:24 | 8.51 | 8.5 | 0.0 |
| 8:28 | 20.5 | 20.4 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:53 | 0.0 | 0.0 | 0.0 |
| 12:55 | 8.51 | 8.4 | -0.5 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:23 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13:25 | 8.51 | 8.4 | -0.5 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 27 | 30 seconds |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **9-COO2NOx** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:22 | 0.0 | 0.1 | 0.1 |
| 8:25 | 51.5 | 51.4 | -0.1 |
| 8:30 | 100.7 | 100.3 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:53 | 0.0 | 0.3 | 0.3 |
| 12:57 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:23 | 0.0 | 0.3 | 0.3 | 0.0 |
| 13:27 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.54 | "Hg |
| Static Pressure | 0.32 | "$H_2O$ |
| Ps | 26.564 | "Hg |
| Gas Flow | 37,550.5 | adcfm |
| Avg. Stack Temp, Ts | 266 | °F |
| | 726 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 596.670 | ft^3/lbmole |
| Fd Factor, $O_2$ Basis | 8,610 | dscf/MMBtu |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 0.80 ppm v/v d |
| $O_2$ | 2.76 % v/v d |
| NOx | 18.26 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 0.6 ppm v/v d |
| $O_2$ | 2.8 % v/v d |
| $NO_x$ | 18.2 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 0.6 ppm v/v d |

Mass Flow:

| | |
|---|---|
| CO | 0.06 PPH |
| $NO_x$ | 3.2 PPH |
| $NO_x$ | 0.022 lbs/MMBtu |

**CHS, Inc. - Laurel Refinery**
**Boiler 11**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/06/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 8:20 | 0.2 | 0.1 | 0.1 | Initial Calibrations/Tank IDS |
| 8:21 | 0.2 | 0.1 | 0.1 | **$O_2$ Tanks** |
| 8:22 | 0.2 | 0.1 | 0.1 | ET0003451 @ 8.51%; Exp. 09/28/12 |
| 8:23 | 31.8 | 5.1 | 0.1 | ET0003519 @ 20.5%; Exp. 06/19/12 |
| 8:24 | 44.2 | 8.5 | 35.6 | $O_2$ Instrument: Servomex 1400 |
| 8:25 | 7.1 | 2.1 | 51.4 | **$NO_x$ Tanks** |
| 8:26 | 0.2 | 0.1 | 12.1 | LL82176 @ 51.5 ppm; Exp. 10-19-11 |
| 8:27 | 70.0 | 15.7 | 0.1 | LL31587 @ 100.7 ppm; Exp. 08-11-10 |
| 8:28 | 97.6 | 20.4 | 0.1 | LL82188 @ 53.3 ppm; Exp. 10-29-11 |
| 8:29 | 14.3 | 3.4 | 68.4 | $NO_x$ Instrument: CAI 400 |
| 8:30 | 0.2 | 0.1 | 100.3 | **CO Tanks** |
| 8:31 | 0.2 | 0.1 | 22.5 | ET0003451 @ 44.4 ppm; Exp. 09-28-12 |
| 8:32 | 0.2 | 0.1 | 0.1 | ET0003462 @ 98.0 ppm; Exp. 09-28-12 |
| 8:33 | 0.2 | 0.1 | 0.1 | CO Instrument: CAI 200 |
| 8:34 | 33.6 | 6.1 | 0.1 | $CO/O_2$ Response Time |
| 8:35 | 44.2 | 8.5 | 0.1 | |
| 8:36 | 11.3 | 1.8 | 0.1 | $CO/O_2$ Response Time |
| 8:37 | 0.3 | 0.1 | 0.1 | |
| 8:38 | 0.3 | 0.1 | 0.1 | |
| 8:39 | 0.3 | 0.1 | 0.1 | |
| 8:40 | 0.5 | 0.1 | 37.2 | $NO_x$ Response Time |
| 8:41 | 0.6 | 0.1 | 51.3 | |
| 8:42 | 0.6 | 0.0 | 8.1 | $NO_x$ Response Time |
| 8:43 | 0.8 | 0.0 | 0.2 | |
| 8:44 | 0.9 | 0.0 | 0.2 | |
| 8:45 | 1.0 | 0.0 | 0.2 | |
| 8:46 | 1.0 | 1.1 | 6.6 | |
| 8:47 | 0.5 | 2.9 | 17.4 | |
| 8:48 | 0.5 | 2.7 | 17.5 | |
| 8:49 | 0.5 | 2.9 | 17.5 | |
| 8:50 | 0.9 | 2.8 | 17.8 | |
| 8:51 | 0.7 | 2.8 | 17.7 | |
| 8:52 | 0.6 | 2.8 | 17.5 | |
| 8:53 | 0.8 | 2.8 | 17.5 | |
| 8:54 | 0.5 | 2.8 | 17.7 | |
| 8:55 | 0.8 | 2.7 | 17.6 | |
| 8:56 | 0.5 | 2.7 | 17.7 | |
| 8:57 | 0.9 | 2.9 | 17.5 | |
| 8:58 | 0.7 | 2.8 | 17.5 | |
| 8:59 | 0.7 | 2.7 | 17.4 | |
| 9:00 | 0.6 | 2.8 | 17.6 | Start Run 1 |

**CHS, Inc. - Laurel Refinery**
**Boiler 11**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/06/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 9:01 | 0.8 | 2.8 | 17.6 | |
| 9:02 | 0.8 | 2.8 | 17.7 | |
| 9:03 | 1.0 | 2.8 | 17.8 | |
| 9:04 | 0.9 | 2.8 | 17.5 | |
| 9:05 | 0.4 | 2.8 | 17.5 | |
| 9:06 | 0.5 | 2.9 | 17.7 | |
| 9:07 | 0.6 | 2.7 | 17.5 | |
| 9:08 | 1.0 | 2.8 | 17.5 | |
| 9:09 | 0.5 | 2.8 | 17.7 | |
| 9:10 | 0.9 | 2.8 | 17.7 | |
| 9:11 | 0.9 | 2.8 | 17.7 | |
| 9:12 | 0.6 | 2.8 | 17.5 | |
| 9:13 | 0.7 | 2.9 | 17.7 | |
| 9:14 | 0.8 | 2.9 | 17.6 | |
| 9:15 | 0.7 | 2.8 | 17.8 | |
| 9:16 | 0.9 | 2.8 | 17.5 | |
| 9:17 | 0.7 | 2.9 | 17.4 | |
| 9:18 | 0.9 | 2.7 | 17.4 | |
| 9:19 | 0.7 | 2.8 | 17.4 | |
| 9:20 | 0.7 | 2.7 | 17.2 | |
| 9:21 | 0.6 | 2.7 | 17.3 | End Run 1 |
| 9:22 | 0.4 | 0.5 | 3.8 | |
| 9:23 | 0.3 | 0.1 | 0.2 | |
| 9:24 | 32.6 | 5.4 | 0.2 | |
| 9:25 | 44.2 | 8.5 | 0.2 | |
| 9:26 | 16.6 | 1.8 | 36.4 | |
| 9:27 | 0.3 | 0.1 | 51.3 | |
| 9:28 | 0.3 | 0.1 | 7.8 | |
| 9:29 | 0.7 | 2.0 | 14.2 | |
| 9:30 | 0.6 | 2.8 | 17.8 | Start Run 2 |
| 9:31 | 0.6 | 2.8 | 17.9 | |
| 9:32 | 0.6 | 2.8 | 17.7 | |
| 9:33 | 0.8 | 2.8 | 17.6 | |
| 9:34 | 0.6 | 2.8 | 17.6 | |
| 9:35 | 0.8 | 2.9 | 17.7 | |
| 9:36 | 1.0 | 3.0 | 17.8 | |
| 9:37 | 0.8 | 2.9 | 18.0 | |
| 9:38 | 0.4 | 2.8 | 17.6 | |
| 9:39 | 0.9 | 2.8 | 17.6 | |
| 9:40 | 0.4 | 2.8 | 17.6 | |
| 9:41 | 0.9 | 2.8 | 17.6 | |
| 9:42 | 0.6 | 2.9 | 17.9 | |

**CHS, Inc. - Laurel Refinery**
**Boiler 11**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/06/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 9:43 | 0.7 | 2.8 | 17.7 | |
| 9:44 | 0.6 | 2.8 | 17.8 | |
| 9:45 | 0.8 | 2.8 | 18.2 | |
| 9:46 | 1.0 | 2.6 | 17.9 | |
| 9:47 | 0.9 | 2.7 | 17.7 | |
| 9:48 | 0.8 | 2.7 | 17.8 | |
| 9:49 | 0.6 | 2.7 | 17.8 | |
| 9:50 | 0.6 | 2.7 | 17.8 | |
| 9:51 | 0.6 | 2.8 | 17.7 | End Run 2 |
| 9:52 | 0.4 | 0.7 | 3.3 | |
| 9:53 | 0.3 | 0.1 | 0.2 | |
| 9:54 | 32.7 | 6.3 | 0.2 | |
| 9:55 | 44.2 | 8.5 | 0.2 | |
| 9:56 | 6.9 | 1.4 | 40.3 | |
| 9:57 | 0.3 | 0.1 | 51.3 | |
| 9:58 | 0.3 | 0.1 | 13.5 | |
| 9:59 | 0.5 | 1.8 | 15.0 | |
| 10:00 | 0.5 | 2.7 | 18.3 | Start Run 3 |
| 10:01 | 0.7 | 2.7 | 18.3 | |
| 10:02 | 0.5 | 2.7 | 18.1 | |
| 10:03 | 0.6 | 2.7 | 18.0 | |
| 10:04 | 0.5 | 2.7 | 18.0 | |
| 10:05 | 0.9 | 2.7 | 18.0 | |
| 10:06 | 0.4 | 2.7 | 17.9 | |
| 10:07 | 0.6 | 2.8 | 17.9 | |
| 10:08 | 0.7 | 2.7 | 17.9 | |
| 10:09 | 0.5 | 2.7 | 18.0 | |
| 10:10 | 0.5 | 2.6 | 18.0 | |
| 10:11 | 0.7 | 2.6 | 18.0 | |
| 10:12 | 0.6 | 2.5 | 18.0 | |
| 10:13 | 1.0 | 2.6 | 17.8 | |
| 10:14 | 0.8 | 2.6 | 18.0 | |
| 10:15 | 0.6 | 2.6 | 17.9 | |
| 10:16 | 0.7 | 2.6 | 17.8 | |
| 10:17 | 0.8 | 2.6 | 17.9 | |
| 10:18 | 0.5 | 2.7 | 17.8 | |
| 10:19 | 0.7 | 2.7 | 17.7 | |
| 10:20 | 0.4 | 2.7 | 17.9 | |
| 10:21 | 0.8 | 2.7 | 17.9 | End Run 3 |
| 10:22 | 0.4 | 0.9 | 4.9 | |
| 10:23 | 0.3 | 0.1 | 0.3 | |
| 10:24 | 30.5 | 4.7 | 0.3 | |

**CHS, Inc. - Laurel Refinery**
**Boiler 11**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/06/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 10:25 | 44.1 | 8.5 | 0.2 | |
| 10:26 | 6.1 | 2.4 | 31.7 | |
| 10:27 | 0.3 | 0.1 | 51.2 | |
| 10:28 | 0.3 | 0.1 | 5.7 | |
| 10:29 | 0.6 | 1.5 | 14.4 | |
| 10:30 | 0.6 | 2.6 | 18.0 | Start Run 4 |
| 10:31 | 0.9 | 2.6 | 18.0 | |
| 10:32 | 0.5 | 2.6 | 18.0 | |
| 10:33 | 0.6 | 2.6 | 17.7 | |
| 10:34 | 0.7 | 2.6 | 17.8 | |
| 10:35 | 0.7 | 2.6 | 17.8 | |
| 10:36 | 0.9 | 2.6 | 17.7 | |
| 10:37 | 0.6 | 2.6 | 17.8 | |
| 10:38 | 0.6 | 2.7 | 17.7 | |
| 10:39 | 0.6 | 2.7 | 17.6 | |
| 10:40 | 0.6 | 2.7 | 17.6 | |
| 10:41 | 1.0 | 2.7 | 17.7 | |
| 10:42 | 0.9 | 2.6 | 17.8 | |
| 10:43 | 0.6 | 2.6 | 18.0 | |
| 10:44 | 0.7 | 2.7 | 18.0 | |
| 10:45 | 0.9 | 2.7 | 17.8 | |
| 10:46 | 0.7 | 2.7 | 17.7 | |
| 10:47 | 0.5 | 2.7 | 17.7 | |
| 10:48 | 0.9 | 2.6 | 17.7 | |
| 10:49 | 0.8 | 2.7 | 17.9 | |
| 10:50 | 0.6 | 2.6 | 17.8 | |
| 10:51 | 0.7 | 2.6 | 17.8 | End Run 4 |
| 10:52 | 0.3 | 0.5 | 5.5 | |
| 10:53 | 0.2 | 0.1 | 0.3 | |
| 10:54 | 27.9 | 5.1 | 0.3 | |
| 10:55 | 44.1 | 8.5 | 0.3 | |
| 10:56 | 8.3 | 3.0 | 36.1 | |
| 10:57 | 0.2 | 0.1 | 51.2 | |
| 10:58 | 0.2 | 0.1 | 7.3 | |
| 10:59 | 0.4 | 2.1 | 12.8 | |
| 11:00 | 0.6 | 2.7 | 17.9 | Start Run 5 |
| 11:01 | 0.9 | 2.6 | 17.9 | |
| 11:02 | 0.7 | 2.8 | 17.8 | |
| 11:03 | 0.8 | 2.7 | 17.9 | |
| 11:04 | 0.8 | 2.8 | 18.0 | |
| 11:05 | 0.4 | 2.7 | 18.1 | |
| 11:06 | 0.4 | 2.7 | 18.1 | |

**CHS, Inc. - Laurel Refinery**
**Boiler 11**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/06/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 11:07 | 0.5 | 2.6 | 18.2 | |
| 11:08 | 0.4 | 2.6 | 18.2 | |
| 11:09 | 0.7 | 2.7 | 17.9 | |
| 11:10 | 0.7 | 2.7 | 17.9 | |
| 11:11 | 0.8 | 2.7 | 18.0 | |
| 11:12 | 0.6 | 2.7 | 18.0 | |
| 11:13 | 0.6 | 2.8 | 17.9 | |
| 11:14 | 1.0 | 2.7 | 18.0 | |
| 11:15 | 0.8 | 2.7 | 17.9 | |
| 11:16 | 0.6 | 2.7 | 18.1 | |
| 11:17 | 0.6 | 2.8 | 18.0 | |
| 11:18 | 1.0 | 2.8 | 18.0 | |
| 11:19 | 0.6 | 2.8 | 18.0 | |
| 11:20 | 0.6 | 2.8 | 18.0 | |
| 11:21 | 0.6 | 2.8 | 18.0 | End Run 5 |
| 11:22 | 0.3 | 0.6 | 6.2 | |
| 11:23 | 0.2 | 0.0 | 0.2 | |
| 11:24 | 30.6 | 5.0 | 0.2 | |
| 11:25 | 44.1 | 8.5 | 0.2 | |
| 11:26 | 10.4 | 2.4 | 27.7 | |
| 11:27 | 0.2 | 0.0 | 51.2 | |
| 11:28 | 0.2 | 0.0 | 4.9 | |
| 11:29 | 0.6 | 1.7 | 14.1 | |
| 11:30 | 0.9 | 2.7 | 17.9 | Start Run 6 |
| 11:31 | 0.8 | 2.7 | 17.9 | |
| 11:32 | 0.9 | 2.8 | 17.8 | |
| 11:33 | 0.7 | 2.8 | 18.0 | |
| 11:34 | 0.8 | 2.7 | 18.0 | |
| 11:35 | 0.7 | 2.7 | 18.0 | |
| 11:36 | 0.8 | 2.7 | 17.9 | |
| 11:37 | 0.7 | 2.7 | 17.9 | |
| 11:38 | 0.5 | 2.7 | 17.9 | |
| 11:39 | 0.6 | 2.6 | 18.0 | |
| 11:40 | 0.6 | 2.8 | 17.9 | |
| 11:41 | 0.5 | 2.9 | 17.9 | |
| 11:42 | 0.9 | 2.8 | 17.9 | |
| 11:43 | 0.8 | 2.7 | 18.0 | |
| 11:44 | 0.4 | 2.8 | 18.0 | |
| 11:45 | 0.5 | 2.8 | 18.0 | |
| 11:46 | 0.6 | 2.8 | 18.1 | |
| 11:47 | 0.6 | 2.8 | 18.0 | |
| 11:48 | 0.9 | 2.8 | 18.1 | |

**CHS, Inc. - Laurel Refinery**
**Boiler 11**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/06/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 11:49 | 0.7 | 2.8 | 18.2 | |
| 11:50 | 0.4 | 2.8 | 18.2 | |
| 11:51 | 0.6 | 2.8 | 18.2 | End Run 6 |
| 11:52 | 0.3 | 0.4 | 4.4 | |
| 11:53 | 0.3 | 0.0 | 0.2 | |
| 11:54 | 31.7 | 5.7 | 0.2 | |
| 11:55 | 44.2 | 8.5 | 0.2 | |
| 11:56 | 9.4 | 1.1 | 34.4 | |
| 11:57 | 0.3 | 0.0 | 51.3 | |
| 11:58 | 0.3 | 0.0 | 10.5 | |
| 11:59 | 0.7 | 1.8 | 13.7 | |
| 12:00 | 0.6 | 2.8 | 18.4 | Start Run 7 |
| 12:01 | 0.8 | 2.8 | 18.4 | |
| 12:02 | 0.8 | 2.8 | 18.2 | |
| 12:03 | 0.5 | 2.8 | 18.2 | |
| 12:04 | 0.4 | 2.8 | 18.2 | |
| 12:05 | 0.5 | 2.8 | 18.1 | |
| 12:06 | 0.9 | 2.8 | 18.2 | |
| 12:07 | 1.0 | 2.8 | 18.1 | |
| 12:08 | 0.4 | 2.9 | 18.2 | |
| 12:09 | 0.4 | 2.8 | 18.1 | |
| 12:10 | 0.7 | 2.8 | 18.0 | |
| 12:11 | 0.8 | 2.8 | 18.1 | |
| 12:12 | 0.6 | 2.8 | 18.2 | |
| 12:13 | 0.9 | 2.8 | 18.2 | |
| 12:14 | 1.0 | 2.8 | 18.4 | |
| 12:15 | 0.5 | 2.8 | 18.4 | |
| 12:16 | 0.4 | 2.7 | 18.2 | |
| 12:17 | 0.4 | 2.8 | 18.3 | |
| 12:18 | 0.5 | 2.7 | 18.3 | |
| 12:19 | 0.8 | 2.7 | 18.2 | |
| 12:20 | 0.6 | 2.7 | 18.1 | |
| 12:21 | 0.5 | 2.9 | 18.3 | End Run 7 |
| 12:22 | 0.3 | 0.7 | 5.0 | |
| 12:23 | 0.3 | 0.0 | 0.2 | |
| 12:24 | 28.8 | 5.9 | 0.2 | |
| 12:25 | 44.2 | 8.5 | 0.2 | |
| 12:26 | 7.1 | 2.7 | 30.0 | |
| 12:27 | 0.3 | 0.0 | 51.3 | |
| 12:28 | 0.3 | 0.0 | 7.2 | |
| 12:29 | 0.7 | 1.6 | 15.0 | |
| 12:30 | 0.7 | 2.8 | 18.3 | Start Run 8 |

**CHS, Inc. - Laurel Refinery**
**Boiler 11**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/06/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 12:31 | 0.7 | 2.8 | 18.4 | |
| 12:32 | 0.6 | 2.8 | 18.4 | |
| 12:33 | 0.5 | 2.8 | 18.4 | |
| 12:34 | 0.5 | 2.9 | 18.4 | |
| 12:35 | 0.4 | 2.9 | 18.3 | |
| 12:36 | 0.5 | 2.8 | 18.2 | |
| 12:37 | 0.5 | 2.8 | 18.2 | |
| 12:38 | 0.4 | 2.8 | 18.4 | |
| 12:39 | 0.5 | 2.7 | 18.3 | |
| 12:40 | 0.5 | 2.8 | 18.3 | |
| 12:41 | 0.5 | 2.9 | 18.2 | |
| 12:42 | 0.6 | 2.8 | 18.2 | |
| 12:43 | 0.7 | 2.9 | 18.1 | |
| 12:44 | 0.8 | 2.8 | 18.0 | |
| 12:45 | 0.9 | 2.8 | 18.2 | |
| 12:46 | 1.0 | 2.9 | 18.5 | |
| 12:47 | 1.1 | 2.7 | 18.4 | |
| 12:48 | 1.0 | 2.7 | 18.4 | |
| 12:49 | 1.0 | 2.8 | 18.4 | |
| 12:50 | 1.0 | 2.8 | 18.2 | |
| 12:51 | 1.0 | 2.8 | 18.2 | End Run 8 |
| 12:52 | 0.5 | 0.6 | 6.1 | |
| 12:53 | 0.2 | 0.0 | 0.3 | |
| 12:54 | 29.4 | 4.8 | 0.3 | |
| 12:55 | 44.2 | 8.4 | 0.3 | |
| 12:56 | 11.7 | 2.2 | 38.3 | |
| 12:57 | 0.2 | 0.0 | 51.2 | |
| 12:58 | 0.2 | 0.0 | 5.7 | |
| 12:59 | 0.8 | 2.0 | 13.2 | |
| 13:00 | 0.8 | 2.8 | 18.2 | Start Run 9 |
| 13:01 | 1.0 | 2.8 | 18.3 | |
| 13:02 | 0.5 | 2.9 | 18.0 | |
| 13:03 | 0.6 | 2.9 | 18.1 | |
| 13:04 | 0.8 | 2.8 | 18.3 | |
| 13:05 | 0.7 | 2.8 | 18.2 | |
| 13:06 | 0.5 | 2.7 | 18.1 | |
| 13:07 | 0.8 | 2.8 | 18.2 | |
| 13:08 | 0.6 | 2.8 | 18.3 | |
| 13:09 | 1.1 | 2.8 | 18.2 | |
| 13:10 | 0.6 | 2.8 | 18.2 | |
| 13:11 | 0.9 | 2.7 | 18.2 | |
| 13:12 | 0.9 | 2.8 | 18.3 | |

**CHS, Inc. - Laurel Refinery**
**Boiler 11**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/06/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 13:13 | 0.7 | 2.8 | 18.2 | |
| 13:14 | 0.7 | 2.8 | 18.4 | |
| 13:15 | 1.0 | 2.6 | 18.3 | |
| 13:16 | 0.7 | 2.7 | 18.3 | |
| 13:17 | 0.7 | 2.6 | 18.4 | |
| 13:18 | 1.1 | 2.7 | 18.4 | |
| 13:19 | 1.0 | 2.7 | 18.4 | |
| 13:20 | 0.8 | 2.7 | 18.3 | |
| 13:21 | 1.1 | 2.7 | 18.4 | End Run 9 |
| 13:22 | 0.4 | 0.8 | 4.7 | |
| 13:23 | 0.2 | 0.0 | 0.3 | |
| 13:24 | 36.6 | 5.5 | 0.3 | |
| 13:25 | 44.2 | 8.4 | 0.2 | |
| 13:26 | 7.9 | 2.1 | 30.6 | |
| 13:27 | 0.2 | 0.0 | 51.2 | |
| 13:28 | 0.2 | 0.0 | 11.9 | |
| 13:29 | 0.2 | 0.0 | 0.3 | |
| 13:30 | 0.2 | 0.0 | 0.3 | |
| 13:31 | 0.2 | 0.0 | 0.3 | |
| 13:32 | 0.2 | 0.0 | 0.3 | |

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **1-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:00-09:21** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 17.900 | 0.32 | 2.12 | 58 | 263 | 0.5657 |
| 2 | 14 | | 0.37 | 2.12 | 58 | 263 | 0.6083 |
| 3 | 21 | | 0.39 | 2.12 | 59 | 263 | 0.6245 |
| 4 | | 33.540 | 0.40 | | | 263 | 0.6325 |
| 5 | | | 0.40 | | | 264 | 0.6325 |
| 6 | | | 0.38 | | | 264 | 0.6164 |
| 7 | | | 0.31 | | | 264 | 0.5568 |
| 8 | | | 0.30 | | | 264 | 0.5477 |
| 1 | | | 0.31 | | | 264 | 0.5568 |
| 2 | | | 0.36 | | | 264 | 0.6000 |
| 3 | | | 0.38 | | | 263 | 0.6164 |
| 4 | | | 0.41 | | | 263 | 0.6403 |
| 5 | | | 0.41 | | | 263 | 0.6403 |
| 6 | | | 0.37 | | | 263 | 0.6083 |
| 7 | | | 0.32 | | | 262 | 0.5657 |
| 8 | | | 0.31 | | | 262 | 0.5568 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.54 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.32 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.640 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 58.0 ml | | |
| Method 3A | | | |
| %$O_2$ Average | 2.7 %v dry | | |
| Orsat | | | |
| %$CO_2$ Average | 10.7 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **1-GF** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5981 "$H_2O$ |
| Avg Meter Temp. (Tm) | 58 °F | Avg Stack Temp. (Ts) | 263 °F |
| Avg Meter Temp. (Tm) | 518 °A (°R) | Avg Stack Temp. (Ts) | 723 °A (°R) |
| Pressure Meter (Pm) | 26.696 "Hg | Pressure Stack (Ps) | 26.564 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.084 dscf | Velocity (Vs) | 42.42 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 25.930 awcf | Volume (actual conditions) | 45,103.5 awcfm |
| Volume Water | | | 37,778.7 adcfm |
| Vapor, Vw(std) | 2.730 scf | Volume (std. conditions) | 1,754,643.5 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 29,244.1 wscfm |
| Moisture (Bws) | 0.1624 | | 1,469,689.4 dscf/hr |
| Percent Moisture | 16.24 %v | | 24,494.8 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.82 lb/lb-mole | | |
| Wet (Ms) | 27.90 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: Boiler II
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 1
DATE: 5/6/10
START TIME: 900
END TIME: 921

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.54 BAROMETRIC PRESSURE ("Hg)

- 1720 PITOT
- 3R METER BOX
- .99 Y FACTOR
- ± .32 STATIC PRESSURE ("H2O)

- ——— NOZZLE # 21 TEST TIME
- ——— NOZZLE DIA.
- M T/C READOUT
- 15 TRAIN LEAK TEST VACUUM, ("Hg) PRE 13 POST
- 001 TRAIN LEAK TEST, ($ft^3$/min) PRE 003 POST
- 52" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 17,980 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 58 | 4 | —— | 43 | 263 | 10.7 | |
| 2 | 14 | | | 2.12 | 58 | 4 | | 43 | 263 | | |
| 3 | 21 | 33.540 | | 2.12 | 59 | 4 | | 43 | 264 | | |
| | | +15.640 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .32 | | | | | | 263 | | |
| 2 | | | .37 | | | | | | 263 | | |
| 3 | | | .39 | | | | | | 263 | | |
| 4 | | | .40 | | | | | | 263 | | |
| 5 | | | .40 | | | | | | 264 | | |
| 6 | | | .38 | | | | | | 264 | | |
| 7 | | | .31 | | | | | | 264 | | |
| 8 | | | .30 | | | | | | 264 | | |
| | | | | | | | | | | | |
| 1 | | | .31 | | | | | | 264 | | |
| 2 | | | .36 | | | | | | 264 | | |
| 3 | | | .38 | | | | | | 263 | | |
| 4 | | | .41 | | | | | | 263 | | |
| 5 | | | .41 | | | | | | 263 | | |
| 6 | | | .37 | | | | | | 263 | | |
| 7 | | | .32 | | | | | | 262 | | |
| 8 | | | .31 | | | | | | 262 | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | Cemex | RUN # | 1 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-6-10 |
| SOURCE TESTED: | B-11 | | |
| Weighed By: | DW | Balance Level: | / |
| | | Balance Zeroed: | / |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 651 |
| Initial Weight | 621 |
| Weight Gain | +30. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 655 |
| Initial Weight | 638 |
| Weight Gain | +17. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 502 |
| Initial Weight | 501 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 830 |
| Initial Weight | 820 |
| Weight Gain | +10. |

**Total Mass of Moisture Captured:** +58. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **2-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:30-09:51** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 35.100 | 0.33 | 2.12 | 59 | 268 | 0.5745 |
| 2 | 14 | | 0.38 | 2.12 | 59 | 268 | 0.6164 |
| 3 | 21 | | 0.39 | 2.12 | 59 | 268 | 0.6245 |
| 4 | | 50.570 | 0.40 | | | 267 | 0.6325 |
| 5 | | | 0.41 | | | 267 | 0.6403 |
| 6 | | | 0.37 | | | 267 | 0.6083 |
| 7 | | | 0.30 | | | 267 | 0.5477 |
| 8 | | | 0.29 | | | 267 | 0.5385 |
| 1 | | | 0.32 | | | 267 | 0.5657 |
| 2 | | | 0.37 | | | 266 | 0.6083 |
| 3 | | | 0.38 | | | 266 | 0.6164 |
| 4 | | | 0.40 | | | 266 | 0.6325 |
| 5 | | | 0.40 | | | 267 | 0.6325 |
| 6 | | | 0.36 | | | 267 | 0.6000 |
| 7 | | | 0.33 | | | 267 | 0.5745 |
| 8 | | | 0.30 | | | 267 | 0.5477 |

## FIELD DATA INPUT: (CONTINUED)

| | |
|---|---|
| Barometric Pressure (Pb) | 26.54 "Hg |
| Static Pressure | 0.32 "$H_2O$ |
| Meter Cal. Factor | 0.99 Y |
| Pitot Factor (cp) | 0.84 |
| Total Test Time | 21 min |
| Sample Time Interval | 7 min |
| Meter Volume (Vm) | 15.470 dcf |
| Water Volume | 60.0 ml |

Method 3A
%$O_2$ Average 2.7 %v dry
Orsat
%$CO_2$ Average 10.6 %v dry

Stack Dimensional Data:
Circular
Diameter 4.750 ft
Rectangular
Width 0.000 ft
Length 0.000 ft
Stack Area 17.721 sq.ft.

**Client:** CHS, Inc. - Laurel Refinery
**Source:** Boiler 11

**Test #:** 2-GF
**Date:** 05/06/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5975 "$H_2O$ |
| Avg Meter Temp. (Tm) | 59 °F | Avg Stack Temp. (Ts) | 267 °F |
| Avg Meter Temp. (Tm) | 519 °A (°R) | Avg Stack Temp. (Ts) | 727 °A (°R) |
| Pressure Meter (Pm) | 26.696 "Hg | Pressure Stack (Ps) | 26.564 "Hg |
| Standard Meter | | <u>Stack Gas:</u> | |
| Volume, Vm(std) | 13.904 dscf | Velocity (Vs) | 42.57 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 25.938 awcf | Volume (actual conditions) | 45,263.0 awcfm |
| Volume Water | | | 37,622.6 adcfm |
| Vapor, Vw(std) | 2.824 scf | Volume (std. conditions) | 1,751,159.8 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 29,186.0 wscfm |
| Moisture (Bws) | 0.1688 | | 1,455,564.0 dscf/hr |
| Percent Moisture | 16.88 %v | | 24,259.4 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.80 lb/lb-mole | | |
| Wet (Ms) | 27.81 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: Boiler 11
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 2
DATE: 5/6/10
START TIME: 930
END TIME: 951

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 29.94 BAROMETRIC PRESSURE ("Hg)

- 170 PITOT
- SR METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg)
- TRAIN LEAK TEST, ($ft^3$/min)
- .32 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- 15 PRE 14 POST
- 000 PRE 002 POST
- 57" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 35.180 | | | | | | | | | |
| 1 | X | | | 2.12 | 59 | 4 | — | 42 | 268 | 10.6 | |
| 2 | 14 | | | 2.12 | 59 | 4 | | 43 | 266 | | |
| 3 | 21 | 50.550 | | 2.12 | 59 | 4 | | 43 | 269 | | |
| | ~ | +15.470 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .33 | | | | | | 268 | | |
| 2 | | | .38 | | | | | | 268 | | |
| 3 | | | .39 | | | | | | 268 | | |
| 4 | | | .40 | | | | | | 267 | | |
| 5 | | | .41 | | | | | | 267 | | |
| 6 | | | .37 | | | | | | 267 | | |
| 7 | | | .30 | | | | | | 267 | | |
| 8 | | | .29 | | | | | | 267 | | |
| | | | | | | | | | | | |
| 1 | | | .32 | | | | | | 267 | | |
| 2 | | | .37 | | | | | | 266 | | |
| 3 | | | .38 | | | | | | 266 | | |
| 4 | | | .40 | | | | | | 266 | | |
| 5 | | | .40 | | | | | | 267 | | |
| 6 | | | .36 | | | | | | 267 | | |
| 7 | | | .33 | | | | | | 267 | | |
| 8 | | | .30 | | | | | | 267 | | |
| | | | | | | | | | | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | Cemex | RUN # | 2 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-6-10 |
| SOURCE TESTED: | B-11 | | |
| Weighed By: | DW | Balance Level: ✓ | Balance Zeroed: ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 660 |
| Initial Weight | 633 |
| Weight Gain | +27. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 638 |
| Initial Weight | 615 |
| Weight Gain | +23. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 492 |
| Initial Weight | 490 |
| Weight Gain | +2. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 849 |
| Initial Weight | 841 |
| Weight Gain | +8. |

**Total Mass of Moisture Captured:** +60. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **3-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:00-10:21** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 52.100 | 0.31 | 2.12 | 59 | 271 | 0.5568 |
| 2 | 14 | | 0.37 | 2.12 | 60 | 271 | 0.6083 |
| 3 | 21 | | 0.38 | 2.12 | 60 | 271 | 0.6164 |
| 4 | | 67.650 | 0.39 | | | 271 | 0.6245 |
| 5 | | | 0.41 | | | 271 | 0.6403 |
| 6 | | | 0.36 | | | 272 | 0.6000 |
| 7 | | | 0.31 | | | 272 | 0.5568 |
| 8 | | | 0.30 | | | 272 | 0.5477 |
| 1 | | | 0.32 | | | 272 | 0.5657 |
| 2 | | | 0.36 | | | 272 | 0.6000 |
| 3 | | | 0.37 | | | 273 | 0.6083 |
| 4 | | | 0.39 | | | 273 | 0.6245 |
| 5 | | | 0.40 | | | 273 | 0.6325 |
| 6 | | | 0.37 | | | 273 | 0.6083 |
| 7 | | | 0.30 | | | 273 | 0.5477 |
| 8 | | | 0.29 | | | 272 | 0.5385 |

## FIELD DATA INPUT: (CONTINUED)

| | |
|---|---|
| Barometric Pressure (Pb) | 26.54 "Hg |
| Static Pressure | 0.32 "$H_2O$ |
| Meter Cal. Factor | 0.99 Y |
| Pitot Factor (cp) | 0.84 |
| Total Test Time | 21 min |
| Sample Time Interval | 7 min |
| Meter Volume (Vm) | 15.550 dcf |
| Water Volume | 57.0 ml |

Method 3A
%$O_2$ Average 2.6 %v dry

Orsat
%$CO_2$ Average 10.7 %v dry

Stack Dimensional Data:
Circular
Diameter 4.750 ft
Rectangular
Width 0.000 ft
Length 0.000 ft
Stack Area 17.721 sq.ft.

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 3-GF
**Source:** Boiler 11 **Date:** 05/06/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5923 "$H_2O$ |
| Avg Meter Temp. (Tm) | 60 °F | Avg Stack Temp. (Ts) | 272 °F |
| Avg Meter Temp. (Tm) | 520 °A (°R) | Avg Stack Temp. (Ts) | 732 °A (°R) |
| Pressure Meter (Pm) | 26.696 "Hg | Pressure Stack (Ps) | 26.564 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.949 dscf | Velocity (Vs) | 42.26 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 25.967 awcf | Volume (actual conditions) | 44,933.4 awcfm |
| Volume Water | | | 37,685.6 adcfm |
| Vapor, Vw(std) | 2.683 scf | Volume (std. conditions) | 1,726,533.2 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 28,775.6 wscfm |
| Moisture (Bws) | 0.1613 | | 1,448,043.4 dscf/hr |
| Percent Moisture | 16.13 %v | | 24,134.1 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.82 lb/lb-mole | | |
| Wet (Ms) | 27.91 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B11
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 3
DATE: 5/6/10
START TIME: 1000
END TIME: 1021

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- ✓ BAROMETRIC PRESSURE ("Hg) 26.41

PITOT 170
METER BOX 88
Y FACTOR .99
TRAIN LEAK TEST VACUUM, ("Hg) 15
TRAIN LEAK TEST, ($ft^3$/min) 001
STATIC PRESSURE ("H2O) .32

NOZZLE # 21 TEST TIME
NOZZLE DIA.
T/C READOUT M
PRE 12 POST
PRE 003 POST
STACK DIMENSIONS 5"

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 52.100 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 59 | 4 | — | 43 | 271 | 10.7 | |
| 2 | 14 | | | 2.12 | 60 | 4 | | 43 | 273 | | |
| 3 | 21 | 60.650 | | 2.12 | 60 | 4 | | 43 | 271 | | |
| | | + 15.550 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .31 | | | | | | 271 | | |
| 2 | | | .37 | | | | | | 271 | | |
| 3 | | | .38 | | | | | | 271 | | |
| 4 | | | .39 | | | | | | 271 | | |
| 5 | | | .41 | | | | | | 271 | | |
| 6 | | | .36 | | | | | | 272 | | |
| 7 | | | .31 | | | | | | 272 | | |
| 8 | | | .30 | | | | | | 272 | | |
| | | | | | | | | | | | |
| 1 | | | .32 | | | | | | 272 | | |
| 2 | | | .36 | | | | | | 272 | | |
| 3 | | | .37 | | | | | | 273 | | |
| 4 | | | .39 | | | | | | 273 | | |
| 5 | | | .40 | | | | | | 273 | | |
| 6 | | | .37 | | | | | | 273 | | |
| 7 | | | .30 | | | | | | 273 | | |
| 8 | | | .29 | | | | | | 272 | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | Cenex | RUN # | 3 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-6-10 |
| SOURCE TESTED: | B-11 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 685 |
| Initial Weight | 651 |
| Weight Gain | +34. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 670 |
| Initial Weight | 655 |
| Weight Gain | +15. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 503 |
| Initial Weight | 502 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 837 |
| Initial Weight | 830 |
| Weight Gain | +7. |

**Total Mass of Moisture Captured:** +57. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **4-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:30-10:51** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 69.100 | 0.32 | 2.12 | 60 | 268 | 0.5657 |
| 2 | 14 | | 0.36 | 2.12 | 60 | 268 | 0.6000 |
| 3 | 21 | | 0.38 | 2.12 | 61 | 268 | 0.6164 |
| 4 | | 84.810 | 0.41 | | | 268 | 0.6403 |
| 5 | | | 0.41 | | | 267 | 0.6403 |
| 6 | | | 0.37 | | | 267 | 0.6083 |
| 7 | | | 0.30 | | | 267 | 0.5477 |
| 8 | | | 0.31 | | | 268 | 0.5568 |
| 1 | | | 0.32 | | | 268 | 0.5657 |
| 2 | | | 0.37 | | | 268 | 0.6083 |
| 3 | | | 0.39 | | | 268 | 0.6245 |
| 4 | | | 0.41 | | | 269 | 0.6403 |
| 5 | | | 0.40 | | | 269 | 0.6325 |
| 6 | | | 0.36 | | | 269 | 0.6000 |
| 7 | | | 0.32 | | | 269 | 0.5657 |
| 8 | | | 0.30 | | | 269 | 0.5477 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.54 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.32 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.710 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 59.0 ml | | |

Method 3A
%$O_2$ Average 2.6 %v dry
Orsat
%$CO_2$ Average 10.7 %v dry

**Client:** CHS, Inc. - Laurel Refinery
**Source:** Boiler 11

**Test #:** 4-GF
**Date:** 05/06/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5975 "$H_2O$ |
| Avg Meter Temp. (Tm) | 60 °F | Avg Stack Temp. (Ts) | 268 °F |
| Avg Meter Temp. (Tm) | 520 °A (°R) | Avg Stack Temp. (Ts) | 728 °A (°R) |
| Pressure Meter (Pm) | 26.696 "Hg | Pressure Stack (Ps) | 26.564 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.093 dscf | Velocity (Vs) | 42.55 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 26.194 awcf | Volume (actual conditions) | 45,241.7 awcfm |
| Volume Water | | | 37,794.9 adcfm |
| Vapor, Vw(std) | 2.777 scf | Volume (std. conditions) | 1,747,932.7 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 29,132.2 wscfm |
| Moisture (Bws) | 0.1646 | | 1,460,223.0 dscf/hr |
| Percent Moisture | 16.46 %v | | 24,337.1 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.82 lb/lb-mole | | |
| Wet (Ms) | 27.87 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B11
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 4
DATE: 5/6/10
START TIME: 1030
END TIME: 1051

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.54 BAROMETRIC PRESSURE ("Hg)

- 170 PITOT
- .98 METER BOX
- .99 Y FACTOR
- .32 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 12 POST
- TRAIN LEAK TEST, ($ft^3$/min) 000 PRE 002 POST
- 5X11 STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 69.180 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 60 | 4 | — | 42 | 265 | 10.7 | |
| 2 | 14 | | | 2.12 | 60 | 4 | | 42 | 268 | | |
| 3 | 21 | 84.810 | | 2.12 | 61 | 4 | | 43 | 269 | | |
| | | +15.210 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .32 | | | | | | 268 | | |
| 2 | | | .36 | | | | | | 268 | | |
| 3 | | | .38 | | | | | | 268 | | |
| 4 | | | .41 | | | | | | 268 | | |
| 5 | | | .41 | | | | | | 267 | | |
| 6 | | | .37 | | | | | | 267 | | |
| 7 | | | .30 | | | | | | 267 | | |
| 8 | | | .31 | | | | | | 268 | | |
| | | | | | | | | | | | |
| 1 | | | .32 | | | | | | 268 | | |
| 2 | | | .37 | | | | | | 268 | | |
| 3 | | | .39 | | | | | | 268 | | |
| 4 | | | .41 | | | | | | 269 | | |
| 5 | | | .40 | | | | | | 269 | | |
| 6 | | | .36 | | | | | | 269 | | |
| 7 | | | .32 | | | | | | 269 | | |
| 8 | | | .30 | | | | | | 269 | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | Cemex | RUN # | 4 |
| PLANT LOCATION: | Lavre | TEST DATE: | 5-6-10 |
| SOURCE TESTED: | B-11 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| Balance Zeroed: | ✓ | | |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 691 |
| Initial Weight | 660 |
| Weight Gain | +31. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 656 |
| Initial Weight | 638 |
| Weight Gain | +18. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 493 |
| Initial Weight | 492 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 858 |
| Initial Weight | 849 |
| Weight Gain | +9. |

**Total Mass of Moisture Captured:** +59. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **5-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:00-11:21** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 86.400 | 0.32 | 2.12 | 61 | 263 | 0.5657 |
| 2 | 14 | | 0.37 | 2.12 | 62 | 263 | 0.6083 |
| 3 | 21 | | 0.39 | 2.12 | 62 | 263 | 0.6245 |
| 4 | | 102.090 | 0.40 | | | 264 | 0.6325 |
| 5 | | | 0.41 | | | 264 | 0.6403 |
| 6 | | | 0.39 | | | 264 | 0.6245 |
| 7 | | | 0.31 | | | 264 | 0.5568 |
| 8 | | | 0.30 | | | 264 | 0.5477 |
| 1 | | | 0.31 | | | 264 | 0.5568 |
| 2 | | | 0.36 | | | 264 | 0.6000 |
| 3 | | | 0.38 | | | 263 | 0.6164 |
| 4 | | | 0.41 | | | 263 | 0.6403 |
| 5 | | | 0.41 | | | 263 | 0.6403 |
| 6 | | | 0.37 | | | 263 | 0.6083 |
| 7 | | | 0.31 | | | 263 | 0.5568 |
| 8 | | | 0.30 | | | 263 | 0.5477 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.54 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.32 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.690 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 61.0 ml | | |

| | |
|---|---|
| Method 3A | |
| %$O_2$ Average | 2.7 %v dry |
| Orsat | |
| %$CO_2$ Average | 10.8 %v dry |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **5-GF** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5979 "$H_2O$ |
| Avg Meter Temp. (Tm) | 62 °F | Avg Stack Temp. (Ts) | 263 °F |
| Avg Meter Temp. (Tm) | 522 °A (°R) | Avg Stack Temp. (Ts) | 723 °A (°R) |
| Pressure Meter (Pm) | 26.696 "Hg | Pressure Stack (Ps) | 26.564 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.021 dscf | Velocity (Vs) | 42.46 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 26.050 awcf | Volume (actual conditions) | 45,146.0 awcfm |
| Volume Water | | | 37,471.2 adcfm |
| Vapor, Vw(std) | 2.871 scf | Volume (std. conditions) | 1,756,298.1 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 29,271.6 wscfm |
| Moisture (Bws) | 0.1700 | | 1,457,727.4 dscf/hr |
| Percent Moisture | 17.00 %v | | 24,295.5 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.84 lb/lb-mole | | |
| Wet (Ms) | 27.83 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B11
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 5
DATE: 5/6/10
START TIME: 1100
END TIME: 1121

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.24 BAROMETRIC PRESSURE ("Hg)

- 120 PITOT
- 3R METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg)
- TRAIN LEAK TEST, ($ft^3$/min)
- .32 STATIC PRESSURE ("H2O)

- ——— NOZZLE # 21 TEST TIME
- ——— NOZZLE DIA.
- M T/C READOUT
- PRE 15 POST 15
- PRE .001 POST .003
- 5'2" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 86.400 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 61 | 4 | ——— | 43 | 262 | 10.8 | |
| 2 | 14 | | | 2.12 | 62 | 4 | | 43 | 262 | | |
| 3 | 21 | 102.090 | | 2.12 | 62 | 4 | | 44 | 264 | | |
| | | +15.690 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .32 | | | | | | 263 | | |
| 2 | | | .37 | | | | | | 263 | | |
| 3 | | | .39 | | | | | | 263 | | |
| 4 | | | .40 | | | | | | 264 | | |
| 5 | | | .41 | | | | | | 264 | | |
| 6 | | | .39 | | | | | | 264 | | |
| 7 | | | .31 | | | | | | 264 | | |
| 8 | | | .30 | | | | | | 264 | | |
| | | | | | | | | | | | |
| 1 | | | .31 | | | | | | 264 | | |
| 2 | | | .36 | | | | | | 264 | | |
| 3 | | | .38 | | | | | | 263 | | |
| 4 | | | .41 | | | | | | 263 | | |
| 5 | | | .41 | | | | | | 263 | | |
| 6 | | | .32 | | | | | | 263 | | |
| 7 | | | .31 | | | | | | 263 | | |
| 8 | | | .30 | | | | | | 263 | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | cemex | RUN # | 5 |
| PLANT LOCATION: | Lauvel | TEST DATE: | 5-6-10 |
| SOURCE TESTED: | B-11 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| Balance Zeroed: | ✓ | | |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 653 |
| Initial Weight | 619 |
| Weight Gain | + 34. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 641 |
| Initial Weight | 621 |
| Weight Gain | + 20. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 500 |
| Initial Weight | 500 |
| Weight Gain | 0 |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 831 |
| Initial Weight | 824 |
| Weight Gain | + 7. |

**Total Mass of Moisture Captured:** + 61. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **6-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:30-11:51** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 103.600 | 0.31 | 2.12 | 62 | 265 | 0.5568 |
| 2 | 14 | | 0.37 | 2.12 | 63 | 265 | 0.6083 |
| 3 | 21 | | 0.38 | 2.12 | 63 | 265 | 0.6164 |
| 4 | | 119.380 | 0.39 | | | 265 | 0.6245 |
| 5 | | | 0.41 | | | 266 | 0.6403 |
| 6 | | | 0.37 | | | 265 | 0.6083 |
| 7 | | | 0.31 | | | 265 | 0.5568 |
| 8 | | | 0.31 | | | 265 | 0.5568 |
| 1 | | | 0.32 | | | 265 | 0.5657 |
| 2 | | | 0.36 | | | 265 | 0.6000 |
| 3 | | | 0.37 | | | 264 | 0.6083 |
| 4 | | | 0.40 | | | 264 | 0.6325 |
| 5 | | | 0.41 | | | 264 | 0.6403 |
| 6 | | | 0.38 | | | 264 | 0.6164 |
| 7 | | | 0.31 | | | 263 | 0.5568 |
| 8 | | | 0.30 | | | 263 | 0.5477 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.54 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.32 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.780 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 59.0 ml | | |

| | |
|---|---|
| Method 3A | |
| %$O_2$ Average | 2.8 %v dry |
| Orsat | |
| %$CO_2$ Average | 10.7 %v dry |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **6-GF** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5960 "$H_2O$ |
| Avg Meter Temp. (Tm) | 63 °F | Avg Stack Temp. (Ts) | 265 °F |
| Avg Meter Temp. (Tm) | 523 °A (°R) | Avg Stack Temp. (Ts) | 725 °A (°R) |
| Pressure Meter (Pm) | 26.696 "Hg | Pressure Stack (Ps) | 26.564 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.074 dscf | Velocity (Vs) | 42.35 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 26.058 awcf | Volume (actual conditions) | 45,029.1 awcfm |
| Volume Water | | | 37,608.3 adcfm |
| Vapor, Vw(std) | 2.777 scf | Volume (std. conditions) | 1,746,915.7 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 29,115.3 wscfm |
| Moisture (Bws) | 0.1648 | | 1,459,024.0 dscf/hr |
| Percent Moisture | 16.48 %v | | 24,317.1 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.82 lb/lb-mole | | |
| Wet (Ms) | 27.87 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B11
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 6
DATE: 5/6/10
START TIME: 1130
END TIME: 1151

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.9 BAROMETRIC PRESSURE ("Hg)

- 1.00 PITOT
- .88 METER BOX
- .99 Y FACTOR
- .32 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 13 POST
- TRAIN LEAK TEST, (ft³/min) .001 PRE .002 POST
- 52" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading (ft³) | Pitot Reading ^P( "H₂O) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 103.600 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 62 | 4 | — | 44 | 265 | 10.7 | |
| 2 | 14 | | | 2.12 | 63 | 4 | | 44 | 263 | | |
| 3 | 21 | 119.380 | | 2.12 | 63 | 4 | | 44 | 262 | | |
| | | +15.780 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .31 | | | | | | 265 | | |
| 2 | | | .32 | | | | | | 265 | | |
| 3 | | | .38 | | | | | | 265 | | |
| 4 | | | .39 | | | | | | 265 | | |
| 5 | | | .41 | | | | | | 266 | | |
| 6 | | | .37 | | | | | | 265 | | |
| 7 | | | .31 | | | | | | 265 | | |
| 8 | | | .31 | | | | | | 265 | | |
| | | | | | | | | | | | |
| 1 | | | .32 | | | | | | 265 | | |
| 2 | | | .36 | | | | | | 265 | | |
| 3 | | | .37 | | | | | | 264 | | |
| 4 | | | .40 | | | | | | 264 | | |
| 5 | | | .41 | | | | | | 264 | | |
| 6 | | | .38 | | | | | | 264 | | |
| 7 | | | .31 | | | | | | 263 | | |
| 8 | | | .30 | | | | | | 263 | | |
| | | | | | | | | | | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | Cemex | RUN # | 6 |
| PLANT LOCATION: | Lavre | TEST DATE: | 5-6-10 |
| SOURCE TESTED: | B-11 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| Balance Zeroed: | ✓ | | |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 638 |
| Initial Weight | 612 |
| Weight Gain | +26. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 644 |
| Initial Weight | 622 |
| Weight Gain | +22. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 494 |
| Initial Weight | 493 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 841 |
| Initial Weight | 831 |
| Weight Gain | +10. |

**Total Mass of Moisture Captured:** +59. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **7-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:00-12:21** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 120.900 | 0.33 | 2.12 | 63 | 267 | 0.5745 |
| 2 | 14 | | 0.37 | 2.12 | 64 | 267 | 0.6083 |
| 3 | 21 | | 0.39 | 2.12 | 64 | 267 | 0.6245 |
| 4 | | 136.530 | 0.40 | | | 268 | 0.6325 |
| 5 | | | 0.41 | | | 268 | 0.6403 |
| 6 | | | 0.36 | | | 268 | 0.6000 |
| 7 | | | 0.31 | | | 268 | 0.5568 |
| 8 | | | 0.30 | | | 269 | 0.5477 |
| 1 | | | 0.32 | | | 269 | 0.5657 |
| 2 | | | 0.37 | | | 268 | 0.6083 |
| 3 | | | 0.38 | | | 268 | 0.6164 |
| 4 | | | 0.41 | | | 267 | 0.6403 |
| 5 | | | 0.41 | | | 267 | 0.6403 |
| 6 | | | 0.36 | | | 267 | 0.6000 |
| 7 | | | 0.33 | | | 267 | 0.5745 |
| 8 | | | 0.30 | | | 267 | 0.5477 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.54 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.32 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.630 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 57.0 ml | | |

Method 3A
%$O_2$ Average 2.8 %v dry
Orsat
%$CO_2$ Average 10.6 %v dry

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 7-GF
**Source:** Boiler 11 **Date:** 05/06/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5986 "$H_2O$ |
| Avg Meter Temp. (Tm) | 64 °F | Avg Stack Temp. (Ts) | 268 °F |
| Avg Meter Temp. (Tm) | 524 °A (°R) | Avg Stack Temp. (Ts) | 728 °A (°R) |
| Pressure Meter (Pm) | 26.696 "Hg | Pressure Stack (Ps) | 26.564 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.914 dscf | Velocity (Vs) | 42.60 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 25.772 awcf | Volume (actual conditions) | 45,294.9 awcfm |
| Volume Water | | | 37,970.7 adcfm |
| Vapor, Vw(std) | 2.683 scf | Volume (std. conditions) | 1,749,986.7 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 29,166.4 wscfm |
| Moisture (Bws) | 0.1617 | | 1,467,013.9 dscf/hr |
| Percent Moisture | 16.17 %v | | 24,450.2 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.81 lb/lb-mole | | |
| Wet (Ms) | 27.90 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B11
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 2
DATE: 5/6/10
START TIME: 1200
END TIME: 1221

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.94 BAROMETRIC PRESSURE ("Hg)
- 170 PITOT
- 4B METER BOX
- .99 Y FACTOR
- .32 STATIC PRESSURE ("H2O)
- ___ NOZZLE # 21 TEST TIME
- ___ NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 14 POST
- TRAIN LEAK TEST, ($ft^3$/min) 000 PRE 003 POST
- SXM STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 120.908 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 63 | 4 | ——— | 44 | 269 | 10.6 | |
| 2 | 14 | | | 2.12 | 64 | 4 | | 43 | 268 | | |
| 3 | 21 | 136.530 | | 2.12 | 64 | 4 | | 43 | 265 | | |
| | | +15.630 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .33 | | | | | | 267 | | |
| 2 | | | .37 | | | | | | 267 | | |
| 3 | | | .39 | | | | | | 267 | | |
| 4 | | | .40 | | | | | | 268 | | |
| 5 | | | .41 | | | | | | 268 | | |
| 6 | | | .36 | | | | | | 268 | | |
| 7 | | | .31 | | | | | | 268 | | |
| 8 | | | .30 | | | | | | 269 | | |
| | | | | | | | | | | | |
| 1 | | | .32 | | | | | | 269 | | |
| 2 | | | .37 | | | | | | 268 | | |
| 3 | | | .38 | | | | | | 268 | | |
| 4 | | | .41 | | | | | | 267 | | |
| 5 | | | .41 | | | | | | 267 | | |
| 6 | | | .36 | | | | | | 267 | | |
| 7 | | | .33 | | | | | | 267 | | |
| 8 | | | .30 | | | | | | 267 | | |
| | | | | | | | | | | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | Cenex | RUN # | 7 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-6-10 |
| SOURCE TESTED: | B-11 | | |
| Weighed By: | DW | Balance Level: | / |
| | | Balance Zeroed: | / |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 687 |
| Initial Weight | 653 |
| Weight Gain | +34. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 654 |
| Initial Weight | 641 |
| Weight Gain | +13. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 502 |
| Initial Weight | 500 |
| Weight Gain | +2. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 839 |
| Initial Weight | 831 |
| Weight Gain | +8. |

**Total Mass of Moisture Captured:** +57. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **8-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:30-12:51** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 138.100 | 0.32 | 2.12 | 65 | 263 | 0.5657 |
| 2 | 14 | | 0.36 | 2.12 | 65 | 263 | 0.6000 |
| 3 | 21 | | 0.39 | 2.12 | 65 | 263 | 0.6245 |
| 4 | | 153.780 | 0.40 | | | 263 | 0.6325 |
| 5 | | | 0.41 | | | 264 | 0.6403 |
| 6 | | | 0.37 | | | 264 | 0.6083 |
| 7 | | | 0.31 | | | 264 | 0.5568 |
| 8 | | | 0.31 | | | 264 | 0.5568 |
| 1 | | | 0.31 | | | 264 | 0.5568 |
| 2 | | | 0.37 | | | 264 | 0.6083 |
| 3 | | | 0.38 | | | 264 | 0.6164 |
| 4 | | | 0.39 | | | 264 | 0.6245 |
| 5 | | | 0.40 | | | 265 | 0.6325 |
| 6 | | | 0.38 | | | 265 | 0.6164 |
| 7 | | | 0.30 | | | 265 | 0.5477 |
| 8 | | | 0.31 | | | 265 | 0.5568 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.54 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.32 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.680 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 60.0 ml | | |

Method 3A
%$O_2$ Average 2.8 %v dry
Orsat
%$CO_2$ Average 10.7 %v dry

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 8-GF
**Source:** Boiler 11 **Date:** 05/06/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5965 "$H_2O$ |
| Avg Meter Temp. (Tm) | 65 °F | Avg Stack Temp. (Ts) | 264 °F |
| Avg Meter Temp. (Tm) | 525 °A (°R) | Avg Stack Temp. (Ts) | 724 °A (°R) |
| Pressure Meter (Pm) | 26.696 "Hg | Pressure Stack (Ps) | 26.564 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.932 dscf | Velocity (Vs) | 42.39 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 25.873 awcf | Volume (actual conditions) | 45,071.6 awcfm |
| Volume Water | | | 37,477.0 adcfm |
| Vapor, Vw(std) | 2.824 scf | Volume (std. conditions) | 1,750,980.8 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 29,183.0 wscfm |
| Moisture (Bws) | 0.1685 | | 1,455,940.5 dscf/hr |
| Percent Moisture | 16.85 %v | | 24,265.7 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.82 lb/lb-mole | | |
| Wet (Ms) | 27.83 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B11
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 8
DATE: 5/6/10
START TIME: 1230
END TIME: 1251

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.54 BAROMETRIC PRESSURE ("Hg)
- 1.00 PITOT
- .86 METER BOX
- .99 Y FACTOR
- .32 STATIC PRESSURE ("H2O)
- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 13 POST
- TRAIN LEAK TEST, ($ft^3$/min) .001 PRE .002 POST
- 5x11 STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 138.100 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 65 | 4 | — | 42 | 265 | 10.2 | |
| 2 | 14 | | | 2.12 | 65 | 4 | | 43 | 263 | | |
| 3 | 21 | 153.780 | | 2.12 | 65 | 4 | | 43 | 266 | | |
| | | +15.680 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .32 | | | | | | 263 | | |
| 2 | | | .36 | | | | | | 263 | | |
| 3 | | | .39 | | | | | | 263 | | |
| 4 | | | .40 | | | | | | 263 | | |
| 5 | | | .41 | | | | | | 264 | | |
| 6 | | | .37 | | | | | | 264 | | |
| 7 | | | .31 | | | | | | 264 | | |
| 8 | | | .31 | | | | | | 264 | | |
| | | | | | | | | | | | |
| 1 | | | .31 | | | | | | 264 | | |
| 2 | | | .37 | | | | | | 264 | | |
| 3 | | | .38 | | | | | | 264 | | |
| 4 | | | .39 | | | | | | 264 | | |
| 5 | | | .40 | | | | | | 265 | | |
| 6 | | | .38 | | | | | | 265 | | |
| 7 | | | .30 | | | | | | 265 | | |
| 8 | | | .31 | | | | | | 265 | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | Cemex | RUN # | 8 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-6-10 |
| SOURCE TESTED: | B-11 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 668 |
| Initial Weight | 638 |
| Weight Gain | + 30. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 666 |
| Initial Weight | 644 |
| Weight Gain | + 22. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 495 |
| Initial Weight | 494 |
| Weight Gain | + 1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 848 |
| Initial Weight | 841 |
| Weight Gain | + 7. |

**Total Mass of Moisture Captured:** + 60. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4**
**Field Data & Calculations**
**Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **9-GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:00-13:21** |
| **Source:** | **Boiler 11** | **Date:** | **05/06/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 155.300 | 0.31 | 2.12 | 65 | 266 | 0.5568 |
| 2 | 14 | | 0.36 | 2.12 | 66 | 266 | 0.6000 |
| 3 | 21 | | 0.38 | 2.12 | 66 | 266 | 0.6164 |
| 4 | | 170.890 | 0.40 | | | 266 | 0.6325 |
| 5 | | | 0.41 | | | 267 | 0.6403 |
| 6 | | | 0.38 | | | 267 | 0.6164 |
| 7 | | | 0.30 | | | 266 | 0.5477 |
| 8 | | | 0.31 | | | 266 | 0.5568 |
| 1 | | | 0.32 | | | 266 | 0.5657 |
| 2 | | | 0.37 | | | 265 | 0.6083 |
| 3 | | | 0.38 | | | 265 | 0.6164 |
| 4 | | | 0.39 | | | 265 | 0.6245 |
| 5 | | | 0.40 | | | 265 | 0.6325 |
| 6 | | | 0.37 | | | 264 | 0.6083 |
| 7 | | | 0.30 | | | 264 | 0.5477 |
| 8 | | | 0.30 | | | 264 | 0.5477 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.54 "Hg | Stack Dimensional Data: | |
| Static Pressure | 0.32 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 4.750 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.590 dcf | Stack Area | 17.721 sq.ft. |
| Water Volume | 58.0 ml | | |

Method 3A
%$O_2$ Average 2.8 %v dry

Orsat
%$CO_2$ Average 10.8 %v dry

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 9-GF
**Source:** Boiler 11 **Date:** 05/06/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5949 "$H_2O$ |
| Avg Meter Temp. (Tm) | 66 °F | Avg Stack Temp. (Ts) | 266 °F |
| Avg Meter Temp. (Tm) | 526 °A (°R) | Avg Stack Temp. (Ts) | 726 °A (°R) |
| Pressure Meter (Pm) | 26.696 "Hg | Pressure Stack (Ps) | 26.564 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.826 dscf | Velocity (Vs) | 42.29 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 25.636 awcf | Volume (actual conditions) | 44,965.3 awcfm |
| | | | 37,550.5 adcfm |
| Volume Water | | | |
| Vapor, Vw(std) | 2.730 scf | Volume (std. conditions) | 1,742,037.9 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 29,034.0 wscfm |
| Moisture (Bws) | 0.1649 | | 1,454,775.9 dscf/hr |
| Percent Moisture | 16.49 %v | | 24,246.3 dscfm |
| Gas Density | | | |
| Dry (Md) | 29.84 lb/lb-mole | | |
| Wet (Ms) | 27.89 lb/lb-mole | | |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B11
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 9
DATE: 5/6/10
START TIME: 1300
END TIME: 1321

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.54 BAROMETRIC PRESSURE ("Hg)
- 170 PITOT
- BR METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg)
- TRAIN LEAK TEST, (ft³/min)
- .32 STATIC PRESSURE ("H2O)
- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- 15 PRE 14 POST
- 000 PRE 002 POST
- 32" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading (ft³) | Pitot Reading ^P( "H2O) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 155.300 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 65 | 4 | — | 43 | 267 | 10.8 | |
| 2 | 14 | | | 2.12 | 66 | 4 | | 43 | 266 | | |
| 3 | 21 | 170.890 | | 2.12 | 66 | 4 | | 43 | 264 | | |
| | | +15.590 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .31 | | | | | | 266 | | |
| 2 | | | .36 | | | | | | 266 | | |
| 3 | | | .38 | | | | | | 266 | | |
| 4 | | | .40 | | | | | | 266 | | |
| 5 | | | .41 | | | | | | 267 | | |
| 6 | | | .38 | | | | | | 267 | | |
| 7 | | | .30 | | | | | | 266 | | |
| 8 | | | .31 | | | | | | 266 | | |
| | | | | | | | | | | | |
| 1 | | | .32 | | | | | | 266 | | |
| 2 | | | .37 | | | | | | 265 | | |
| 3 | | | .38 | | | | | | 265 | | |
| 4 | | | .39 | | | | | | 265 | | |
| 5 | | | .40 | | | | | | 265 | | |
| 6 | | | .37 | | | | | | 264 | | |
| 7 | | | .30 | | | | | | 264 | | |
| 8 | | | .30 | | | | | | 264 | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | cemex | RUN # | 9 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-6-10 |
| SOURCE TESTED: | B-11 | | |
| Weighed By: | DW | Balance Level: ✓ | Balance Zeroed: ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 669 |
| Initial Weight | 633 |
| Weight Gain | +36. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 650 |
| Initial Weight | 637 |
| Weight Gain | +13. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 501 |
| Initial Weight | 499 |
| Weight Gain | +2. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 832 |
| Initial Weight | 825 |
| Weight Gain | +7. |

**Total Mass of Moisture Captured:** +58. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 imf

# ORSAT SHEET

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: B-11
TEST DATE: 5/6/10

| | Gas | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| Run # 1 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.2 | 10.6 | 10.2 | 10.2 |
| | $O_2$ | | | | |
| Run # 2 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.2 | 10.6 | 10.6 | 10.6 |
| | $O_2$ | | | | |
| Run # 3 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.2 | 10.2 | 10.2 | 10.2 |
| | $O_2$ | | | | |
| Run # 4 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.2 | 10.2 | 10.2 | 10.2 |
| | $O_2$ | | | | |
| Run # 5 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.2 | 10.8 | 10.8 | 10.8 |
| | $O_2$ | | | | |
| Run # 6 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.2 | 10.6 | 10.2 | 10.2 |
| | $O_2$ | | | | |
| Run # 7 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.2 | 10.6 | 10.6 | 10.6 |
| | $O_2$ | | | | |
| Run # 8 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.2 | 10.2 | 10.8 | 10.2 |
| | $O_2$ | | | | |
| Run # 9 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 10.8 | 10.8 | 10.2 | 10.8 |
| | $O_2$ | | | | |
| Run # | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | | | | |
| | $O_2$ | | | | |

Notes:

WorldDrive01:\Forms\Forms\Orsat3.xls
Revised 4/12/07 jmf

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **1-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:30-09:51** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 9:30 | 2.4 | 2.5 | 29.3 |
| 2 | 9:31 | 2.4 | 2.8 | 28.8 |
| 3 | 9:32 | 2.4 | 2.6 | 28.9 |
| 4 | 9:33 | 2.2 | 2.8 | 29.4 |
| 5 | 9:34 | 2.2 | 2.8 | 30.2 |
| 6 | 9:35 | 1.8 | 2.8 | 29.2 |
| 7 | 9:36 | 2.0 | 2.8 | 29.9 |
| 8 | 9:37 | 1.9 | 2.7 | 30.1 |
| 9 | 9:38 | 2.0 | 2.7 | 29.1 |
| 10 | 9:39 | 2.1 | 2.7 | 28.8 |
| 11 | 9:40 | 2.1 | 2.6 | 29.0 |
| 12 | 9:41 | 1.6 | 2.5 | 29.6 |
| 13 | 9:42 | 1.7 | 2.8 | 31.3 |
| 14 | 9:43 | 1.7 | 2.5 | 30.3 |
| 15 | 9:44 | 2.1 | 2.8 | 29.6 |
| 16 | 9:45 | 1.8 | 3.0 | 30.1 |
| 17 | 9:46 | 2.1 | 2.8 | 29.2 |
| 18 | 9:47 | 2.3 | 2.7 | 30.3 |
| 19 | 9:48 | 1.6 | 2.7 | 30.0 |
| 20 | 9:49 | 1.5 | 2.6 | 29.7 |
| 21 | 9:50 | 1.6 | 2.6 | 30.4 |
| 22 | 9:51 | 1.6 | 2.6 | 30.0 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **1.96** | **2.70** | **29.69** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 1-COO2NOx
**Source :** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0 | 0.1 | 0.1 |
| 8:31 | 44.4 | 44.3 | -0.1 |
| 8:35 | 98.0 | 97.5 | -0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 8:44 | 0 | 0.2 | 0.2 |
| 8:42 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:53 | 0 | 0.2 | 0.2 | 0.0 |
| 9:55 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.0 | 0.0 |
| 8:31 | 8.51 | 8.5 | 0.0 |
| 8:35 | 20.5 | 20.6 | 0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 8:44 | 0.0 | 0.1 | 0.5 |
| 8:42 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:53 | 0.0 | 0.1 | 0.5 | 0.0 |
| 9:55 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 28 | 25 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 1-COO2NOx
**Source:** Zone D H1001 **Date:** 05/10/10

**Instrument Calibration Checks - continued**

$NO_x$ Instrument Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.2 | 0.2 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 8:49 | 0.0 | 0.2 | 0.2 |
| 8:47 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 9:53 | 0.0 | 0.2 | 0.2 | 0.0 |
| 9:57 | 51.5 | 51.2 | -0.3 | -0.1 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 36 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.42 "Hg |
| Static Pressure | -0.15 "$H_2O$ |
| Ps | 26.409 "Hg |
| Gas Flow | 46,889.0 adcfm |
| Avg. Stack Temp, Ts | 352 °F |
| | 812 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole Act Conditions | 671.267 ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.2 PPH |
| $NO_x$ | 5.7 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 1.96 ppm v/v d |
| $O_2$ | 2.70 % v/v d |
| NOx | 29.69 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 1.8 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 29.7 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 1.8 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **2-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:00-10:21** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 10:00 | 1.5 | 2.7 | 30.2 |
| 2 | 10:01 | 1.6 | 2.6 | 29.9 |
| 3 | 10:02 | 2.1 | 2.6 | 30.7 |
| 4 | 10:03 | 2.2 | 2.7 | 30.5 |
| 5 | 10:04 | 1.9 | 2.6 | 31.0 |
| 6 | 10:05 | 2.2 | 2.5 | 30.6 |
| 7 | 10:06 | 1.5 | 2.6 | 30.8 |
| 8 | 10:07 | 2.1 | 2.9 | 31.9 |
| 9 | 10:08 | 1.9 | 2.7 | 31.7 |
| 10 | 10:09 | 2.2 | 2.7 | 31.7 |
| 11 | 10:10 | 2.2 | 2.6 | 30.0 |
| 12 | 10:11 | 1.6 | 2.4 | 30.0 |
| 13 | 10:12 | 1.8 | 2.7 | 29.7 |
| 14 | 10:13 | 2.3 | 2.8 | 28.8 |
| 15 | 10:14 | 2.2 | 2.7 | 29.5 |
| 16 | 10:15 | 1.5 | 2.7 | 29.6 |
| 17 | 10:16 | 1.9 | 2.7 | 31.0 |
| 18 | 10:17 | 1.6 | 2.7 | 30.5 |
| 19 | 10:18 | 1.9 | 2.9 | 30.4 |
| 20 | 10:19 | 1.5 | 2.8 | 29.4 |
| 21 | 10:20 | 2.3 | 2.7 | 30.3 |
| 22 | 10:21 | 2.1 | 2.7 | 28.9 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **1.91** | **2.68** | **30.32** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 2-COO2NOx
**Source :** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0 | 0.2 | 0.2 |
| 8:31 | 44.4 | 44.3 | -0.1 |
| 8:35 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:53 | 0 | 0.2 | 0.2 |
| 9:55 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:23 | 0 | 0.2 | 0.2 | 0.0 |
| 10:25 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.0 | 0.0 |
| 8:31 | 8.51 | 8.5 | 0.0 |
| 8:35 | 20.5 | 20.6 | 0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:53 | 0.0 | 0.1 | 0.5 |
| 9:55 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:23 | 0.0 | 0.1 | 0.5 | 0.0 |
| 10:25 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 28 | 25 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 2-COO2NOx
**Source:** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.2 | 0.2 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 9:53 | 0.0 | 0.2 | 0.2 |
| 9:57 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:23 | 0.0 | 0.2 | 0.2 | 0.0 |
| 10:27 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 36 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.42 "Hg |
| Static Pressure | -0.15 "$H_2O$ |
| Ps | 26.409 "Hg |
| Gas Flow | 46,889.0 adcfm |
| Avg. Stack Temp, Ts | 352 °F |
| | 812 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole Act Conditions | 671.267 ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.2 PPH |
| $NO_x$ | 5.9 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 1.91 ppm v/v d |
| $O_2$ | 2.68 % v/v d |
| NOx | 30.32 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 1.7 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 30.4 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 1.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **3-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:30-10:51** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 10:30 | 1.9 | 2.7 | 29.3 |
| 2 | 10:31 | 1.5 | 2.8 | 29.6 |
| 3 | 10:32 | 1.6 | 2.7 | 30.2 |
| 4 | 10:33 | 1.9 | 2.6 | 29.1 |
| 5 | 10:34 | 1.9 | 2.6 | 29.2 |
| 6 | 10:35 | 2.1 | 2.5 | 29.9 |
| 7 | 10:36 | 1.7 | 2.3 | 28.7 |
| 8 | 10:37 | 1.6 | 2.5 | 28.1 |
| 9 | 10:38 | 1.6 | 2.4 | 28.0 |
| 10 | 10:39 | 1.9 | 2.6 | 30.4 |
| 11 | 10:40 | 2.3 | 3.0 | 28.9 |
| 12 | 10:41 | 1.8 | 2.7 | 29.8 |
| 13 | 10:42 | 2.3 | 2.9 | 30.0 |
| 14 | 10:43 | 2.2 | 3.5 | 30.0 |
| 15 | 10:44 | 1.9 | 4.0 | 29.5 |
| 16 | 10:45 | 2.2 | 3.8 | 30.4 |
| 17 | 10:46 | 1.8 | 3.6 | 29.6 |
| 18 | 10:47 | 2.1 | 3.2 | 30.2 |
| 19 | 10:48 | 1.9 | 3.0 | 29.6 |
| 20 | 10:49 | 1.7 | 2.8 | 30.4 |
| 21 | 10:50 | 2.0 | 2.7 | 29.2 |
| 22 | 10:51 | 2.3 | 2.8 | 30.3 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **1.92** | **2.90** | **29.56** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 3-COO2NOx
**Source :** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0 | 0.2 | 0.2 |
| 8:31 | 44.4 | 44.3 | -0.1 |
| 8:35 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:23 | 0 | 0.2 | 0.2 |
| 10:25 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:53 | 0 | 0.3 | 0.3 | 0.1 |
| 10:55 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.0 | 0.0 |
| 8:31 | 8.51 | 8.5 | 0.0 |
| 8:35 | 20.5 | 20.6 | 0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:23 | 0.0 | 0.1 | 0.5 |
| 10:25 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:53 | 0.0 | 0.1 | 0.5 | 0.0 |
| 10:55 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 28 | 25 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 3-COO2NOx
**Source:** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.2 | 0.2 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:23 | 0.0 | 0.2 | 0.2 |
| 10:27 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 10:53 | 0.0 | 0.2 | 0.2 | 0.0 |
| 10:57 | 51.5 | 51.3 | -0.2 | 0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 36 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.42 "Hg |
| Static Pressure | -0.15 "$H_2O$ |
| Ps | 26.409 "Hg |
| Gas Flow | 46,806.5 adcfm |
| Avg. Stack Temp, Ts | 347 °F |
| | 807 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole Act Conditions | 667.133 ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.2 PPH |
| $NO_x$ | 5.7 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 1.92 ppm v/v d |
| $O_2$ | 2.90 % v/v d |
| NOx | 29.56 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 1.7 ppm v/v d |
| $O_2$ | 2.8 % v/v d |
| $NO_x$ | 29.6 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 1.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **4-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:00-11:21** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 11:00 | 2.2 | 3.0 | 28.9 |
| 2 | 11:01 | 2.2 | 2.8 | 29.4 |
| 3 | 11:02 | 1.8 | 2.9 | 29.2 |
| 4 | 11:03 | 1.8 | 2.7 | 29.5 |
| 5 | 11:04 | 2.0 | 2.5 | 29.3 |
| 6 | 11:05 | 2.0 | 2.6 | 29.3 |
| 7 | 11:06 | 2.2 | 2.6 | 28.9 |
| 8 | 11:07 | 1.9 | 2.5 | 28.9 |
| 9 | 11:08 | 1.8 | 2.5 | 29.0 |
| 10 | 11:09 | 2.0 | 2.5 | 29.7 |
| 11 | 11:10 | 2.0 | 2.4 | 29.8 |
| 12 | 11:11 | 2.3 | 2.7 | 29.4 |
| 13 | 11:12 | 2.1 | 2.6 | 29.3 |
| 14 | 11:13 | 1.8 | 2.6 | 30.4 |
| 15 | 11:14 | 1.9 | 2.6 | 29.1 |
| 16 | 11:15 | 1.7 | 2.6 | 30.3 |
| 17 | 11:16 | 1.6 | 2.6 | 30.5 |
| 18 | 11:17 | 1.8 | 2.7 | 28.8 |
| 19 | 11:18 | 1.6 | 2.5 | 29.0 |
| 20 | 11:19 | 2.1 | 2.6 | 30.6 |
| 21 | 11:20 | 2.3 | 2.7 | 29.5 |
| 22 | 11:21 | 1.8 | 2.6 | 30.3 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **1.95** | **2.63** | **29.50** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 4-COO2NOx
**Source :** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0 | 0.2 | 0.2 |
| 8:31 | 44.4 | 44.3 | -0.1 |
| 8:35 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:53 | 0 | 0.3 | 0.3 |
| 10:55 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:23 | 0 | 0.3 | 0.3 | 0.0 |
| 11:25 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.0 | 0.0 |
| 8:31 | 8.51 | 8.5 | 0.0 |
| 8:35 | 20.5 | 20.6 | 0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:53 | 0.0 | 0.1 | 0.5 |
| 10:55 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:23 | 0.0 | 0.0 | 0.0 | -0.5 |
| 11:25 | 8.51 | 8.4 | -0.5 | -0.5 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 28 | 25 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 4-COO2NOx
**Source:** Zone D H1001 **Date:** 05/10/10

**Instrument Calibration Checks - continued**

$NO_x$ Instrument Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.2 | 0.2 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 10:53 | 0.0 | 0.2 | 0.2 |
| 10:57 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:23 | 0.0 | 0.2 | 0.2 | 0.0 |
| 11:27 | 51.5 | 51.3 | -0.2 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 36 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.42 "Hg |
| Static Pressure | -0.15 "$H_2O$ |
| Ps | 26.409 "Hg |
| Gas Flow | 46,748.3 adcfm |
| Avg. Stack Temp, Ts | 347 °F |
| | 807 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole Act Conditions | 667.133 ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.2 PPH |
| $NO_x$ | 5.7 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 1.95 ppm v/v d |
| $O_2$ | 2.63 % v/v d |
| NOx | 29.50 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 1.7 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 29.5 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 1.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **5-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:30-11:51** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 11:30 | 1.6 | 2.6 | 30.4 |
| 2 | 11:31 | 1.6 | 2.6 | 30.1 |
| 3 | 11:32 | 2.2 | 2.4 | 30.4 |
| 4 | 11:33 | 2.0 | 2.8 | 30.2 |
| 5 | 11:34 | 2.1 | 2.6 | 29.6 |
| 6 | 11:35 | 2.2 | 2.7 | 28.8 |
| 7 | 11:36 | 1.8 | 2.7 | 29.7 |
| 8 | 11:37 | 1.6 | 2.6 | 28.9 |
| 9 | 11:38 | 2.0 | 2.6 | 29.4 |
| 10 | 11:39 | 2.0 | 2.7 | 30.2 |
| 11 | 11:40 | 1.9 | 2.5 | 30.1 |
| 12 | 11:41 | 1.6 | 2.7 | 29.5 |
| 13 | 11:42 | 1.9 | 2.5 | 28.6 |
| 14 | 11:43 | 1.9 | 2.4 | 31.3 |
| 15 | 11:44 | 2.2 | 3.0 | 30.3 |
| 16 | 11:45 | 2.2 | 2.9 | 30.5 |
| 17 | 11:46 | 2.1 | 3.0 | 30.2 |
| 18 | 11:47 | 2.3 | 3.0 | 29.5 |
| 19 | 11:48 | 2.1 | 2.8 | 29.0 |
| 20 | 11:49 | 2.0 | 2.6 | 29.0 |
| 21 | 11:50 | 1.7 | 2.6 | 29.4 |
| 22 | 11:51 | 2.0 | 2.6 | 28.8 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **1.95** | **2.68** | **29.72** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 5-COO2NOx
**Source :** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0 | 0.2 | 0.2 |
| 8:31 | 44.4 | 44.3 | -0.1 |
| 8:35 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:23 | 0 | 0.3 | 0.3 |
| 11:25 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:53 | 0 | 0.3 | 0.3 | 0.0 |
| 11:55 | 44.4 | 44.1 | -0.3 | -0.1 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.0 | 0.0 |
| 8:31 | 8.51 | 8.5 | 0.0 |
| 8:35 | 20.5 | 20.6 | 0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:23 | 0.0 | 0.0 | 0.0 |
| 11:25 | 8.51 | 8.4 | -0.5 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:53 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11:55 | 8.51 | 8.4 | -0.5 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 28 | 25 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 5-COO2NOx
**Source:** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.2 | 0.2 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:23 | 0.0 | 0.2 | 0.2 |
| 11:27 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 11:53 | 0.0 | 0.3 | 0.3 | 0.1 |
| 11:57 | 51.5 | 51.3 | -0.2 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 36 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.42 "Hg |
| Static Pressure | -0.15 "$H_2O$ |
| Ps | 26.409 "Hg |
| Gas Flow | 46,846.3 adcfm |
| Avg. Stack Temp, Ts | 344 °F |
| | 804 °A (°R) |
| CO Molecular Wt. | 28 |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole Act Conditions | 664.653 ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.2 PPH |
| $NO_x$ | 5.8 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 1.95 ppm v/v d |
| $O_2$ | 2.68 % v/v d |
| NOx | 29.72 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 1.7 ppm v/v d |
| $O_2$ | 2.7 % v/v d |
| $NO_x$ | 29.7 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 1.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **6-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:00-12:21** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 12:00 | 2.3 | 2.7 | 29.3 |
| 2 | 12:01 | 2.4 | 2.8 | 29.4 |
| 3 | 12:02 | 2.1 | 2.6 | 28.5 |
| 4 | 12:03 | 1.6 | 2.5 | 29.5 |
| 5 | 12:04 | 2.2 | 2.5 | 28.5 |
| 6 | 12:05 | 2.2 | 2.6 | 28.3 |
| 7 | 12:06 | 2.1 | 2.6 | 28.7 |
| 8 | 12:07 | 2.0 | 2.5 | 29.6 |
| 9 | 12:08 | 2.0 | 2.6 | 29.6 |
| 10 | 12:09 | 2.2 | 2.8 | 30.2 |
| 11 | 12:10 | 2.1 | 2.6 | 29.9 |
| 12 | 12:11 | 1.8 | 2.6 | 29.7 |
| 13 | 12:12 | 2.0 | 2.6 | 29.2 |
| 14 | 12:13 | 2.1 | 2.5 | 30.1 |
| 15 | 12:14 | 2.1 | 2.5 | 28.5 |
| 16 | 12:15 | 1.8 | 2.6 | 28.9 |
| 17 | 12:16 | 1.9 | 2.3 | 31.2 |
| 18 | 12:17 | 1.9 | 2.9 | 29.7 |
| 19 | 12:18 | 2.1 | 3.4 | 28.7 |
| 20 | 12:19 | 1.7 | 3.0 | 29.0 |
| 21 | 12:20 | 1.6 | 2.9 | 28.8 |
| 22 | 12:21 | 1.6 | 2.7 | 30.1 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **1.99** | **2.67** | **29.34** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 6-COO2NOx
**Source :** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0 | 0.2 | 0.2 |
| 8:31 | 44.4 | 44.3 | -0.1 |
| 8:35 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:53 | 0 | 0.3 | 0.3 |
| 11:55 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:23 | 0 | 0.2 | 0.2 | -0.1 |
| 12:25 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.0 | 0.0 |
| 8:31 | 8.51 | 8.5 | 0.0 |
| 8:35 | 20.5 | 20.6 | 0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:53 | 0.0 | 0.0 | 0.0 |
| 11:55 | 8.51 | 8.4 | -0.5 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:23 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12:25 | 8.51 | 8.5 | 0.0 | 0.5 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 28 | 25 seconds |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.2 | 0.2 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 11:53 | 0.0 | 0.3 | 0.3 |
| 11:57 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:23 | 0.0 | 0.3 | 0.3 | 0.0 |
| 12:27 | 51.5 | 51.3 | -0.2 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 36 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.42 | "Hg |
| Static Pressure | -0.15 | "$H_2O$ |
| Ps | 26.409 | "Hg |
| Gas Flow | 47,084.6 | adcfm |
| Avg. Stack Temp, Ts | 349 | °F |
| | 809 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole | | |
| Act Conditions | 668.787 | ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.2 PPH |
| $NO_x$ | 5.7 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 1.99 ppm v/v d |
| $O_2$ | 2.67 % v/v d |
| NOx | 29.34 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 1.8 ppm v/v d |
| $O_2$ | 2.7 % v/v d |
| $NO_x$ | 29.3 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 1.8 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **7-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:30-12:51** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 12:30 | 2.3 | 2.7 | 30.4 |
| 2 | 12:31 | 1.5 | 2.8 | 30.8 |
| 3 | 12:32 | 1.8 | 2.7 | 30.6 |
| 4 | 12:33 | 2.1 | 2.7 | 29.4 |
| 5 | 12:34 | 2.2 | 2.6 | 29.8 |
| 6 | 12:35 | 1.7 | 2.6 | 30.1 |
| 7 | 12:36 | 1.7 | 2.6 | 29.0 |
| 8 | 12:37 | 2.2 | 2.8 | 30.8 |
| 9 | 12:38 | 2.3 | 2.6 | 30.2 |
| 10 | 12:39 | 2.0 | 2.5 | 29.5 |
| 11 | 12:40 | 2.4 | 2.7 | 29.2 |
| 12 | 12:41 | 1.7 | 2.5 | 29.6 |
| 13 | 12:42 | 2.1 | 2.7 | 29.3 |
| 14 | 12:43 | 1.6 | 2.7 | 29.3 |
| 15 | 12:44 | 2.3 | 2.6 | 30.7 |
| 16 | 12:45 | 2.0 | 2.5 | 29.5 |
| 17 | 12:46 | 1.8 | 2.5 | 29.1 |
| 18 | 12:47 | 1.6 | 2.7 | 30.1 |
| 19 | 12:48 | 1.5 | 2.5 | 30.4 |
| 20 | 12:49 | 2.0 | 2.4 | 30.6 |
| 21 | 12:50 | 1.9 | 2.6 | 30.3 |
| 22 | 12:51 | 1.7 | 2.6 | 29.8 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **1.93** | **2.62** | **29.93** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 7-COO2NOx
**Source :** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0 | 0.2 | 0.2 |
| 8:31 | 44.4 | 44.3 | -0.1 |
| 8:35 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:23 | 0 | 0.2 | 0.2 |
| 12:25 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:53 | 0 | 0.2 | 0.2 | 0.0 |
| 12:55 | 44.4 | 44.1 | -0.3 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.0 | 0.0 |
| 8:31 | 8.51 | 8.5 | 0.0 |
| 8:35 | 20.5 | 20.6 | 0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:23 | 0.0 | 0.0 | 0.0 |
| 12:25 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:53 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12:55 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 28 | 25 seconds |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.2 | 0.2 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:23 | 0.0 | 0.3 | 0.3 |
| 12:27 | 51.5 | 51.3 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 12:53 | 0.0 | 0.3 | 0.3 | 0.0 |
| 12:57 | 51.5 | 51.2 | -0.3 | -0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 36 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.42 | "Hg |
| Static Pressure | -0.15 | "$H_2O$ |
| Ps | 26.409 | "Hg |
| Gas Flow | 46,741.7 | adcfm |
| Avg. Stack Temp, Ts | 349 | °F |
| | 809 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 668.787 | ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.2 PPH |
| $NO_x$ | 5.8 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 1.93 ppm v/v d |
| $O_2$ | 2.62 % v/v d |
| NOx | 29.93 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 1.7 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 29.9 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 1.7 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **8-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:00-13:21** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 13:00 | 2.2 | 2.4 | 29.1 |
| 2 | 13:01 | 1.7 | 2.4 | 28.8 |
| 3 | 13:02 | 1.9 | 2.7 | 29.5 |
| 4 | 13:03 | 2.2 | 2.5 | 28.9 |
| 5 | 13:04 | 1.9 | 2.6 | 30.0 |
| 6 | 13:05 | 2.3 | 2.5 | 28.5 |
| 7 | 13:06 | 2.3 | 2.4 | 30.3 |
| 8 | 13:07 | 2.1 | 2.5 | 30.2 |
| 9 | 13:08 | 2.4 | 2.5 | 29.9 |
| 10 | 13:09 | 2.0 | 2.6 | 28.9 |
| 11 | 13:10 | 1.8 | 2.5 | 30.3 |
| 12 | 13:11 | 2.3 | 2.6 | 29.8 |
| 13 | 13:12 | 1.8 | 2.5 | 28.6 |
| 14 | 13:13 | 1.9 | 2.6 | 30.6 |
| 15 | 13:14 | 1.5 | 2.5 | 29.3 |
| 16 | 13:15 | 1.5 | 2.7 | 29.5 |
| 17 | 13:16 | 2.3 | 2.5 | 29.4 |
| 18 | 13:17 | 2.2 | 2.7 | 28.5 |
| 19 | 13:18 | 2.3 | 2.5 | 29.2 |
| 20 | 13:19 | 1.6 | 2.6 | 29.4 |
| 21 | 13:20 | 1.7 | 2.4 | 29.8 |
| 22 | 13:21 | 2.3 | 2.6 | 29.0 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **2.01** | **2.54** | **29.43** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 8-COO2NOx
**Source :** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0 | 0.2 | 0.2 |
| 8:31 | 44.4 | 44.3 | -0.1 |
| 8:35 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:53 | 0 | 0.2 | 0.2 |
| 12:55 | 44.4 | 44.1 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:23 | 0 | 0.2 | 0.2 | 0.0 |
| 13:25 | 44.4 | 44.2 | -0.2 | 0.1 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.0 | 0.0 |
| 8:31 | 8.51 | 8.5 | 0.0 |
| 8:35 | 20.5 | 20.6 | 0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:53 | 0.0 | 0.0 | 0.0 |
| 12:55 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:23 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13:25 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 28 | 25 seconds |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 8-COO2NOx
**Source:** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.2 | 0.2 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 12:53 | 0.0 | 0.3 | 0.3 |
| 12:57 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:23 | 0.0 | 0.2 | 0.2 | -0.1 |
| 13:27 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 36 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.42 | "Hg |
| Static Pressure | -0.15 | "$H_2O$ |
| Ps | 26.409 | "Hg |
| Gas Flow | 46,968.7 | adcfm |
| Avg. Stack Temp, Ts | 346 | °F |
| | 806 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole Act Conditions | 666.306 | ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.2 PPH |
| $NO_x$ | 5.7 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 2.01 ppm v/v d |
| $O_2$ | 2.54 % v/v d |
| NOx | 29.43 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 1.8 ppm v/v d |
| $O_2$ | 2.5 % v/v d |
| $NO_x$ | 29.5 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 1.8 ppm v/v d |

**Relative Accuracy Reference Data**
**EPA Methods #3A, 7E & 10**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **9-COO2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:30-13:51** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| # | Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|---|
| 1 | 13:30 | 2.1 | 2.6 | 30.5 |
| 2 | 13:31 | 1.8 | 2.5 | 29.2 |
| 3 | 13:32 | 1.5 | 2.6 | 29.9 |
| 4 | 13:33 | 2.0 | 2.4 | 30.0 |
| 5 | 13:34 | 1.8 | 2.5 | 30.1 |
| 6 | 13:35 | 1.6 | 2.5 | 29.6 |
| 7 | 13:36 | 1.8 | 2.4 | 29.0 |
| 8 | 13:37 | 2.3 | 2.7 | 29.1 |
| 9 | 13:38 | 2.1 | 2.6 | 31.5 |
| 10 | 13:39 | 1.8 | 2.5 | 28.9 |
| 11 | 13:40 | 1.6 | 2.5 | 30.5 |
| 12 | 13:41 | 2.1 | 2.4 | 29.3 |
| 13 | 13:42 | 2.4 | 2.7 | 29.8 |
| 14 | 13:43 | 1.6 | 2.6 | 28.5 |
| 15 | 13:44 | 2.0 | 2.5 | 29.8 |
| 16 | 13:45 | 1.7 | 2.5 | 30.4 |
| 17 | 13:46 | 2.4 | 2.7 | 29.7 |
| 18 | 13:47 | 2.1 | 2.6 | 28.9 |
| 19 | 13:48 | 2.0 | 2.6 | 29.3 |
| 20 | 13:49 | 1.7 | 2.5 | 29.5 |
| 21 | 13:50 | 2.3 | 2.6 | 29.9 |
| 22 | 13:51 | 2.0 | 2.5 | 28.8 |

**Averages:**

| CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|
| **1.94** | **2.55** | **29.65** |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 9-COO2NOx
**Source :** Zone D H1001 **Date:** 05/10/10

## Instrument Calibration Checks

CO Instrument — Calibration Span, CS: 98.0 ppm v/v Dry

CO Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0 | 0.2 | 0.2 |
| 8:31 | 44.4 | 44.3 | -0.1 |
| 8:35 | 98.0 | 97.6 | -0.4 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 13:23 | 0 | 0.2 | 0.2 |
| 13:25 | 44.4 | 44.2 | -0.2 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:53 | 0 | 0.2 | 0.2 | 0.0 |
| 13:55 | 44.4 | 44.2 | -0.2 | 0.0 |

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

$O_2$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.0 | 0.0 |
| 8:31 | 8.51 | 8.5 | 0.0 |
| 8:35 | 20.5 | 20.6 | 0.5 |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 13:23 | 0.0 | 0.0 | 0.0 |
| 13:25 | 8.51 | 8.5 | 0.0 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$- $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:53 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13:55 | 8.51 | 8.5 | 0.0 | 0.0 |

**Instrument Response Times:**

| | Zero | High |
|---|---|---|
| CO | 33 | 31 seconds |
| $O_2$ | 28 | 25 seconds |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **9-COO2NOx** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

$NO_x$ Calibration Error Tests

| Time | Tank Value $C_v$ | Instrument Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) |
|---|---|---|---|
| 8:27 | 0.0 | 0.2 | 0.2 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (5/3/10 FCC logger) |

Initial System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_i$ (< 5% of span) |
|---|---|---|---|
| 13:23 | 0.0 | 0.2 | 0.2 |
| 13:27 | 51.5 | 51.2 | -0.3 |

Post System Bias Check

| Time | Tank Value $C_v$ | Instrument Resp., $C_S$ | System Bias, $SB_f$ (< 5% of span) | Drift, D ($SB_f$ - $SB_i$) (< 3% of span) |
|---|---|---|---|---|
| 13:53 | 0.0 | 0.2 | 0.2 | 0.0 |
| 13:57 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $NO_x$ | 34 | 36 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.42 | "Hg |
| Static Pressure | -0.15 | "$H_2O$ |
| Ps | 26.409 | "Hg |
| Gas Flow | 46,517.5 | adcfm |
| Avg. Stack Temp, Ts | 345 | °F |
| | 805 | °A (°R) |
| CO Molecular Wt. | 28 | |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole | | |
| Act Conditions | 665.480 | ft^3/lbmole |

Mass Flow:

| | |
|---|---|
| CO | 0.2 PPH |
| $NO_x$ | 5.7 PPH |

**Calculations:**

Averages:

| | |
|---|---|
| CO | 1.94 ppm v/v d |
| $O_2$ | 2.55 % v/v d |
| NOx | 29.65 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| CO | 1.8 ppm v/v d |
| $O_2$ | 2.6 % v/v d |
| $NO_x$ | 29.7 ppm v/v d |

Corrected to 3% $O_2$

| | |
|---|---|
| CO | 1.8 ppm v/v d |

**CHS, Inc. - Laurel Refinery**
**Zone D H1001**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/10/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 8:20 | 0.1 | 0.0 | 0.2 | Initial Calibrations/Tank IDS |
| 8:21 | 0.1 | 0.0 | 0.2 | **$O_2$ Tanks** |
| 8:22 | 0.1 | 0.0 | 0.2 | ET0003451 @ 8.51%; Exp. 09/28/12 |
| 8:23 | 0.1 | 0.0 | 0.2 | ET0003519 @ 20.5%; Exp. 06/19/12 |
| 8:24 | 0.1 | 0.0 | 0.2 | $O_2$ Instrument: Servomex 1400 |
| 8:25 | 0.1 | 0.0 | 0.2 | **$NO_x$ Tanks** |
| 8:26 | 0.1 | 0.0 | 0.2 | LL82176 @ 51.5 ppm; Exp. 10-19-11 |
| 8:27 | 0.1 | 0.0 | 0.2 | LL31587 @ 100.7 ppm; Exp. 08-11-10 |
| 8:28 | 0.1 | 0.0 | 0.2 | LL82188 @ 53.3 ppm; Exp. 10-29-11 |
| 8:29 | 0.1 | 0.0 | 0.2 | $NO_x$ Instrument: CAI 400 |
| 8:30 | 32.5 | 5.1 | 0.2 | **CO Tanks** |
| 8:31 | 44.3 | 8.5 | 0.2 | ET0003451 @ 44.4 ppm; Exp. 09-28-12 |
| 8:32 | 5.2 | 2.1 | 31.1 | ET0003462 @ 98.0 ppm; Exp. 09-28-12 |
| 8:33 | 0.1 | 0.0 | 51.4 | CO Instrument: CAI 200 |
| 8:34 | 62.8 | 16.2 | 6.8 | |
| 8:35 | 97.5 | 20.6 | 0.2 | |
| 8:36 | 7.4 | 3.1 | 0.2 | |
| 8:37 | 0.1 | 0.0 | 70.2 | |
| 8:38 | 0.1 | 0.0 | 100.4 | |
| 8:39 | 0.1 | 0.0 | 11.4 | |
| 8:40 | 0.1 | 0.0 | 0.2 | |
| 8:41 | 30.6 | 5.5 | 0.2 | $CO/O_2$ Response Time |
| 8:42 | 44.2 | 8.5 | 0.2 | |
| 8:43 | 4.8 | 1.6 | 0.2 | $CO/O_2$ Response Time |
| 8:44 | 0.2 | 0.1 | 0.2 | |
| 8:45 | 0.2 | 0.1 | 0.2 | |
| 8:46 | 0.2 | 0.1 | 33.6 | $NO_x$ Response Time |
| 8:47 | 0.2 | 0.1 | 51.3 | |
| 8:48 | 0.2 | 0.1 | 7.3 | $NO_x$ Response Time |
| 8:49 | 0.2 | 0.0 | 0.2 | |
| 8:50 | 0.2 | 0.0 | 0.2 | |
| 8:51 | 0.2 | 0.0 | 0.2 | |
| 8:52 | 0.2 | 0.0 | 0.2 | |
| 8:53 | 0.2 | 0.0 | 0.2 | |
| 8:54 | 0.2 | 0.0 | 0.2 | |
| 8:55 | 0.2 | 0.0 | 0.2 | |
| 8:56 | 0.2 | 0.0 | 0.2 | |
| 8:57 | 0.2 | 0.0 | 0.2 | |
| 8:58 | 0.2 | 0.0 | 0.2 | |
| 8:59 | 0.2 | 0.0 | 0.2 | |
| 9:00 | 0.2 | 0.0 | 0.2 | |

**CHS, Inc. - Laurel Refinery**
**Zone D H1001**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/10/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 9:01 | 0.2 | 0.0 | 0.2 | |
| 9:02 | 0.2 | 0.0 | 0.2 | |
| 9:03 | 0.2 | 0.0 | 0.2 | |
| 9:04 | 0.2 | 0.0 | 0.2 | |
| 9:05 | 0.2 | 0.0 | 0.2 | |
| 9:06 | 0.2 | 0.0 | 0.2 | |
| 9:07 | 0.2 | 0.0 | 0.2 | |
| 9:08 | 0.2 | 0.0 | 0.2 | |
| 9:09 | 0.2 | 0.0 | 0.2 | |
| 9:10 | 0.2 | 0.0 | 0.2 | |
| 9:11 | 1.0 | 1.1 | 12.5 | |
| 9:12 | 1.5 | 2.8 | 30.9 | |
| 9:13 | 1.8 | 2.8 | 30.7 | |
| 9:14 | 1.9 | 2.8 | 29.8 | |
| 9:15 | 2.0 | 2.6 | 30.1 | |
| 9:16 | 1.9 | 2.6 | 30.3 | |
| 9:17 | 1.7 | 2.5 | 29.2 | |
| 9:18 | 2.4 | 2.5 | 29.2 | |
| 9:19 | 2.4 | 2.4 | 30.5 | |
| 9:20 | 1.9 | 2.7 | 29.2 | |
| 9:21 | 2.3 | 2.5 | 29.0 | |
| 9:22 | 2.4 | 2.9 | 29.2 | |
| 9:23 | 1.7 | 2.9 | 30.3 | |
| 9:24 | 1.6 | 2.8 | 29.6 | |
| 9:25 | 2.0 | 2.7 | 30.5 | |
| 9:26 | 2.1 | 2.7 | 30.3 | |
| 9:27 | 2.0 | 2.6 | 30.4 | |
| 9:28 | 1.7 | 2.7 | 29.8 | |
| 9:29 | 2.1 | 2.6 | 30.3 | |
| 9:30 | 2.4 | 2.5 | 29.3 | Start Run 1 |
| 9:31 | 2.4 | 2.8 | 28.8 | |
| 9:32 | 2.4 | 2.6 | 28.9 | |
| 9:33 | 2.2 | 2.8 | 29.4 | |
| 9:34 | 2.2 | 2.8 | 30.2 | |
| 9:35 | 1.8 | 2.8 | 29.2 | |
| 9:36 | 2.0 | 2.8 | 29.9 | |
| 9:37 | 1.9 | 2.7 | 30.1 | |
| 9:38 | 2.0 | 2.7 | 29.1 | |
| 9:39 | 2.1 | 2.7 | 28.8 | |
| 9:40 | 2.1 | 2.6 | 29.0 | |
| 9:41 | 1.6 | 2.5 | 29.6 | |
| 9:42 | 1.7 | 2.8 | 31.3 | |

**CHS, Inc. - Laurel Refinery**
**Zone D H1001**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/10/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 9:43 | 1.7 | 2.5 | 30.3 | |
| 9:44 | 2.1 | 2.8 | 29.6 | |
| 9:45 | 1.8 | 3.0 | 30.1 | |
| 9:46 | 2.1 | 2.8 | 29.2 | |
| 9:47 | 2.3 | 2.7 | 30.3 | |
| 9:48 | 1.6 | 2.7 | 30.0 | |
| 9:49 | 1.5 | 2.6 | 29.7 | |
| 9:50 | 1.6 | 2.6 | 30.4 | |
| 9:51 | 1.6 | 2.6 | 30.0 | End Run 1 |
| 9:52 | 0.7 | 0.5 | 3.9 | |
| 9:53 | 0.2 | 0.1 | 0.2 | |
| 9:54 | 32.5 | 6.6 | 0.2 | |
| 9:55 | 44.2 | 8.5 | 0.2 | |
| 9:56 | 6.8 | 3.1 | 34.2 | |
| 9:57 | 0.2 | 0.1 | 51.2 | |
| 9:58 | 0.2 | 0.1 | 7.3 | |
| 9:59 | 0.8 | 1.1 | 22.1 | |
| 10:00 | 1.5 | 2.7 | 30.2 | Start Run 2 |
| 10:01 | 1.6 | 2.6 | 29.9 | |
| 10:02 | 2.1 | 2.6 | 30.7 | |
| 10:03 | 2.2 | 2.7 | 30.5 | |
| 10:04 | 1.9 | 2.6 | 31.0 | |
| 10:05 | 2.2 | 2.5 | 30.6 | |
| 10:06 | 1.5 | 2.6 | 30.8 | |
| 10:07 | 2.1 | 2.9 | 31.9 | |
| 10:08 | 1.9 | 2.7 | 31.7 | |
| 10:09 | 2.2 | 2.7 | 31.7 | |
| 10:10 | 2.2 | 2.6 | 30.0 | |
| 10:11 | 1.6 | 2.4 | 30.0 | |
| 10:12 | 1.8 | 2.7 | 29.7 | |
| 10:13 | 2.3 | 2.8 | 28.8 | |
| 10:14 | 2.2 | 2.7 | 29.5 | |
| 10:15 | 1.5 | 2.7 | 29.6 | |
| 10:16 | 1.9 | 2.7 | 31.0 | |
| 10:17 | 1.6 | 2.7 | 30.5 | |
| 10:18 | 1.9 | 2.9 | 30.4 | |
| 10:19 | 1.5 | 2.8 | 29.4 | |
| 10:20 | 2.3 | 2.7 | 30.3 | |
| 10:21 | 2.1 | 2.7 | 28.9 | End Run 2 |
| 10:22 | 0.5 | 0.6 | 4.9 | |
| 10:23 | 0.2 | 0.1 | 0.2 | |
| 10:24 | 30.5 | 4.7 | 0.2 | |

**CHS, Inc. - Laurel Refinery**
**Zone D H1001**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/10/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 10:25 | 44.2 | 8.5 | 0.2 | |
| 10:26 | 5.9 | 2.0 | 29.6 | |
| 10:27 | 0.2 | 0.1 | 51.2 | |
| 10:28 | 0.2 | 0.1 | 10.4 | |
| 10:29 | 0.9 | 1.1 | 23.0 | |
| 10:30 | 1.9 | 2.7 | 29.3 | Start Run 3 |
| 10:31 | 1.5 | 2.8 | 29.6 | |
| 10:32 | 1.6 | 2.7 | 30.2 | |
| 10:33 | 1.9 | 2.6 | 29.1 | |
| 10:34 | 1.9 | 2.6 | 29.2 | |
| 10:35 | 2.1 | 2.5 | 29.9 | |
| 10:36 | 1.7 | 2.3 | 28.7 | |
| 10:37 | 1.6 | 2.5 | 28.1 | |
| 10:38 | 1.6 | 2.4 | 28.0 | |
| 10:39 | 1.9 | 2.6 | 30.4 | |
| 10:40 | 2.3 | 3.0 | 28.9 | |
| 10:41 | 1.8 | 2.7 | 29.8 | |
| 10:42 | 2.3 | 2.9 | 30.0 | |
| 10:43 | 2.2 | 3.5 | 30.0 | |
| 10:44 | 1.9 | 4.0 | 29.5 | |
| 10:45 | 2.2 | 3.8 | 30.4 | |
| 10:46 | 1.8 | 3.6 | 29.6 | |
| 10:47 | 2.1 | 3.2 | 30.2 | |
| 10:48 | 1.9 | 3.0 | 29.6 | |
| 10:49 | 1.7 | 2.8 | 30.4 | |
| 10:50 | 2.0 | 2.7 | 29.2 | |
| 10:51 | 2.3 | 2.8 | 30.3 | End Run 3 |
| 10:52 | 0.6 | 0.4 | 6.3 | |
| 10:53 | 0.3 | 0.1 | 0.2 | |
| 10:54 | 35.1 | 5.7 | 0.2 | |
| 10:55 | 44.2 | 8.5 | 0.2 | |
| 10:56 | 7.0 | 2.0 | 34.9 | |
| 10:57 | 0.3 | 0.1 | 51.3 | |
| 10:58 | 0.3 | 0.1 | 6.1 | |
| 10:59 | 0.8 | 1.2 | 23.3 | |
| 11:00 | 2.2 | 3.0 | 28.9 | Start Run 4 |
| 11:01 | 2.2 | 2.8 | 29.4 | |
| 11:02 | 1.8 | 2.9 | 29.2 | |
| 11:03 | 1.8 | 2.7 | 29.5 | |
| 11:04 | 2.0 | 2.5 | 29.3 | |
| 11:05 | 2.0 | 2.6 | 29.3 | |
| 11:06 | 2.2 | 2.6 | 28.9 | |

**CHS, Inc. - Laurel Refinery**
**Zone D H1001**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/10/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 11:07 | 1.9 | 2.5 | 28.9 | |
| 11:08 | 1.8 | 2.5 | 29.0 | |
| 11:09 | 2.0 | 2.5 | 29.7 | |
| 11:10 | 2.0 | 2.4 | 29.8 | |
| 11:11 | 2.3 | 2.7 | 29.4 | |
| 11:12 | 2.1 | 2.6 | 29.3 | |
| 11:13 | 1.8 | 2.6 | 30.4 | |
| 11:14 | 1.9 | 2.6 | 29.1 | |
| 11:15 | 1.7 | 2.6 | 30.3 | |
| 11:16 | 1.6 | 2.6 | 30.5 | |
| 11:17 | 1.8 | 2.7 | 28.8 | |
| 11:18 | 1.6 | 2.5 | 29.0 | |
| 11:19 | 2.1 | 2.6 | 30.6 | |
| 11:20 | 2.3 | 2.7 | 29.5 | |
| 11:21 | 1.8 | 2.6 | 30.3 | End Run 4 |
| 11:22 | 0.5 | 0.3 | 7.1 | |
| 11:23 | 0.3 | 0.0 | 0.2 | |
| 11:24 | 28.8 | 6.1 | 0.2 | |
| 11:25 | 44.2 | 8.4 | 0.2 | |
| 11:26 | 6.7 | 1.5 | 37.4 | |
| 11:27 | 0.3 | 0.0 | 51.3 | |
| 11:28 | 0.2 | 0.0 | 6.6 | |
| 11:29 | 0.9 | 1.3 | 20.1 | |
| 11:30 | 1.6 | 2.6 | 30.4 | Start Run 5 |
| 11:31 | 1.6 | 2.6 | 30.1 | |
| 11:32 | 2.2 | 2.4 | 30.4 | |
| 11:33 | 2.0 | 2.8 | 30.2 | |
| 11:34 | 2.1 | 2.6 | 29.6 | |
| 11:35 | 2.2 | 2.7 | 28.8 | |
| 11:36 | 1.8 | 2.7 | 29.7 | |
| 11:37 | 1.6 | 2.6 | 28.9 | |
| 11:38 | 2.0 | 2.6 | 29.4 | |
| 11:39 | 2.0 | 2.7 | 30.2 | |
| 11:40 | 1.9 | 2.5 | 30.1 | |
| 11:41 | 1.6 | 2.7 | 29.5 | |
| 11:42 | 1.9 | 2.5 | 28.6 | |
| 11:43 | 1.9 | 2.4 | 31.3 | |
| 11:44 | 2.2 | 3.0 | 30.3 | |
| 11:45 | 2.2 | 2.9 | 30.5 | |
| 11:46 | 2.1 | 3.0 | 30.2 | |
| 11:47 | 2.3 | 3.0 | 29.5 | |
| 11:48 | 2.1 | 2.8 | 29.0 | |

**CHS, Inc. - Laurel Refinery**
**Zone D H1001**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/10/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 11:49 | 2.0 | 2.6 | 29.0 | |
| 11:50 | 1.7 | 2.6 | 29.4 | |
| 11:51 | 2.0 | 2.6 | 28.8 | End Run 5 |
| 11:52 | 0.8 | 0.7 | 6.2 | |
| 11:53 | 0.3 | 0.0 | 0.3 | |
| 11:54 | 30.8 | 5.0 | 0.3 | |
| 11:55 | 44.1 | 8.4 | 0.2 | |
| 11:56 | 5.7 | 2.2 | 38.1 | |
| 11:57 | 0.3 | 0.0 | 51.3 | |
| 11:58 | 0.3 | 0.0 | 10.4 | |
| 11:59 | 1.9 | 1.1 | 24.1 | |
| 12:00 | 2.3 | 2.7 | 29.3 | Start Run 6 |
| 12:01 | 2.4 | 2.8 | 29.4 | |
| 12:02 | 2.1 | 2.6 | 28.5 | |
| 12:03 | 1.6 | 2.5 | 29.5 | |
| 12:04 | 2.2 | 2.5 | 28.5 | |
| 12:05 | 2.2 | 2.6 | 28.3 | |
| 12:06 | 2.1 | 2.6 | 28.7 | |
| 12:07 | 2.0 | 2.5 | 29.6 | |
| 12:08 | 2.0 | 2.6 | 29.6 | |
| 12:09 | 2.2 | 2.8 | 30.2 | |
| 12:10 | 2.1 | 2.6 | 29.9 | |
| 12:11 | 1.8 | 2.6 | 29.7 | |
| 12:12 | 2.0 | 2.6 | 29.2 | |
| 12:13 | 2.1 | 2.5 | 30.1 | |
| 12:14 | 2.1 | 2.5 | 28.5 | |
| 12:15 | 1.8 | 2.6 | 28.9 | |
| 12:16 | 1.9 | 2.3 | 31.2 | |
| 12:17 | 1.9 | 2.9 | 29.7 | |
| 12:18 | 2.1 | 3.4 | 28.7 | |
| 12:19 | 1.7 | 3.0 | 29.0 | |
| 12:20 | 1.6 | 2.9 | 28.8 | |
| 12:21 | 1.6 | 2.7 | 30.1 | End Run 6 |
| 12:22 | 0.5 | 0.4 | 4.7 | |
| 12:23 | 0.2 | 0.0 | 0.3 | |
| 12:24 | 31.8 | 4.9 | 0.3 | |
| 12:25 | 44.1 | 8.5 | 0.3 | |
| 12:26 | 6.0 | 1.4 | 31.5 | |
| 12:27 | 0.2 | 0.0 | 51.3 | |
| 12:28 | 0.2 | 0.0 | 7.2 | |
| 12:29 | 1.2 | 1.3 | 17.9 | |
| 12:30 | 2.3 | 2.7 | 30.4 | Start Run 7 |

**CHS, Inc. - Laurel Refinery**
**Zone D H1001**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/10/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 12:31 | 1.5 | 2.8 | 30.8 | |
| 12:32 | 1.8 | 2.7 | 30.6 | |
| 12:33 | 2.1 | 2.7 | 29.4 | |
| 12:34 | 2.2 | 2.6 | 29.8 | |
| 12:35 | 1.7 | 2.6 | 30.1 | |
| 12:36 | 1.7 | 2.6 | 29.0 | |
| 12:37 | 2.2 | 2.8 | 30.8 | |
| 12:38 | 2.3 | 2.6 | 30.2 | |
| 12:39 | 2.0 | 2.5 | 29.5 | |
| 12:40 | 2.4 | 2.7 | 29.2 | |
| 12:41 | 1.7 | 2.5 | 29.6 | |
| 12:42 | 2.1 | 2.7 | 29.3 | |
| 12:43 | 1.6 | 2.7 | 29.3 | |
| 12:44 | 2.3 | 2.6 | 30.7 | |
| 12:45 | 2.0 | 2.5 | 29.5 | |
| 12:46 | 1.8 | 2.5 | 29.1 | |
| 12:47 | 1.6 | 2.7 | 30.1 | |
| 12:48 | 1.5 | 2.5 | 30.4 | |
| 12:49 | 2.0 | 2.4 | 30.6 | |
| 12:50 | 1.9 | 2.6 | 30.3 | |
| 12:51 | 1.7 | 2.6 | 29.8 | End Run 7 |
| 12:52 | 0.4 | 0.4 | 6.6 | |
| 12:53 | 0.2 | 0.0 | 0.3 | |
| 12:54 | 33.6 | 6.3 | 0.3 | |
| 12:55 | 44.1 | 8.5 | 0.2 | |
| 12:56 | 8.3 | 1.8 | 29.9 | |
| 12:57 | 0.2 | 0.0 | 51.2 | |
| 12:58 | 0.2 | 0.0 | 5.8 | |
| 12:59 | 1.7 | 1.7 | 23.2 | |
| 13:00 | 2.2 | 2.4 | 29.1 | Start Run 8 |
| 13:01 | 1.7 | 2.4 | 28.8 | |
| 13:02 | 1.9 | 2.7 | 29.5 | |
| 13:03 | 2.2 | 2.5 | 28.9 | |
| 13:04 | 1.9 | 2.6 | 30.0 | |
| 13:05 | 2.3 | 2.5 | 28.5 | |
| 13:06 | 2.3 | 2.4 | 30.3 | |
| 13:07 | 2.1 | 2.5 | 30.2 | |
| 13:08 | 2.4 | 2.5 | 29.9 | |
| 13:09 | 2.0 | 2.6 | 28.9 | |
| 13:10 | 1.8 | 2.5 | 30.3 | |
| 13:11 | 2.3 | 2.6 | 29.8 | |
| 13:12 | 1.8 | 2.5 | 28.6 | |

**CHS, Inc. - Laurel Refinery**
**Zone D H1001**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/10/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 13:13 | 1.9 | 2.6 | 30.6 | |
| 13:14 | 1.5 | 2.5 | 29.3 | |
| 13:15 | 1.5 | 2.7 | 29.5 | |
| 13:16 | 2.3 | 2.5 | 29.4 | |
| 13:17 | 2.2 | 2.7 | 28.5 | |
| 13:18 | 2.3 | 2.5 | 29.2 | |
| 13:19 | 1.6 | 2.6 | 29.4 | |
| 13:20 | 1.7 | 2.4 | 29.8 | |
| 13:21 | 2.3 | 2.6 | 29.0 | End Run 8 |
| 13:22 | 0.7 | 0.8 | 5.2 | |
| 13:23 | 0.2 | 0.0 | 0.2 | |
| 13:24 | 36.1 | 4.4 | 0.2 | |
| 13:25 | 44.2 | 8.5 | 0.2 | |
| 13:26 | 10.1 | 1.7 | 30.9 | |
| 13:27 | 0.2 | 0.0 | 51.2 | |
| 13:28 | 0.2 | 0.0 | 7.2 | |
| 13:29 | 1.0 | 0.9 | 24.1 | |
| 13:30 | 2.1 | 2.6 | 30.5 | Start Run 9 |
| 13:31 | 1.8 | 2.5 | 29.2 | |
| 13:32 | 1.5 | 2.6 | 29.9 | |
| 13:33 | 2.0 | 2.4 | 30.0 | |
| 13:34 | 1.8 | 2.5 | 30.1 | |
| 13:35 | 1.6 | 2.5 | 29.6 | |
| 13:36 | 1.8 | 2.4 | 29.0 | |
| 13:37 | 2.3 | 2.7 | 29.1 | |
| 13:38 | 2.1 | 2.6 | 31.5 | |
| 13:39 | 1.8 | 2.5 | 28.9 | |
| 13:40 | 1.6 | 2.5 | 30.5 | |
| 13:41 | 2.1 | 2.4 | 29.3 | |
| 13:42 | 2.4 | 2.7 | 29.8 | |
| 13:43 | 1.6 | 2.6 | 28.5 | |
| 13:44 | 2.0 | 2.5 | 29.8 | |
| 13:45 | 1.7 | 2.5 | 30.4 | |
| 13:46 | 2.4 | 2.7 | 29.7 | |
| 13:47 | 2.1 | 2.6 | 28.9 | |
| 13:48 | 2.0 | 2.6 | 29.3 | |
| 13:49 | 1.7 | 2.5 | 29.5 | |
| 13:50 | 2.3 | 2.6 | 29.9 | |
| 13:51 | 2.0 | 2.5 | 28.8 | End Run 9 |
| 13:52 | 0.5 | 0.4 | 11.2 | |
| 13:53 | 0.2 | 0.0 | 0.2 | |
| 13:54 | 37.0 | 6.3 | 0.2 | |

**CHS, Inc. - Laurel Refinery**
**Zone D H1001**
**$CO/O_2/NO_x$ Computer Logger Data**
**05/10/10**

| Time | CO - ppm v/v Dry | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|---|
| 13:55 | 44.2 | 8.5 | 0.2 | |
| 13:56 | 9.3 | 3.0 | 38.8 | |
| 13:57 | 0.3 | 0.0 | 51.2 | |
| 13:58 | 0.2 | 0.0 | 7.4 | |
| 13:59 | 0.2 | 0.0 | 0.2 | |
| 14:00 | 0.2 | 0.0 | 0.2 | |
| 14:01 | 0.2 | 0.0 | 0.2 | |

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **1-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:30-09:51** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 191.000 | 0.26 | 2.12 | 58 | 351 | 0.5099 |
| 2 | 14 | | 0.26 | 2.12 | 58 | 351 | 0.5099 |
| 3 | 21 | | 0.31 | 2.12 | 59 | 350 | 0.5568 |
| 4 | | 206.550 | 0.32 | | | 350 | 0.5657 |
| 5 | | | 0.34 | | | 350 | 0.5831 |
| 6 | | | 0.40 | | | 350 | 0.6325 |
| 7 | | | 0.42 | | | 349 | 0.6481 |
| 8 | | | 0.44 | | | 349 | 0.6633 |
| 1 | | | 0.24 | | | 350 | 0.4899 |
| 2 | | | 0.25 | | | 350 | 0.5000 |
| 3 | | | 0.30 | | | 351 | 0.5477 |
| 4 | | | 0.33 | | | 351 | 0.5745 |
| 5 | | | 0.35 | | | 351 | 0.5916 |
| 6 | | | 0.41 | | | 351 | 0.6403 |
| 7 | | | 0.43 | | | 351 | 0.6557 |
| 8 | | | 0.44 | | | 352 | 0.6633 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.42 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 5.167 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.550 dcf | Stack Area | 20.969 sq.ft. |
| Water Volume | 40.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 2.6 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 2.0 ml |
| $\%CO_2$ Average | 17.7 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **1-SO2/GF** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5833 "$H_2O$ |
| Avg Meter Temp. (Tm) | 58 °F | Avg Stack Temp. (Ts) | 350 °F |
| Avg Meter Temp. (Tm) | 518 °A (°R) | Avg Stack Temp. (Ts) | 810 °A (°R) |
| Pressure Meter (Pm) | 26.576 "Hg | Pressure Stack (Ps) | 26.409 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.940 dscf | Velocity (Vs) | 42.78 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 27.497 awcf | Volume (actual conditions) | 53,823.2 awcfm |
| Volume Water | | | 47,418.2 adcfm |
| Vapor, Vw(std) | 1.883 scf | Volume (std. conditions) | 1,858,062.3 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 30,967.7 wscfm |
| Moisture (Bws) | 0.1190 | | 1,636,952.9 dscf/hr |
| Percent Moisture | 11.90 %v | | 27,282.5 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.94 lb/lb-mole | Dry Basis | 0.6 ppmv d |
| Wet (Ms) | 29.40 lb/lb-mole | Wet Basis | 0.6 ppmv a |
| | | $SO_2$ Concentration | 1.023E-07 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.17 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
OURCE TESTED: H100
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 1
DATE: 5/10/10
START TIME: 930
END TIME: 951

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.42 BAROMETRIC PRESSURE ("Hg)
- 120 PITOT
- .84 METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg)
- TRAIN LEAK TEST, ($ft^3$/min)
- −.15 STATIC PRESSURE ("H2O)
- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- 15 PRE 14 POST
- 001 PRE 003 POST
- 62" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 191.000 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 58 | 5 | | 41 | 351 | 17.7 | |
| 2 | 14 | | | 2.12 | 58 | 5 | | 41 | 350 | | |
| 3 | 21 | 206.550 | | 2.12 | 59 | 5 | | 42 | 350 | | |
| | ↘ | +15.550 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .26 | | | | | | 351 | | |
| 2 | | | .26 | | | | | | 351 | | |
| 3 | | | .31 | | | | | | 350 | | |
| 4 | | | .32 | | | | | | 350 | | |
| 5 | | | .34 | | | | | | 350 | | |
| 6 | | | .40 | | | | | | 350 | | |
| 7 | | | .42 | | | | | | 349 | | |
| 8 | | | .44 | | | | | | 349 | | |
| | | | | | | | | | | | |
| 1 | | | .24 | | | | | | 350 | | |
| 2 | | | .25 | | | | | | 350 | | |
| 3 | | | .30 | | | | | | 351 | | |
| 4 | | | .33 | | | | | | 351 | | |
| 5 | | | .35 | | | | | | 351 | | |
| 6 | | | .41 | | | | | | 351 | | |
| 7 | | | .43 | | | | | | 351 | | |
| 8 | | | .44 | | | | | | 352 | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | Cemex | RUN # | 1 |
| PLANT LOCATION: | Lavvel | TEST DATE: | 5-10-10 |
| SOURCE TESTED: | H1001 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 658 |
| Initial Weight | 635 |
| Weight Gain | + 23. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 629 |
| Initial Weight | 619 |
| Weight Gain | + 10. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 490 |
| Initial Weight | 490 |
| Weight Gain | 0 |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 832 |
| Initial Weight | 825 |
| Weight Gain | + 7. |

**Total Mass of Moisture Captured:** + 40. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 imf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **2-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:00-10:21** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 207.000 | 0.25 | 2.12 | 59 | 353 | 0.5000 |
| 2 | 14 | | 0.26 | 2.12 | 60 | 353 | 0.5099 |
| 3 | 21 | | 0.30 | 2.12 | 60 | 353 | 0.5477 |
| 4 | | 222.740 | 0.31 | | | 353 | 0.5568 |
| 5 | | | 0.34 | | | 353 | 0.5831 |
| 6 | | | 0.39 | | | 352 | 0.6245 |
| 7 | | | 0.41 | | | 352 | 0.6403 |
| 8 | | | 0.42 | | | 352 | 0.6481 |
| 1 | | | 0.24 | | | 352 | 0.4899 |
| 2 | | | 0.26 | | | 352 | 0.5099 |
| 3 | | | 0.30 | | | 352 | 0.5477 |
| 4 | | | 0.32 | | | 351 | 0.5657 |
| 5 | | | 0.35 | | | 351 | 0.5916 |
| 6 | | | 0.40 | | | 351 | 0.6325 |
| 7 | | | 0.42 | | | 352 | 0.6481 |
| 8 | | | 0.43 | | | 352 | 0.6557 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.42 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 5.167 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.740 dcf | Stack Area | 20.969 sq.ft. |
| Water Volume | 42.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 2.6 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 3.0 ml |
| $\%CO_2$ Average | 17.7 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **2-SO2/GF** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5782 "$H_2O$ |
| Avg Meter Temp. (Tm) | 60 °F | Avg Stack Temp. (Ts) | 352 °F |
| Avg Meter Temp. (Tm) | 520 °A (°R) | Avg Stack Temp. (Ts) | 812 °A (°R) |
| Pressure Meter (Pm) | 26.576 "Hg | Pressure Stack (Ps) | 26.409 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.056 dscf | Velocity (Vs) | 42.51 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 27.931 awcf | Volume (actual conditions) | 53,483.5 awcfm |
| Volume Water | | | 46,889.0 adcfm |
| Vapor, Vw(std) | 1.977 scf | Volume (std. conditions) | 1,841,787.8 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 30,696.5 wscfm |
| Moisture (Bws) | 0.1233 | | 1,614,695.4 dscf/hr |
| Percent Moisture | 12.33 %v | | 26,911.6 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.94 lb/lb-mole | Dry Basis | 0.9 ppmv d |
| Wet (Ms) | 29.34 lb/lb-mole | Wet Basis | 0.9 ppmv a |
| | | $SO_2$ Concentration | 1.522E-07 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.25 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: FCC
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 2
DATE: 5/10/10
START TIME: 1000
END TIME: 1021

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.48 BAROMETRIC PRESSURE ("Hg)

- 170 PITOT
- [illegible] METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg)
- TRAIN LEAK TEST, (ft³/min)
- -.15 STATIC PRESSURE ("H2O)

- ——— NOZZLE #
- ——— NOZZLE DIA.
- M T/C READOUT
- 15 PRE / 13 POST
- 000 PRE / 001 POST
- 6021 STACK DIMENSIONS

21 TEST TIME

| Sample Point | Time (min) | Dry Gas Meter Reading (ft³) | Pitot Reading ^P( "H2O) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 202.000 | | | | | | | | | |
| 1 | 2 | | | 2.12 | 59 | 5 | —— | 42 | 352 | 17.7 | |
| 2 | 14 | | | 2.12 | 60 | 5 | | 42 | 352 | | |
| 3 | 21 | 222.248 | | 2.12 | 60 | 5 | | 42 | 352 | | |
| | | +15.248 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .25 | | | | | | 353 | | |
| 2 | | | .26 | | | | | | 353 | | |
| 3 | | | .30 | | | | | | 353 | | |
| 4 | | | .31 | | | | | | 353 | | |
| 5 | | | .34 | | | | | | 353 | | |
| 6 | | | .39 | | | | | | 352 | | |
| 7 | | | .41 | | | | | | 352 | | |
| 8 | | | .42 | | | | | | 352 | | |
| | | | | | | | | | | | |
| 1 | | | .24 | | | | | | 352 | | |
| 2 | | | .26 | | | | | | 352 | | |
| 3 | | | .30 | | | | | | 352 | | |
| 4 | | | .32 | | | | | | 351 | | |
| 5 | | | .35 | | | | | | 351 | | |
| 6 | | | .40 | | | | | | 351 | | |
| 7 | | | .42 | | | | | | 352 | | |
| 8 | | | .43 | | | | | | 352 | | |
| | | | | | | | | | | | |
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Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | cenex | RUN # | 2 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-10-10 |
| SOURCE TESTED: | H1001 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 646 |
| Initial Weight | 621 |
| Weight Gain | +25. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 638 |
| Initial Weight | 629 |
| Weight Gain | +9. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 506 |
| Initial Weight | 505 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 845 |
| Initial Weight | 838 |
| Weight Gain | +7. |

**Total Mass of Moisture Captured:** +42. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **3-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:30-10:51** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft.) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 224.200 | 0.26 | 2.12 | 60 | 348 | 0.5099 |
| 2 | 14 | | 0.25 | 2.12 | 61 | 348 | 0.5000 |
| 3 | 21 | | 0.29 | 2.12 | 61 | 348 | 0.5385 |
| 4 | | 239.910 | 0.31 | | | 348 | 0.5568 |
| 5 | | | 0.31 | | | 348 | 0.5568 |
| 6 | | | 0.40 | | | 348 | 0.6325 |
| 7 | | | 0.41 | | | 347 | 0.6403 |
| 8 | | | 0.43 | | | 347 | 0.6557 |
| 1 | | | 0.23 | | | 347 | 0.4796 |
| 2 | | | 0.25 | | | 347 | 0.5000 |
| 3 | | | 0.28 | | | 347 | 0.5292 |
| 4 | | | 0.32 | | | 346 | 0.5657 |
| 5 | | | 0.34 | | | 346 | 0.5831 |
| 6 | | | 0.42 | | | 346 | 0.6481 |
| 7 | | | 0.42 | | | 346 | 0.6481 |
| 8 | | | 0.43 | | | 346 | 0.6557 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.42 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 5.167 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.710 dcf | Stack Area | 20.969 sq.ft. |
| Water Volume | 39.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 2.8 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 3.5 ml |
| $\%CO_2$ Average | 17.6 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **3-SO2/GF** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5750 "$H_2O$ |
| Avg Meter Temp. (Tm) | 61 °F | Avg Stack Temp. (Ts) | 347 °F |
| Avg Meter Temp. (Tm) | 521 °A (°R) | Avg Stack Temp. (Ts) | 807 °A (°R) |
| Pressure Meter (Pm) | 26.576 "Hg | Pressure Stack (Ps) | 26.409 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.003 dscf | Velocity (Vs) | 42.08 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 27.421 awcf | Volume (actual conditions) | 52,942.5 awcfm |
| Volume Water | | | 46,806.5 adcfm |
| Vapor, Vw(std) | 1.836 scf | Volume (std. conditions) | 1,834,453.5 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 30,574.2 wscfm |
| Moisture (Bws) | 0.1159 | | 1,621,840.3 dscf/hr |
| Percent Moisture | 11.59 %v | | 27,030.7 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.93 lb/lb-mole | Dry Basis | 1.1 ppmv d |
| Wet (Ms) | 29.43 lb/lb-mole | Wet Basis | 1.1 ppmv a |
| | | $SO_2$ Concentration | 1.783E-07 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.29 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: #1001
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 3
DATE: 5/10/10
START TIME: 1030
END TIME: 1051

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.42 BAROMETRIC PRESSURE ("Hg)
- 1.20 PITOT
- BR METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg)
- TRAIN LEAK TEST, ($ft^3$/min)
- -.15 STATIC PRESSURE ("H2O)
- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- 15 PRE 14 POST
- 001 PRE 001 POST
- 6'2" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ΔP( "$H_2O$) | Meter ΔH | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 224.200 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 60 | 5 | — | 41 | 349 | 17.6 | |
| 2 | 14 | | | 2.12 | 61 | 5 | | 41 | 348 | | |
| 3 | 21 | 239.910 | | 2.12 | 61 | 5 | | 42 | 346 | | |
| | | +15.710 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .26 | | | | | | 348 | | |
| 2 | | | .25 | | | | | | 348 | | |
| 3 | | | .29 | | | | | | 348 | | |
| 4 | | | .31 | | | | | | 348 | | |
| 5 | | | .31 | | | | | | 348 | | |
| 6 | | | .40 | | | | | | 348 | | |
| 7 | | | .41 | | | | | | 347 | | |
| 8 | | | .43 | | | | | | 347 | | |
| | | | | | | | | | | | |
| 1 | | | .23 | | | | | | 347 | | |
| 2 | | | .25 | | | | | | 347 | | |
| 3 | | | .28 | | | | | | 347 | | |
| 4 | | | .32 | | | | | | 346 | | |
| 5 | | | .34 | | | | | | 346 | | |
| 6 | | | .42 | | | | | | 346 | | |
| 7 | | | .42 | | | | | | 346 | | |
| 8 | | | .43 | | | | | | 346 | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | cenex | RUN # | 3 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-10-10 |
| SOURCE TESTED: | H1001 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 678 |
| Initial Weight | 658 |
| Weight Gain | + 20. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 639 |
| Initial Weight | 629 |
| Weight Gain | + 10. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 491 |
| Initial Weight | 490 |
| Weight Gain | + 1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 840 |
| Initial Weight | 832 |
| Weight Gain | + 8. |

**Total Mass of Moisture Captured:** + 39. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **4-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:00-11:21** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 241.400 | 0.26 | 2.12 | 62 | 348 | 0.5099 |
| 2 | 14 | | 0.26 | 2.12 | 62 | 348 | 0.5099 |
| 3 | 21 | | 0.30 | 2.12 | 62 | 348 | 0.5477 |
| 4 | | 257.050 | 0.31 | | | 348 | 0.5568 |
| 5 | | | 0.34 | | | 348 | 0.5831 |
| 6 | | | 0.40 | | | 347 | 0.6325 |
| 7 | | | 0.41 | | | 347 | 0.6403 |
| 8 | | | 0.42 | | | 347 | 0.6481 |
| 1 | | | 0.23 | | | 347 | 0.4796 |
| 2 | | | 0.26 | | | 347 | 0.5099 |
| 3 | | | 0.28 | | | 346 | 0.5292 |
| 4 | | | 0.33 | | | 346 | 0.5745 |
| 5 | | | 0.36 | | | 347 | 0.6000 |
| 6 | | | 0.39 | | | 347 | 0.6245 |
| 7 | | | 0.41 | | | 347 | 0.6403 |
| 8 | | | 0.42 | | | 348 | 0.6481 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.42 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 5.167 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.650 dcf | Stack Area | 20.969 sq.ft. |
| Water Volume | 41.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 2.6 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 2.0 ml |
| $\%CO_2$ Average | 17.5 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **4-SO2/GF** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5772 "$H_2O$ |
| Avg Meter Temp. (Tm) | 62 °F | Avg Stack Temp. (Ts) | 347 °F |
| Avg Meter Temp. (Tm) | 522 °A (°R) | Avg Stack Temp. (Ts) | 807 °A (°R) |
| Pressure Meter (Pm) | 26.576 "Hg | Pressure Stack (Ps) | 26.409 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.922 dscf | Velocity (Vs) | 42.31 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 27.447 awcf | Volume (actual conditions) | 53,231.9 awcfm |
| Volume Water | | | 46,748.3 adcfm |
| Vapor, Vw(std) | 1.930 scf | Volume (std. conditions) | 1,844,480.2 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 30,741.3 wscfm |
| Moisture (Bws) | 0.1218 | | 1,619,822.5 dscf/hr |
| Percent Moisture | 12.18 %v | | 26,997.0 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.90 lb/lb-mole | Dry Basis | 0.6 ppmv d |
| Wet (Ms) | 29.33 lb/lb-mole | Wet Basis | 0.6 ppmv a |
| | | $SO_2$ Concentration | 1.025E-07 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.17 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: H1001
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 4
DATE: 5/10/10
START TIME: 1100
END TIME: 1121

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.42 BAROMETRIC PRESSURE ("Hg)

- 120 PITOT
- SB METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg)
- TRAIN LEAK TEST, ($ft^3$/min)
- -.15 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- 4
- 15 PRE 12 POST
- 000 PRE 002 POST
- 62" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ΔP( "$H_2O$) | Meter ΔH | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 241.400 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 62 | 5 | — | 42 | 347 | 17.5 | |
| 2 | 14 | | | 2.12 | 62 | 5 | | 43 | 348 | | |
| 3 | 21 | 257.050 | | 2.12 | 62 | 5 | | 43 | 348 | | |
| | | +15.650 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .26 | | | | | | 348 | | |
| 2 | | | .26 | | | | | | 348 | | |
| 3 | | | .30 | | | | | | 348 | | |
| 4 | | | .31 | | | | | | 348 | | |
| 5 | | | .34 | | | | | | 348 | | |
| 6 | | | .40 | | | | | | 347 | | |
| 7 | | | .41 | | | | | | 347 | | |
| 8 | | | .42 | | | | | | 347 | | |
| | | | | | | | | | | | |
| 1 | | | .23 | | | | | | 347 | | |
| 2 | | | .26 | | | | | | 347 | | |
| 3 | | | .28 | | | | | | 346 | | |
| 4 | | | .33 | | | | | | 346 | | |
| 5 | | | .36 | | | | | | 347 | | |
| 6 | | | .39 | | | | | | 347 | | |
| 7 | | | .41 | | | | | | 347 | | |
| 8 | | | .42 | | | | | | 348 | | |
| | | | | | | | | | | | |
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Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | cenex | RUN # | 4 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-10-10 |
| SOURCE TESTED: | H1001 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| Balance Zeroed: | ✓ | | |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 665 |
| Initial Weight | 646 |
| Weight Gain | +19. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 652 |
| Initial Weight | 638 |
| Weight Gain | +14. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 508 |
| Initial Weight | 506 |
| Weight Gain | +2. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 851 |
| Initial Weight | 845 |
| Weight Gain | +6. |

**Total Mass of Moisture Captured:** +41. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **5-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:30-11:51** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft.) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 258.500 | 0.25 | 2.12 | 62 | 345 | 0.5000 |
| 2 | 14 | | 0.26 | 2.12 | 63 | 345 | 0.5099 |
| 3 | 21 | | 0.30 | 2.12 | 64 | 344 | 0.5477 |
| 4 | | 274.270 | 0.30 | | | 344 | 0.5477 |
| 5 | | | 0.35 | | | 344 | 0.5916 |
| 6 | | | 0.39 | | | 343 | 0.6245 |
| 7 | | | 0.42 | | | 344 | 0.6481 |
| 8 | | | 0.42 | | | 344 | 0.6481 |
| 1 | | | 0.24 | | | 344 | 0.4899 |
| 2 | | | 0.25 | | | 344 | 0.5000 |
| 3 | | | 0.27 | | | 344 | 0.5196 |
| 4 | | | 0.33 | | | 345 | 0.5745 |
| 5 | | | 0.35 | | | 345 | 0.5916 |
| 6 | | | 0.42 | | | 345 | 0.6481 |
| 7 | | | 0.42 | | | 345 | 0.6481 |
| 8 | | | 0.43 | | | 345 | 0.6557 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.42 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 5.167 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.770 dcf | Stack Area | 20.969 sq.ft. |
| Water Volume | 40.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 2.7 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 3.0 ml |
| $\%CO_2$ Average | 17.5 %v dry | | |

**Client:** CHS, Inc. - Laurel Refinery **Test #:** 5-SO2/GF
**Source:** Zone D H1001 **Date:** 05/10/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5778 "$H_2O$ |
| Avg Meter Temp. (Tm) | 63 °F | Avg Stack Temp. (Ts) | 344 °F |
| Avg Meter Temp. (Tm) | 523 °A (°R) | Avg Stack Temp. (Ts) | 804 °A (°R) |
| Pressure Meter (Pm) | 26.576 "Hg | Pressure Stack (Ps) | 26.409 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.002 dscf | Velocity (Vs) | 42.24 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 27.399 awcf | Volume (actual conditions) | 53,143.8 awcfm |
| Volume Water | | | 46,846.3 adcfm |
| Vapor, Vw(std) | 1.883 scf | Volume (std. conditions) | 1,848,299.6 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 30,805.0 wscfm |
| Moisture (Bws) | 0.1185 | | 1,629,276.1 dscf/hr |
| Percent Moisture | 11.85 %v | | 27,154.6 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.91 lb/lb-mole | Dry Basis | 0.9 ppmv d |
| Wet (Ms) | 29.38 lb/lb-mole | Wet Basis | 0.9 ppmv a |
| | | $SO_2$ Concentration | 1.528E-07 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.25 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: #1001
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 5
DATE: 5/10/10
START TIME: 1130
END TIME: 1151

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.42 BAROMETRIC PRESSURE ("Hg)
- 120 PITOT
- SR METER BOX
- .99 Y FACTOR
- -.15 STATIC PRESSURE ("H2O)
- NOZZLE # 21
- NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 15 POST
- TRAIN LEAK TEST, ($ft^3$/min) .001 PRE .001 POST
- 62" STACK DIMENSIONS

TEST TIME

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ΔP( "$H_2O$) | Meter ΔH | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 258.500 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 62 | 5 | — | 43 | 345 | 17.5 | |
| 2 | 14 | | | 2.12 | 63 | 5 | | 43 | 344 | | |
| 3 | 21 | 274.270 | | 2.12 | 64 | 5 | | 43 | 346 | | |
| | ↘ | +15.770 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .25 | | | | | | 345 | | |
| 2 | | | .26 | | | | | | 345 | | |
| 3 | | | .30 | | | | | | 344 | | |
| 4 | | | .30 | | | | | | 344 | | |
| 5 | | | .35 | | | | | | 344 | | |
| 6 | | | .39 | | | | | | 343 | | |
| 7 | | | .42 | | | | | | 344 | | |
| 8 | | | .42 | | | | | | 344 | | |
| | | | | | | | | | | | |
| 1 | | | .24 | | | | | | 344 | | |
| 2 | | | .25 | | | | | | 344 | | |
| 3 | | | .27 | | | | | | 344 | | |
| 4 | | | .33 | | | | | | 345 | | |
| 5 | | | .35 | | | | | | 345 | | |
| 6 | | | .42 | | | | | | 345 | | |
| 7 | | | .42 | | | | | | 345 | | |
| 8 | | | .43 | | | | | | 345 | | |
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Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | cenex | RUN # | 5 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-10-10 |
| SOURCE TESTED: | H1001 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| Balance Zeroed: | ✓ | | |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 645 |
| Initial Weight | 624 |
| Weight Gain | +21. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 625 |
| Initial Weight | 615 |
| Weight Gain | +10. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 490 |
| Initial Weight | 490 |
| Weight Gain | 0 |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 849 |
| Initial Weight | 840 |
| Weight Gain | +9. |

**Total Mass of Moisture Captured:** +40. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **6-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:00-12:21** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 276.000 | 0.25 | 2.12 | 64 | 349 | 0.5000 |
| 2 | 14 | | 0.26 | 2.12 | 64 | 349 | 0.5099 |
| 3 | 21 | | 0.31 | 2.12 | 65 | 349 | 0.5568 |
| 4 | | 291.810 | 0.32 | | | 349 | 0.5657 |
| 5 | | | 0.34 | | | 349 | 0.5831 |
| 6 | | | 0.40 | | | 349 | 0.6325 |
| 7 | | | 0.41 | | | 350 | 0.6403 |
| 8 | | | 0.42 | | | 350 | 0.6481 |
| 1 | | | 0.24 | | | 350 | 0.4899 |
| 2 | | | 0.25 | | | 349 | 0.5000 |
| 3 | | | 0.30 | | | 349 | 0.5477 |
| 4 | | | 0.31 | | | 349 | 0.5568 |
| 5 | | | 0.36 | | | 348 | 0.6000 |
| 6 | | | 0.39 | | | 348 | 0.6245 |
| 7 | | | 0.41 | | | 348 | 0.6403 |
| 8 | | | 0.42 | | | 348 | 0.6481 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.42 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 5.167 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.810 dcf | Stack Area | 20.969 sq.ft. |
| Water Volume | 39.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 2.7 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 4.0 ml |
| $\%CO_2$ Average | 17.6 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **6-SO2/GF** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5777 "$H_2O$ |
| Avg Meter Temp. (Tm) | 64 °F | Avg Stack Temp. (Ts) | 349 °F |
| Avg Meter Temp. (Tm) | 524 °A (°R) | Avg Stack Temp. (Ts) | 809 °A (°R) |
| Pressure Meter (Pm) | 26.576 "Hg | Pressure Stack (Ps) | 26.409 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.011 dscf | Velocity (Vs) | 42.33 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 27.506 awcf | Volume (actual conditions) | 53,257.1 awcfm |
| Volume Water | | | 47,084.6 adcfm |
| Vapor, Vw(std) | 1.836 scf | Volume (std. conditions) | 1,840,790.0 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 30,679.8 wscfm |
| Moisture (Bws) | 0.1159 | | 1,627,442.4 dscf/hr |
| Percent Moisture | 11.59 %v | | 27,124.0 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.92 lb/lb-mole | Dry Basis | 1.2 ppmv d |
| Wet (Ms) | 29.42 lb/lb-mole | Wet Basis | 1.2 ppmv a |
| | | $SO_2$ Concentration | 2.036E-07 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.33 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: H1001
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 6
DATE: 5/10/10
START TIME: 1200
END TIME: 1221

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.45 BAROMETRIC PRESSURE ("Hg)

- 1.70 PITOT
- BR METER BOX
- .99 Y FACTOR
- -.15 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 13 POST
- TRAIN LEAK TEST, (ft³/min) .001 PRE .003 POST
- 62" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading (ft³) | Pitot Reading ^P( "H2O) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 276.000 | | | | | | | | | |
| 1 | 2 | | | 2.12 | 64 | 5 | — | 43 | 348 | 12.6 | |
| 2 | 14 | | | 2.12 | 64 | 5 | | 44 | 349 | | |
| 3 | 21 | 291.810 | | 2.12 | 65 | 5 | | 44 | 349 | | |
| | | +15.810 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .25 | | | | | | 349 | | |
| 2 | | | .26 | | | | | | 349 | | |
| 3 | | | .31 | | | | | | 349 | | |
| 4 | | | .32 | | | | | | 349 | | |
| 5 | | | .34 | | | | | | 349 | | |
| 6 | | | .40 | | | | | | 349 | | |
| 7 | | | .41 | | | | | | 350 | | |
| 8 | | | .42 | | | | | | 350 | | |
| | | | | | | | | | | | |
| 1 | | | .24 | | | | | | 350 | | |
| 2 | | | .25 | | | | | | 349 | | |
| 3 | | | .30 | | | | | | 349 | | |
| 4 | | | .31 | | | | | | 349 | | |
| 5 | | | .36 | | | | | | 348 | | |
| 6 | | | .39 | | | | | | 348 | | |
| 7 | | | .41 | | | | | | 348 | | |
| 8 | | | .42 | | | | | | 348 | | |
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Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | Cenex | RUN # | 6 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-10-10 |
| SOURCE TESTED: | H1001 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 691 |
| Initial Weight | 665 |
| Weight Gain | +26.1 |

**Impinger #2**

| | |
|---|---|
| Final Weight | 658 |
| Initial Weight | 652 |
| Weight Gain | +6. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 508 |
| Initial Weight | 508 |
| Weight Gain | 0 |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 858 |
| Initial Weight | 851 |
| Weight Gain | +7. |

**Total Mass of Moisture Captured:** +39. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **7-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:30-12:51** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 293.300 | 0.26 | 2.12 | 65 | 350 | 0.5099 |
| 2 | 14 | | 0.26 | 2.12 | 65 | 350 | 0.5099 |
| 3 | 21 | | 0.30 | 2.12 | 65 | 350 | 0.5477 |
| 4 | | 309.060 | 0.31 | | | 350 | 0.5568 |
| 5 | | | 0.35 | | | 349 | 0.5916 |
| 6 | | | 0.39 | | | 349 | 0.6245 |
| 7 | | | 0.41 | | | 349 | 0.6403 |
| 8 | | | 0.43 | | | 349 | 0.6557 |
| 1 | | | 0.23 | | | 349 | 0.4796 |
| 2 | | | 0.25 | | | 349 | 0.5000 |
| 3 | | | 0.28 | | | 348 | 0.5292 |
| 4 | | | 0.33 | | | 348 | 0.5745 |
| 5 | | | 0.36 | | | 348 | 0.6000 |
| 6 | | | 0.40 | | | 348 | 0.6325 |
| 7 | | | 0.42 | | | 348 | 0.6481 |
| 8 | | | 0.42 | | | 348 | 0.6481 |

## FIELD DATA INPUT: (CONTINUED)

| | |
|---|---|
| Barometric Pressure (Pb) | 26.42 "Hg |
| Static Pressure | -0.15 "$H_2O$ |
| Meter Cal. Factor | 0.99 Y |
| Pitot Factor (cp) | 0.84 |
| Total Test Time | 21 min |
| Sample Time Interval | 7 min |
| Meter Volume (Vm) | 15.760 dcf |
| Water Volume | 42.0 ml |

Method 3A

| | |
|---|---|
| %$O_2$ Average | 2.6 %v dry |

Orsat

| | |
|---|---|
| %$CO_2$ Average | 17.7 %v dry |

Stack Dimensional Data:

| | |
|---|---|
| Circular | |
| Diameter | 5.167 ft |
| Rectangular | |
| Width | 0.000 ft |
| Length | 0.000 ft |
| Stack Area | 20.969 sq.ft. |

$SO_2$ Analysis Titration

| | |
|---|---|
| Normality $Ba^{++}$ Solution | 0.0101 N |
| Vol. $Ba^{++}$ Solution | 3.5 ml |

**Client:** CHS, Inc. - Laurel Refinery
**Source:** Zone D H1001

**Test #:** 7-SO2/GF
**Date:** 05/10/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5780 "$H_2O$ |
| Avg Meter Temp. (Tm) | 65 °F | Avg Stack Temp. (Ts) | 349 °F |
| Avg Meter Temp. (Tm) | 525 °A (°R) | Avg Stack Temp. (Ts) | 809 °A (°R) |
| Pressure Meter (Pm) | 26.576 "Hg | Pressure Stack (Ps) | 26.409 "Hg |
| Standard Meter Volume, Vm(std) | 13.940 dscf | Stack Gas: Velocity (Vs) | 42.42 fps |
| Actual Meter Volume, Vm(actual) | 27.626 awcf | Volume (actual conditions) | 53,370.3 awcfm |
| | | | 46,741.7 adcfm |
| Volume Water Vapor, Vw(std) | 1.977 scf | Volume (std. conditions) | 1,844,703.8 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 30,745.1 wscfm |
| Moisture (Bws) | 0.1242 | | 1,615,591.6 dscf/hr |
| Percent Moisture | 12.42 %v | | 26,926.5 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.94 lb/lb-mole | Dry Basis | 1.1 ppmv d |
| Wet (Ms) | 29.33 lb/lb-mole | Wet Basis | 1.1 ppmv a |
| | | $SO_2$ Concentration | 1.791E-07 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.29 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION Laurel
SOURCE TESTED H1001
METER BOX OPERATOR: JW TECHNICIANS: DW

RUN #: 2
DATE: 5/10/10
START TIME: 1230
END TIME: 1251

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.42 BAROMETRIC PRESSURE ("Hg)

- 170 PITOT
- 38 METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg) 15
- TRAIN LEAK TEST, ($ft^3$/min) 001
- -.15 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- PRE 14 POST
- PRE 003 POST
- 62" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 293.300 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 65 | 5 | — | 44 | 350 | 17.4 | |
| 2 | 14 | | | 2.12 | 65 | 5 | | 44 | 347 | | |
| 3 | 21 | 309.060 | | 2.12 | 65 | 5 | | 44 | 349 | | |
| | ✓ | +15.760 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .26 | | | | | | 350 | | |
| 2 | | | .26 | | | | | | 350 | | |
| 3 | | | .30 | | | | | | 350 | | |
| 4 | | | .31 | | | | | | 350 | | |
| 5 | | | .35 | | | | | | 349 | | |
| 6 | | | .39 | | | | | | 349 | | |
| 7 | | | .41 | | | | | | 349 | | |
| 8 | | | .43 | | | | | | 349 | | |
| | | | | | | | | | | | |
| 1 | | | .23 | | | | | | 349 | | |
| 2 | | | .25 | | | | | | 349 | | |
| 3 | | | .28 | | | | | | 348 | | |
| 4 | | | .33 | | | | | | 348 | | |
| 5 | | | .36 | | | | | | 348 | | |
| 6 | | | .40 | | | | | | 348 | | |
| 7 | | | .42 | | | | | | 348 | | |
| 8 | | | .42 | | | | | | 348 | | |
| | | | | | | | | | | | |
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Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | cenex | RUN # | 7 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-10-10 |
| SOURCE TESTED: | H1001 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| Balance Zeroed: | ✓ | | |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 668 |
| Initial Weight | 645 |
| Weight Gain | +23. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 636 |
| Initial Weight | 625 |
| Weight Gain | +11. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 492 |
| Initial Weight | 490 |
| Weight Gain | +2. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 824 |
| Initial Weight | 818 |
| Weight Gain | +6. |

**Total Mass of Moisture Captured:** +42. grams

Notes:

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **8-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:00-13:21** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft.) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 310.500 | 0.26 | 2.12 | 66 | 344 | 0.5099 |
| 2 | 14 | | 0.26 | 2.12 | 66 | 344 | 0.5099 |
| 3 | 21 | | 0.31 | 2.12 | 67 | 345 | 0.5568 |
| 4 | | 326.340 | 0.31 | | | 345 | 0.5568 |
| 5 | | | 0.34 | | | 345 | 0.5831 |
| 6 | | | 0.39 | | | 345 | 0.6245 |
| 7 | | | 0.42 | | | 345 | 0.6481 |
| 8 | | | 0.43 | | | 345 | 0.6557 |
| 1 | | | 0.24 | | | 346 | 0.4899 |
| 2 | | | 0.25 | | | 346 | 0.5000 |
| 3 | | | 0.30 | | | 346 | 0.5477 |
| 4 | | | 0.33 | | | 347 | 0.5745 |
| 5 | | | 0.36 | | | 347 | 0.6000 |
| 6 | | | 0.39 | | | 347 | 0.6245 |
| 7 | | | 0.40 | | | 347 | 0.6325 |
| 8 | | | 0.42 | | | 347 | 0.6481 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.42 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 5.167 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.840 dcf | Stack Area | 20.969 sq.ft. |
| Water Volume | 40.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 2.5 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 2.0 ml |
| $\%CO_2$ Average | 17.7 %v dry | | |

**Client:** CHS, Inc. - Laurel Refinery
**Source:** Zone D H1001

**Test #:** 8-SO2/GF
**Date:** 05/10/10

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5789 "$H_2O$ |
| Avg Meter Temp. (Tm) | 66 °F | Avg Stack Temp. (Ts) | 346 °F |
| Avg Meter Temp. (Tm) | 526 °A (°R) | Avg Stack Temp. (Ts) | 806 °A (°R) |
| Pressure Meter (Pm) | 26.576 "Hg | Pressure Stack (Ps) | 26.409 "Hg |
| Standard Meter Volume, Vm(std) | 13.984 dscf | Stack Gas: Velocity (Vs) | 42.36 fps |
| Actual Meter Volume, Vm(actual) | 27.438 awcf | Volume (actual conditions) | 53,294.8 awcfm |
| | | | 46,968.7 adcfm |
| Volume Water Vapor, Vw(std) | 1.883 scf | Volume (std. conditions) | 1,848,951.1 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 30,815.9 wscfm |
| Moisture (Bws) | 0.1187 | | 1,629,480.6 dscf/hr |
| Percent Moisture | 11.87 %v | | 27,158.0 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.93 lb/lb-mole | Dry Basis | 0.6 ppmv d |
| Wet (Ms) | 29.40 lb/lb-mole | Wet Basis | 0.6 ppmv a |
| | | $SO_2$ Concentration | 1.020E-07 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.17 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION Laurel
SOURCE TESTED H1001
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 8
DATE: 5/10/18
START TIME: 1300
END TIME: 1321

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.42 BAROMETRIC PRESSURE ("Hg)

- 120 PITOT
- 85 METER BOX
- .99 Y FACTOR
- -.15 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- 74 T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 13 POST
- TRAIN LEAK TEST, ($ft^3$/min) 000 PRE 002 POST
- 6211 STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 310.500 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 66 | 5 | — | 43 | 343 | 17.7 | |
| 2 | 14 | | | 2.12 | 66 | 5 | | 43 | 344 | | |
| 3 | 21 | 326.340 | | 2.12 | 67 | 5 | | 44 | 347 | | |
| | ✓ | +15.840 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .26 | | | | | | 344 | | |
| 2 | | | .26 | | | | | | 344 | | |
| 3 | | | .31 | | | | | | 345 | | |
| 4 | | | .31 | | | | | | 345 | | |
| 5 | | | .34 | | | | | | 345 | | |
| 6 | | | .39 | | | | | | 345 | | |
| 7 | | | .42 | | | | | | 345 | | |
| 8 | | | .43 | | | | | | 345 | | |
| | | | | | | | | | | | |
| 1 | | | .24 | | | | | | 346 | | |
| 2 | | | .25 | | | | | | 346 | | |
| 3 | | | .30 | | | | | | 346 | | |
| 4 | | | .33 | | | | | | 347 | | |
| 5 | | | .36 | | | | | | 347 | | |
| 6 | | | .39 | | | | | | 347 | | |
| 7 | | | .40 | | | | | | 347 | | |
| 8 | | | .42 | | | | | | 347 | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | Cenex | RUN # | 8 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-10-10 |
| SOURCE TESTED: | H1001 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 649 |
| Initial Weight | 630 |
| Weight Gain | + 19. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 638 |
| Initial Weight | 625 |
| Weight Gain | + 13. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 507 |
| Initial Weight | 506 |
| Weight Gain | + 1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 842 |
| Initial Weight | 835 |
| Weight Gain | + 7. |

**Total Mass of Moisture Captured:** + 40. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **9-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:30-13:51** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft.) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 327.800 | 0.25 | 2.12 | 67 | 345 | 0.5000 |
| 2 | 14 | | 0.26 | 2.12 | 68 | 345 | 0.5099 |
| 3 | 21 | | 0.30 | 2.12 | 69 | 345 | 0.5477 |
| 4 | | 343.530 | 0.31 | | | 345 | 0.5568 |
| 5 | | | 0.35 | | | 345 | 0.5916 |
| 6 | | | 0.40 | | | 346 | 0.6325 |
| 7 | | | 0.41 | | | 346 | 0.6403 |
| 8 | | | 0.41 | | | 346 | 0.6403 |
| 1 | | | 0.23 | | | 346 | 0.4796 |
| 2 | | | 0.24 | | | 346 | 0.4899 |
| 3 | | | 0.28 | | | 346 | 0.5292 |
| 4 | | | 0.33 | | | 346 | 0.5745 |
| 5 | | | 0.36 | | | 345 | 0.6000 |
| 6 | | | 0.40 | | | 345 | 0.6325 |
| 7 | | | 0.41 | | | 345 | 0.6403 |
| 8 | | | 0.42 | | | 345 | 0.6481 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.42 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.15 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 5.167 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.730 dcf | Stack Area | 20.969 sq.ft. |
| Water Volume | 41.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| %$O_2$ Average | 2.6 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 2.5 ml |
| %$CO_2$ Average | 17.8 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **9-SO2/GF** |
| **Source:** | **Zone D H1001** | **Date:** | **05/10/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.5758 "$H_2O$ |
| Avg Meter Temp. (Tm) | 68 °F | Avg Stack Temp. (Ts) | 345 °F |
| Avg Meter Temp. (Tm) | 528 °A (°R) | Avg Stack Temp. (Ts) | 805 °A (°R) |
| Pressure Meter (Pm) | 26.576 "Hg | Pressure Stack (Ps) | 26.409 "Hg |
| Standard Meter Volume, Vm(std) | 13.835 dscf | Stack Gas: Velocity (Vs) | 42.13 fps |
| Actual Meter Volume, Vm(actual) | 27.225 awcf | Volume (actual conditions) | 53,005.4 awcfm |
| | | | 46,517.5 adcfm |
| Volume Water Vapor, Vw(std) | 1.930 scf | Volume (std. conditions) | 1,841,196.3 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 30,686.6 wscfm |
| Moisture (Bws) | 0.1224 | | 1,615,833.9 dscf/hr |
| Percent Moisture | 12.24 %v | | 26,930.6 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 30.95 lb/lb-mole | Dry Basis | 0.8 ppmv d |
| Wet (Ms) | 29.36 lb/lb-mole | Wet Basis | 0.8 ppmv a |
| | | $SO_2$ Concentration | 1.289E-07 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.21 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: #1001
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 9
DATE: 5/10/10
START TIME: 1330
END TIME: 1351

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.42 BAROMETRIC PRESSURE ("Hg)
- 1.70 PITOT
- 88 METER BOX
- .99 Y FACTOR
- -.15 STATIC PRESSURE ("H2O)
- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 14 POST
- TRAIN LEAK TEST, ($ft^3$/min) 000 PRE 001 POST
- 62" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ΔP("$H_2O$) | Meter ΔH | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 327.800 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 67 | 5 | — | 44 | 345 | 17.8 | |
| 2 | 14 | | | 2.12 | 68 | 5 | | 44 | 346 | | |
| 3 | 21 | 343.530 | | 2.12 | 69 | 5 | | 44 | 345 | | |
| | ↘ | +15.730 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .25 | | | | | | 345 | | |
| 2 | | | .26 | | | | | | 345 | | |
| 3 | | | .30 | | | | | | 345 | | |
| 4 | | | .31 | | | | | | 345 | | |
| 5 | | | .35 | | | | | | 345 | | |
| 6 | | | .40 | | | | | | 346 | | |
| 7 | | | .41 | | | | | | 346 | | |
| 8 | | | .41 | | | | | | 346 | | |
| | | | | | | | | | | | |
| 1 | | | .23 | | | | | | 346 | | |
| 2 | | | .24 | | | | | | 346 | | |
| 3 | | | .28 | | | | | | 346 | | |
| 4 | | | .33 | | | | | | 346 | | |
| 5 | | | .36 | | | | | | 345 | | |
| 6 | | | .40 | | | | | | 345 | | |
| 7 | | | .41 | | | | | | 345 | | |
| 8 | | | .42 | | | | | | 345 | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | cenex | RUN # | 9 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5-10-10 |
| SOURCE TESTED: | H1001 | | |
| Weighed By: | DW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 655 |
| Initial Weight | 629 |
| Weight Gain | +26. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 641 |
| Initial Weight | 636 |
| Weight Gain | + 5. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 493 |
| Initial Weight | 492 |
| Weight Gain | + 1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 833 |
| Initial Weight | 824 |
| Weight Gain | +9. |

**Total Mass of Moisture Captured:** +41. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

EEMC

# ORSAT SHEET

COMPANY NAME: Cemex
PLANT LOCATION: Laurel
SOURCE TESTED: H1001
TEST DATE: 5-10-10

| | Gas | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| Run # 1 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 17.7 | 17.7 | 17.6 | 17.7 |
| | $O_2$ | | | | |
| Run # 2 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 17.6 | 17.7 | 17.7 | 17.7 |
| | $O_2$ | | | | |
| Run # 3 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 17.6 | 17.6 | 17.6 | 17.6 |
| | $O_2$ | | | | |
| Run # 4 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 17.6 | 17.5 | 17.5 | 17.5 |
| | $O_2$ | | | | |
| Run # 5 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 17.5 | 17.5 | 17.5 | 17.5 |
| | $O_2$ | | | | |
| Run # 6 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 17.6 | 17.6 | 17.6 | 17.6 |
| | $O_2$ | | | | |
| Run # 7 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 17.6 | 17.7 | 17.7 | 17.7 |
| | $O_2$ | | | | |
| Run # 8 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 17.8 | 17.7 | 17.7 | 17.7 |
| | $O_2$ | | | | |
| Run # 9 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 17.8 | 17.8 | 17.8 | 17.8 |
| | $O_2$ | | | | |
| Run # | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | | | | |
| | $O_2$ | | | | |

Notes:

WorldDrive01:\Forms\Forms\Orsat3.xls
Revised 4/12/07 jmf

EEMC

# $SO_2$ ANALYSIS TITRATION

COMPANY NAME: Cenex DATE: 5-10-10

SOURCE TESTED: H1001 Normality $Ba(ClO_4)_2$ : .0101

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Run # | Blank | Total Volume | | Dilution: | | | |
| Aliquot (ml.) | 20 | Ba++ (ml.) | 0 | Blank (ml.) | | Total Titration: | 0 |
| Run # | 1 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 25 | Ba++ (ml.) | .1 | Blank (ml.) | 0 | Total Titration: | 2.0 |
| | | | .1 | | | | |
| Run # | 2 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 25 | Ba++ (ml.) | .15 | Blank (ml.) | 0 | Total Titration: | 3.0 |
| | | | .15 | | | | |
| Run # | 3 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 25 | Ba++ (ml.) | .15 | Blank (ml.) | 0 | Total Titration: | 3.5 |
| | | | .2 | | | | |
| Run # | 4 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 25 | Ba++ (ml.) | .1 | Blank (ml.) | 0 | Total Titration: | 2.0 |
| | | | .1 | | | | |
| Run # | 5 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 25 | Ba++ (ml.) | .15 | Blank (ml.) | 0 | Total Titration: | 3.0 |
| | | | .15 | | | | |
| Run # | 6 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 25 | Ba++ (ml.) | .2 | Blank (ml.) | 0 | Total Titration: | 4.0 |
| | | | .2 | | | | |
| Run # | 7 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 25 | Ba++ (ml.) | .2 | Blank (ml.) | 0 | Total Titration: | 3.5 |
| | | | .15 | | | | |
| Run # | 8 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 25 | Ba++ (ml.) | .1 | Blank (ml.) | 0 | Total Titration: | 2.0 |
| | | | .1 | | | | |
| Run # | 9 | Total Volume | 500 | Dilution: | | | |
| Aliquot (ml.) | 25 | Ba++ (ml.) | .1 | Blank (ml.) | 0 | Total Titration: | 2.5 |
| | | | .15 | | | | |

WorldDrive01:\Forms\Forms\SO2 Analysis Titration1.xls
Revised 06/25/07 jmf

**Reference Data**
**EPA Methods #3A & 7E**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **1-O2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:15-09:36** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| # | Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|
| 1 | 9:15 | 7.7 | 12.6 |
| 2 | 9:16 | 7.7 | 14.1 |
| 3 | 9:17 | 7.9 | 12.6 |
| 4 | 9:18 | 7.8 | 11.1 |
| 5 | 9:19 | 7.9 | 11.0 |
| 6 | 9:20 | 7.6 | 15.7 |
| 7 | 9:21 | 7.8 | 13.7 |
| 8 | 9:22 | 7.5 | 13.0 |
| 9 | 9:23 | 8.1 | 12.1 |
| 10 | 9:24 | 8.3 | 12.0 |
| 11 | 9:25 | 7.8 | 12.0 |
| 12 | 9:26 | 7.6 | 11.2 |
| 13 | 9:27 | 8.2 | 13.1 |
| 14 | 9:28 | 8.0 | 14.6 |
| 15 | 9:29 | 7.7 | 12.9 |
| 16 | 9:30 | 8.3 | 16.2 |
| 17 | 9:31 | 8.3 | 14.3 |
| 18 | 9:32 | 7.7 | 13.8 |
| 19 | 9:33 | 8.1 | 14.1 |
| 20 | 9:34 | 8.4 | 12.7 |
| 21 | 9:35 | 7.6 | 15.1 |
| 22 | 9:36 | 8.4 | 11.4 |
| **Averages:** | | **7.93** | **13.15** |

**Instrument Calibration Checks**

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE | |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) | |
| 8:26 | 0.0 | 0.0 | 0.0 | |
| 8:31 | 8.51 | 8.5 | 0.0 | |
| 8:35 | 20.5 | 20.5 | 0.0 | |
| **Initial Sys Bias Check** | **Tank Value** | **Instrument** | **System Bias, $SB_i$** | |
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | |
| 8:44 | 0.0 | 0.1 | 0.5 | |
| 8:42 | 8.51 | 8.5 | 0.0 | |
| **Post Sys Bias Check** | **Tank Value** | **Instrument** | **System Bias, $SB_f$** | **Drift, D ($SB_f$ - $SB_i$)** |
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 9:38 | 0.0 | 0.1 | 0.5 | 0.0 |
| 9:40 | 8.51 | 8.5 | 0.0 | 0.0 |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **1-O2NOx** |
| **Source :** | **Zone D SRU** | **Date:** | **05/11/10** |

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) |
| 8:26 | 0.0 | 0.1 | 0.1 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (05/03/11 FCC Logger) |

| Initial Sys Bias Check | Tank Value | Instrument | System Bias, $SB_i$ |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) |
| 8:50 | 0.0 | 0.2 | 0.2 |
| 8:48 | 51.5 | 51.3 | -0.2 |

| Post Sys Bias Check | Tank Value | Instrument | System Bias, $SB_f$ | Drift, D ($SB_f$- $SB_i$) |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 9:38 | 0.0 | 0.2 | 0.2 | 0.0 |
| 9:42 | 51.5 | 51.3 | -0.2 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $O_2$ | 26 | 23 seconds |
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.50 | "Hg |
| Static Pressure | -0.30 | "$H_2O$ |
| Ps | 26.478 | "Hg |
| Gas Flow | 12,972.2 | adcfm |
| Avg. Stack Temp, Ts | 908 | °F |
| | 1,368 | °A (°R) |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole | | |
| Act Conditions | 1127.955 | ft^3/lbmole |

**Calculations:**

Averages:

| | |
|---|---|
| $O_2$ | 7.93 % v/v d |
| NOx | 13.15 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| $O_2$ | 7.9 % v/v d |
| $NO_x$ | 13.1 ppm v/v d |

Mass Flow:

| | |
|---|---|
| $NO_x$ | 0.42 PPH |

**Reference Data**
**EPA Methods #3A & 7E**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **2-O2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:45-10:06** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| # | Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|
| 1 | 9:45 | 9.9 | 9.1 |
| 2 | 9:46 | 6.4 | 19.0 |
| 3 | 9:47 | 10.1 | 9.0 |
| 4 | 9:48 | 6.4 | 19.1 |
| 5 | 9:49 | 10.0 | 9.0 |
| 6 | 9:50 | 8.5 | 13.5 |
| 7 | 9:51 | 8.2 | 14.0 |
| 8 | 9:52 | 8.1 | 14.7 |
| 9 | 9:53 | 8.6 | 12.7 |
| 10 | 9:54 | 7.7 | 15.5 |
| 11 | 9:55 | 8.9 | 11.9 |
| 12 | 9:56 | 7.5 | 16.2 |
| 13 | 9:57 | 9.0 | 11.2 |
| 14 | 9:58 | 7.2 | 16.9 |
| 15 | 9:59 | 9.3 | 10.6 |
| 16 | 10:00 | 7.0 | 17.5 |
| 17 | 10:01 | 9.2 | 10.3 |
| 18 | 10:02 | 6.8 | 17.5 |
| 19 | 10:03 | 9.5 | 10.0 |
| 20 | 10:04 | 6.6 | 18.0 |
| 21 | 10:05 | 9.5 | 9.6 |
| 22 | 10:06 | 6.5 | 19.0 |
| **Averages:** | | **8.22** | **13.83** |

**Instrument Calibration Checks**

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) |
| 8:26 | 0.0 | 0.0 | 0.0 |
| 8:31 | 8.51 | 8.5 | 0.0 |
| 8:35 | 20.5 | 20.5 | 0.0 |

| Initial Sys Bias Check | Tank Value | Instrument | System Bias, $SB_i$ |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) |
| 9:38 | 0.0 | 0.1 | 0.5 |
| 9:40 | 8.51 | 8.5 | 0.0 |

| Post Sys Bias Check | Tank Value | Instrument | System Bias, $SB_f$ | Drift, D ($SB_f$ - $SB_i$) |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 10:08 | 0.0 | 0.1 | 0.5 | 0.0 |
| 10:10 | 8.51 | 8.5 | 0.0 | 0.0 |

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) |
| 8:26 | 0.0 | 0.1 | 0.1 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (05/03/11 FCC Logger) |

| Initial Sys Bias Check | Tank Value | Instrument | System Bias, $SB_i$ |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) |
| 9:38 | 0.0 | 0.2 | 0.2 |
| 9:42 | 51.5 | 51.3 | -0.2 |

| Post Sys Bias Check | Tank Value | Instrument | System Bias, $SB_f$ | Drift, D ($SB_f$ - $SB_i$) |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 10:08 | 0.0 | 0.2 | 0.2 | 0.0 |
| 10:12 | 51.5 | 51.2 | -0.3 | -0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $O_2$ | 26 | 23 seconds |
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.50 | "Hg |
| Static Pressure | -0.30 | "$H_2O$ |
| Ps | 26.478 | "Hg |
| Gas Flow | 12,884.7 | adcfm |
| Avg. Stack Temp, Ts | 893 | °F |
| | 1,353 | °A (°R) |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole | | |
| Act Conditions | 1115.587 | ft^3/lbmole |

**Calculations:**

Averages:

| | |
|---|---|
| $O_2$ | 8.22 % v/v d |
| NOx | 13.83 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| $O_2$ | 8.2 % v/v d |
| $NO_x$ | 13.8 ppm v/v d |

Mass Flow:

| | |
|---|---|
| $NO_x$ | 0.44 PPH |

**Reference Data**
**EPA Methods #3A & 7E**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **3-O2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:15-10:36** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| # | Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|
| 1 | 10:15 | 9.9 | 9.3 |
| 2 | 10:16 | 6.6 | 18.9 |
| 3 | 10:17 | 10.0 | 9.4 |
| 4 | 10:18 | 6.8 | 18.7 |
| 5 | 10:19 | 9.7 | 10.0 |
| 6 | 10:20 | 7.0 | 17.7 |
| 7 | 10:21 | 9.6 | 10.6 |
| 8 | 10:22 | 7.1 | 17.6 |
| 9 | 10:23 | 9.4 | 11.2 |
| 10 | 10:24 | 7.5 | 16.4 |
| 11 | 10:25 | 9.2 | 11.6 |
| 12 | 10:26 | 7.6 | 16.1 |
| 13 | 10:27 | 8.9 | 12.5 |
| 14 | 10:28 | 8.2 | 14.8 |
| 15 | 10:29 | 8.6 | 13.9 |
| 16 | 10:30 | 8.7 | 13.6 |
| 17 | 10:31 | 8.5 | 14.7 |
| 18 | 10:32 | 8.8 | 13.0 |
| 19 | 10:33 | 8.2 | 15.4 |
| 20 | 10:34 | 9.2 | 12.4 |
| 21 | 10:35 | 8.0 | 16.1 |
| 22 | 10:36 | 9.4 | 11.4 |
| **Averages:** | | **8.50** | **13.88** |

**Instrument Calibration Checks**

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE | |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) | |
| 8:26 | 0.0 | 0.0 | 0.0 | |
| 8:31 | 8.51 | 8.5 | 0.0 | |
| 8:35 | 20.5 | 20.4 | -0.5 | |
| **Initial Sys Bias Check** | **Tank Value** | **Instrument** | **System Bias, $SB_i$** | |
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | |
| 10:08 | 0.0 | 0.1 | 0.5 | |
| 10:10 | 8.51 | 8.5 | 0.0 | |
| **Post Sys Bias Check** | **Tank Value** | **Instrument** | **System Bias, $SB_f$** | **Drift, D ($SB_f$- $SB_i$)** |
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 10:38 | 0.0 | 0.1 | 0.5 | 0.0 |
| 10:40 | 8.51 | 8.5 | 0.0 | 0.0 |

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) |
| 8:26 | 0.0 | 0.1 | 0.1 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (05/03/11 FCC Logger) |

| Initial Sys Bias Check | Tank Value | Instrument | System Bias, $SB_i$ |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) |
| 10:08 | 0.0 | 0.2 | 0.2 |
| 10:12 | 51.5 | 51.2 | -0.3 |

| Post Sys Bias Check | Tank Value | Instrument | System Bias, $SB_f$ | Drift, D ($SB_f$- $SB_i$) |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 10:38 | 0.0 | 0.2 | 0.2 | 0.0 |
| 10:42 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $O_2$ | 26 | 23 seconds |
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.50 "Hg |
| Static Pressure | -0.30 "$H_2O$ |
| Ps | 26.478 "Hg |
| Gas Flow | 12,884.7 adcfm |
| Avg. Stack Temp, Ts | 893 °F |
| | 1,353 °A (°R) |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole | |
| Act Conditions | 1115.587 ft^3/lbmole |

**Calculations:**

Averages:

| | |
|---|---|
| $O_2$ | 8.50 % v/v d |
| NOx | 13.88 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| $O_2$ | 8.5 % v/v d |
| $NO_x$ | 13.8 ppm v/v d |

Mass Flow:

| | |
|---|---|
| $NO_x$ | 0.44 PPH |

**Reference Data**
**EPA Methods #3A & 7E**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **4-O2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:45-11:06** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| # | Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|
| 1 | 10:45 | 7.5 | 14.9 |
| 2 | 10:46 | 9.4 | 8.5 |
| 3 | 10:47 | 9.2 | 8.4 |
| 4 | 10:48 | 8.9 | 10.1 |
| 5 | 10:49 | 7.6 | 14.2 |
| 6 | 10:50 | 9.5 | 8.5 |
| 7 | 10:51 | 8.7 | 10.7 |
| 8 | 10:52 | 7.7 | 14.1 |
| 9 | 10:53 | 9.4 | 8.6 |
| 10 | 10:54 | 8.7 | 11.1 |
| 11 | 10:55 | 7.7 | 14.0 |
| 12 | 10:56 | 9.1 | 8.4 |
| 13 | 10:57 | 8.5 | 10.7 |
| 14 | 10:58 | 7.8 | 13.9 |
| 15 | 10:59 | 9.3 | 8.7 |
| 16 | 11:00 | 7.8 | 12.8 |
| 17 | 11:01 | 8.0 | 11.6 |
| 18 | 11:02 | 9.2 | 8.4 |
| 19 | 11:03 | 7.8 | 13.0 |
| 20 | 11:04 | 8.1 | 11.7 |
| 21 | 11:05 | 9.1 | 8.4 |
| 22 | 11:06 | 8.1 | 12.1 |
| **Averages:** | | **8.50** | **11.04** |

**Instrument Calibration Checks**

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE | |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) | |
| 8:26 | 0.0 | 0.0 | 0.0 | |
| 8:31 | 8.51 | 8.5 | 0.0 | |
| 8:35 | 20.5 | 20.4 | -0.5 | |
| **Initial Sys Bias Check** | **Tank Value** | **Instrument** | **System Bias, $SB_i$** | |
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | |
| 10:38 | 0.0 | 0.1 | 0.5 | |
| 10:40 | 8.51 | 8.5 | 0.0 | |
| **Post Sys Bias Check** | **Tank Value** | **Instrument** | **System Bias, $SB_f$** | **Drift, D ($SB_f$- $SB_i$)** |
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 11:08 | 0.0 | 0.1 | 0.5 | 0.0 |
| 11:10 | 8.51 | 8.6 | 0.4 | 0.4 |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **4-O2NOx** |
| **Source :** | **Zone D SRU** | **Date:** | **05/11/10** |

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) |
| 8:26 | 0.0 | 0.1 | 0.1 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (05/03/11 FCC Logger) |

| Initial Sys Bias Check | Tank Value | Instrument | System Bias, $SB_i$ |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) |
| 10:38 | 0.0 | 0.2 | 0.2 |
| 10:42 | 51.5 | 51.2 | -0.3 |

| Post Sys Bias Check | Tank Value | Instrument | System Bias, $SB_f$ | Drift, D ($SB_f$ - $SB_i$) |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 11:08 | 0.0 | 0.2 | 0.2 | 0.0 |
| 11:12 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $O_2$ | 26 | 23 seconds |
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.50 "Hg |
| Static Pressure | -0.30 "$H_2O$ |
| Ps | 26.478 "Hg |
| Gas Flow | 12,884.7 adcfm |
| Avg. Stack Temp, Ts | 893 °F |
| | 1,353 °A (°R) |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole | |
| Act Conditions | 1115.587 ft^3/lbmole |

**Calculations:**

Averages:

| | |
|---|---|
| $O_2$ | 8.50 % v/v d |
| NOx | 11.04 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| $O_2$ | 8.5 % v/v d |
| $NO_x$ | 10.9 ppm v/v d |

Mass Flow:

| | |
|---|---|
| $NO_x$ | 0.35 PPH |

**Reference Data**
**EPA Methods #3A & 7E**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **5-O2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:15-11:36** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| # | Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|
| 1 | 11:15 | 9.6 | 9.2 |
| 2 | 11:16 | 6.6 | 17.6 |
| 3 | 11:17 | 9.5 | 9.6 |
| 4 | 11:18 | 6.6 | 17.5 |
| 5 | 11:19 | 9.4 | 10.0 |
| 6 | 11:20 | 6.9 | 17.4 |
| 7 | 11:21 | 9.3 | 10.4 |
| 8 | 11:22 | 7.0 | 16.5 |
| 9 | 11:23 | 9.1 | 11.0 |
| 10 | 11:24 | 7.3 | 16.7 |
| 11 | 11:25 | 8.9 | 11.9 |
| 12 | 11:26 | 7.4 | 15.8 |
| 13 | 11:27 | 8.8 | 12.2 |
| 14 | 11:28 | 7.6 | 15.1 |
| 15 | 11:29 | 8.6 | 12.8 |
| 16 | 11:30 | 7.7 | 15.1 |
| 17 | 11:31 | 8.6 | 13.2 |
| 18 | 11:32 | 8.0 | 14.2 |
| 19 | 11:33 | 8.3 | 13.9 |
| 20 | 11:34 | 8.2 | 14.1 |
| 21 | 11:35 | 8.2 | 14.5 |
| 22 | 11:36 | 8.4 | 13.5 |
| **Averages:** | | **8.18** | **13.74** |

**Instrument Calibration Checks**

$O_2$ Instrument

| Calibration Error Tests | Tank Value | Instrument | Calibration Span, CS: | 20.5 % v/v Dry |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | System CE, SCE (< 2% of span) | |
| 8:26 | 0.0 | 0.0 | 0.0 | |
| 8:31 | 8.51 | 8.5 | 0.0 | |
| 8:35 | 20.5 | 20.4 | -0.5 | |
| **Initial Sys Bias Check** | **Tank Value** | **Instrument** | **System Bias, $SB_i$** | |
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | |
| 11:08 | 0.0 | 0.1 | 0.5 | |
| 11:10 | 8.51 | 8.6 | 0.4 | |
| **Post Sys Bias Check** | **Tank Value** | **Instrument** | **System Bias, $SB_f$** | **Drift, D ($SB_f$- $SB_i$)** |
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 11:38 | 0.0 | 0.0 | 0.0 | -0.5 |
| 11:40 | 8.51 | 8.6 | 0.4 | 0.0 |

## Instrument Calibration Checks - continued

$NO_x$ Instrument

Calibration Span, CS: 100.7 ppm v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) |
| 8:26 | 0.0 | 0.1 | 0.1 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (05/03/11 FCC Logger) |

| Initial Sys Bias Check | Tank Value | Instrument | System Bias, $SB_i$ |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) |
| 11:08 | 0.0 | 0.2 | 0.2 |
| 11:12 | 51.5 | 51.2 | -0.3 |

| Post Sys Bias Check | Tank Value | Instrument | System Bias, $SB_f$ | Drift, D ($SB_f$- $SB_i$) |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 11:38 | 0.0 | 0.3 | 0.3 | 0.1 |
| 11:42 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $O_2$ | 26 | 23 seconds |
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.50 "Hg |
| Static Pressure | -0.30 "$H_2O$ |
| Ps | 26.478 "Hg |
| Gas Flow | 12,884.7 adcfm |
| Avg. Stack Temp, Ts | 893 °F |
| | 1,353 °A (°R) |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole | |
| Act Conditions | 1115.587 ft^3/lbmole |

**Calculations:**

Averages:

| | |
|---|---|
| $O_2$ | 8.18 % v/v d |
| NOx | 13.74 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| $O_2$ | 8.1 % v/v d |
| $NO_x$ | 13.6 ppm v/v d |

Mass Flow:

| | |
|---|---|
| $NO_x$ | 0.43 PPH |

**Reference Data**
**EPA Methods #3A & 7E**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **6-O2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:45-12:06** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| # | Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|
| 1 | 11:45 | 7.3 | 16.4 |
| 2 | 11:46 | 9.5 | 11.0 |
| 3 | 11:47 | 7.2 | 17.2 |
| 4 | 11:48 | 9.6 | 10.7 |
| 5 | 11:49 | 7.2 | 18.1 |
| 6 | 11:50 | 9.8 | 10.1 |
| 7 | 11:51 | 6.8 | 18.4 |
| 8 | 11:52 | 10.0 | 9.8 |
| 9 | 11:53 | 6.9 | 19.0 |
| 10 | 11:54 | 10.3 | 9.4 |
| 11 | 11:55 | 6.7 | 19.2 |
| 12 | 11:56 | 10.2 | 9.6 |
| 13 | 11:57 | 6.7 | 19.0 |
| 14 | 11:58 | 10.3 | 9.6 |
| 15 | 11:59 | 6.9 | 19.2 |
| 16 | 12:00 | 10.1 | 10.0 |
| 17 | 12:01 | 6.9 | 18.4 |
| 18 | 12:02 | 10.0 | 10.1 |
| 19 | 12:03 | 7.5 | 17.0 |
| 20 | 12:04 | 9.5 | 11.2 |
| 21 | 12:05 | 8.1 | 15.1 |
| 22 | 12:06 | 9.0 | 12.9 |
| **Averages:** | | **8.48** | **14.15** |

**Instrument Calibration Checks**

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) |
| 8:26 | 0.0 | 0.0 | 0.0 |
| 8:31 | 8.51 | 8.5 | 0.0 |
| 8:35 | 20.5 | 20.4 | -0.5 |

| Initial Sys Bias Check | Tank Value | Instrument | System Bias, $SB_i$ |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) |
| 11:38 | 0.0 | 0.0 | 0.0 |
| 11:40 | 8.51 | 8.6 | 0.4 |

| Post Sys Bias Check | Tank Value | Instrument | System Bias, $SB_f$ | Drift, D ($SB_f$- $SB_i$) |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 12:08 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12:10 | 8.51 | 8.6 | 0.4 | 0.0 |

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) |
| 8:26 | 0.0 | 0.1 | 0.1 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (05/03/11 FCC Logger) |

| Initial Sys Bias Check | Tank Value | Instrument | System Bias, $SB_i$ |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) |
| 11:38 | 0.0 | 0.3 | 0.3 |
| 11:42 | 51.5 | 51.2 | -0.3 |

| Post Sys Bias Check | Tank Value | Instrument | System Bias, $SB_f$ | Drift, D ($SB_f$ - $SB_i$) |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 12:08 | 0.0 | 0.3 | 0.3 | 0.0 |
| 12:12 | 51.5 | 51.3 | -0.2 | 0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $O_2$ | 26 | 23 seconds |
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.50 "Hg |
| Static Pressure | -0.30 "$H_2O$ |
| Ps | 26.478 "Hg |
| Gas Flow | 12,884.7 adcfm |
| Avg. Stack Temp, Ts | 893 °F |
| | 1,353 °A (°R) |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole | |
| Act Conditions | 1115.587 ft^3/lbmole |

**Calculations:**

Averages:

| | |
|---|---|
| $O_2$ | 8.48 % v/v d |
| NOx | 14.15 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| $O_2$ | 8.4 % v/v d |
| $NO_x$ | 14.0 ppm v/v d |

Mass Flow:

| | |
|---|---|
| $NO_x$ | 0.45 PPH |

**Reference Data**
**EPA Methods #3A & 7E**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **7-O2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:15-12:36** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| # | Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|
| 1 | 12:15 | 10.1 | 9.3 |
| 2 | 12:16 | 6.8 | 18.6 |
| 3 | 12:17 | 10.1 | 9.5 |
| 4 | 12:18 | 7.1 | 17.3 |
| 5 | 12:19 | 9.5 | 10.2 |
| 6 | 12:20 | 8.2 | 14.3 |
| 7 | 12:21 | 8.6 | 13.7 |
| 8 | 12:22 | 9.1 | 11.5 |
| 9 | 12:23 | 7.7 | 16.4 |
| 10 | 12:24 | 9.9 | 9.7 |
| 11 | 12:25 | 6.9 | 18.2 |
| 12 | 12:26 | 10.1 | 9.2 |
| 13 | 12:27 | 6.7 | 18.6 |
| 14 | 12:28 | 10.0 | 9.3 |
| 15 | 12:29 | 7.2 | 17.6 |
| 16 | 12:30 | 9.6 | 10.3 |
| 17 | 12:31 | 8.0 | 14.9 |
| 18 | 12:32 | 8.9 | 12.6 |
| 19 | 12:33 | 8.6 | 13.7 |
| 20 | 12:34 | 8.3 | 14.4 |
| 21 | 12:35 | 9.0 | 12.6 |
| 22 | 12:36 | 8.0 | 15.9 |
| **Averages:** | | **8.56** | **13.54** |

**Instrument Calibration Checks**

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) |
| 8:26 | 0.0 | 0.0 | 0.0 |
| 8:31 | 8.51 | 8.5 | 0.0 |
| 8:35 | 20.5 | 20.4 | -0.5 |

| Initial Sys Bias Check | Tank Value | Instrument | System Bias, $SB_i$ |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) |
| 12:08 | 0.0 | 0.0 | 0.0 |
| 12:10 | 8.51 | 8.6 | 0.4 |

| Post Sys Bias Check | Tank Value | Instrument | System Bias, $SB_f$ | Drift, D ($SB_f$- $SB_i$) |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 12:38 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12:40 | 8.51 | 8.5 | 0.0 | -0.4 |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **7-O2NOx** |
| **Source :** | **Zone D SRU** | **Date:** | **05/11/10** |

**Instrument Calibration Checks - continued**

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) |
| 8:26 | 0.0 | 0.1 | 0.1 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (05/03/11 FCC Logger) |

| Initial Sys Bias Check | Tank Value | Instrument | System Bias, $SB_i$ |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) |
| 12:08 | 0.0 | 0.3 | 0.3 |
| 12:12 | 51.5 | 51.3 | -0.2 |

| Post Sys Bias Check | Tank Value | Instrument | System Bias, $SB_f$ | Drift, D ($SB_f$- $SB_i$) |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 12:38 | 0.0 | 0.3 | 0.3 | 0.0 |
| 12:42 | 51.5 | 51.3 | -0.2 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $O_2$ | 26 | 23 seconds |
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.50 "Hg |
| Static Pressure | -0.30 "$H_2O$ |
| Ps | 26.478 "Hg |
| Gas Flow | 12,884.7 adcfm |
| Avg. Stack Temp, Ts | 893 °F |
| | 1,353 °A (°R) |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole | |
| Act Conditions | 1115.587 ft^3/lbmole |

**Calculations:**

Averages:

| | |
|---|---|
| $O_2$ | 8.56 % v/v d |
| NOx | 13.54 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| $O_2$ | 8.5 % v/v d |
| $NO_x$ | 13.4 ppm v/v d |

Mass Flow:

| | |
|---|---|
| $NO_x$ | 0.43 PPH |

**Reference Data**
**EPA Methods #3A & 7E**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **8-O2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:45-13:06** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| # | Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|
| 1 | 12:45 | 10.1 | 9.5 |
| 2 | 12:46 | 6.7 | 19.4 |
| 3 | 12:47 | 10.4 | 9.2 |
| 4 | 12:48 | 6.7 | 19.3 |
| 5 | 12:49 | 10.1 | 9.6 |
| 6 | 12:50 | 7.1 | 18.3 |
| 7 | 12:51 | 9.9 | 10.4 |
| 8 | 12:52 | 7.4 | 17.2 |
| 9 | 12:53 | 9.5 | 11.4 |
| 10 | 12:54 | 8.2 | 14.8 |
| 11 | 12:55 | 8.8 | 13.3 |
| 12 | 12:56 | 9.0 | 12.9 |
| 13 | 12:57 | 8.2 | 15.4 |
| 14 | 12:58 | 9.3 | 11.5 |
| 15 | 12:59 | 7.8 | 16.6 |
| 16 | 13:00 | 8.8 | 10.9 |
| 17 | 13:01 | 7.5 | 17.4 |
| 18 | 13:02 | 8.9 | 10.3 |
| 19 | 13:03 | 7.1 | 17.9 |
| 20 | 13:04 | 9.2 | 9.9 |
| 21 | 13:05 | 7.0 | 18.7 |
| 22 | 13:06 | 8.5 | 9.7 |
| **Averages:** | | **8.46** | **13.80** |

**Instrument Calibration Checks**

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE | |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) | |
| 8:26 | 0.0 | 0.0 | 0.0 | |
| 8:31 | 8.51 | 8.5 | 0.0 | |
| 8:35 | 20.5 | 20.4 | -0.5 | |
| **Initial Sys Bias Check** | **Tank Value** | **Instrument** | **System Bias, $SB_i$** | |
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | |
| 12:38 | 0.0 | 0.0 | 0.0 | |
| 12:40 | 8.51 | 8.5 | 0.0 | |
| **Post Sys Bias Check** | **Tank Value** | **Instrument** | **System Bias, $SB_f$** | **Drift, D ($SB_f$- $SB_i$)** |
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 13:08 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13:10 | 8.51 | 8.5 | 0.0 | 0.0 |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **8-O2NOx** |
| **Source :** | **Zone D SRU** | **Date:** | **05/11/10** |

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) |
| 8:26 | 0.0 | 0.1 | 0.1 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (05/03/11 FCC Logger) |

| Initial Sys Bias Check | Tank Value | Instrument | System Bias, $SB_i$ |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) |
| 12:38 | 0.0 | 0.3 | 0.3 |
| 12:42 | 51.5 | 51.3 | -0.2 |

| Post Sys Bias Check | Tank Value | Instrument | System Bias, $SB_f$ | Drift, D ($SB_f$- $SB_i$) |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 13:08 | 0.0 | 0.3 | 0.3 | 0.0 |
| 13:12 | 51.5 | 51.2 | -0.3 | -0.1 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $O_2$ | 26 | 23 seconds |
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | | |
|---|---|---|
| Bar Pressure, Pb | 26.50 | "Hg |
| Static Pressure | -0.30 | "$H_2O$ |
| Ps | 26.478 | "Hg |
| Gas Flow | 12,884.7 | adcfm |
| Avg. Stack Temp, Ts | 893 | °F |
| | 1,353 | °A (°R) |
| $NO_x$ Molecular Wt. | 46 | |
| cu.ft/lb-mole | | |
| Act Conditions | 1115.587 | ft^3/lbmole |

**Calculations:**

Averages:

| | |
|---|---|
| $O_2$ | 8.46 % v/v d |
| NOx | 13.80 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| $O_2$ | 8.5 % v/v d |
| $NO_x$ | 13.6 ppm v/v d |

Mass Flow:

| | |
|---|---|
| $NO_x$ | 0.43 PPH |

**Reference Data**
**EPA Methods #3A & 7E**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Run #:** | **9-O2NOx** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:15-13:36** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| # | Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry |
|---|---|---|---|
| 1 | 13:15 | 7.5 | 17.4 |
| 2 | 13:16 | 9.8 | 11.2 |
| 3 | 13:17 | 7.9 | 16.5 |
| 4 | 13:18 | 9.5 | 12.3 |
| 5 | 13:19 | 8.3 | 15.4 |
| 6 | 13:20 | 9.4 | 13.2 |
| 7 | 13:21 | 8.9 | 14.5 |
| 8 | 13:22 | 9.0 | 14.6 |
| 9 | 13:23 | 9.3 | 13.4 |
| 10 | 13:24 | 8.6 | 15.6 |
| 11 | 13:25 | 9.6 | 11.9 |
| 12 | 13:26 | 7.9 | 16.9 |
| 13 | 13:27 | 9.0 | 12.7 |
| 14 | 13:28 | 7.8 | 11.1 |
| 15 | 13:29 | 8.3 | 16.1 |
| 16 | 13:30 | 7.8 | 11.0 |
| 17 | 13:31 | 7.6 | 15.8 |
| 18 | 13:32 | 8.7 | 11.8 |
| 19 | 13:33 | 8.1 | 14.7 |
| 20 | 13:34 | 8.1 | 16.4 |
| 21 | 13:35 | 7.8 | 13.2 |
| 22 | 13:36 | 8.2 | 14.0 |
| **Averages:** | | **8.50** | **14.08** |

**Instrument Calibration Checks**

$O_2$ Instrument — Calibration Span, CS: 20.5 % v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE | |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) | |
| 8:26 | 0.0 | 0.0 | 0.0 | |
| 8:31 | 8.51 | 8.5 | 0.0 | |
| 8:35 | 20.5 | 20.4 | -0.5 | |
| **Initial Sys Bias Check** | **Tank Value** | **Instrument** | **System Bias, $SB_i$** | |
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | |
| 13:08 | 0.0 | 0.0 | 0.0 | |
| 13:10 | 8.51 | 8.5 | 0.0 | |
| **Post Sys Bias Check** | **Tank Value** | **Instrument** | **System Bias, $SB_f$** | **Drift, D ($SB_f$- $SB_i$)** |
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 13:38 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13:40 | 8.51 | 8.5 | 0.0 | 0.0 |

## Instrument Calibration Checks - continued

$NO_x$ Instrument — Calibration Span, CS: 100.7 ppm v/v Dry

| Calibration Error Tests | Tank Value | Instrument | System CE, SCE |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_{Dir}$ | (< 2% of span) |
| 8:26 | 0.0 | 0.1 | 0.1 |
| 8:33 | 51.5 | 51.4 | -0.1 |
| 8:38 | 100.7 | 100.4 | -0.3 |
| 8:45 | 53.3 | 49.4 | (05/03/11 FCC Logger) |

| Initial Sys Bias Check | Tank Value | Instrument | System Bias, $SB_i$ |
|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) |
| 13:08 | 0.0 | 0.3 | 0.3 |
| 13:12 | 51.5 | 51.2 | -0.3 |

| Post Sys Bias Check | Tank Value | Instrument | System Bias, $SB_f$ | Drift, D ($SB_f$- $SB_i$) |
|---|---|---|---|---|
| Time | $C_v$ | Resp., $C_S$ | (< 5% of span) | (< 3% of span) |
| 13:38 | 0.0 | 0.3 | 0.3 | 0.0 |
| 13:42 | 51.5 | 51.2 | -0.3 | 0.0 |

| **Instrument Response Times:** | Zero | High |
|---|---|---|
| $O_2$ | 26 | 23 seconds |
| $NO_x$ | 34 | 31 seconds |

**Data From Concurrent Traverse:**

| | |
|---|---|
| Bar Pressure, Pb | 26.50 "Hg |
| Static Pressure | -0.30 "$H_2O$ |
| Ps | 26.478 "Hg |
| Gas Flow | 12,884.7 adcfm |
| Avg. Stack Temp, Ts | 893 °F |
| | 1,353 °A (°R) |
| $NO_x$ Molecular Wt. | 46 |
| cu.ft/lb-mole | |
| Act Conditions | 1115.587 ft^3/lbmole |

**Calculations:**

Averages:

| | |
|---|---|
| $O_2$ | 8.50 % v/v d |
| NOx | 14.08 ppm v/v d |

Calibration Corrected Values:

| | |
|---|---|
| $O_2$ | 8.5 % v/v d |
| $NO_x$ | 13.9 ppm v/v d |

Mass Flow:

| | |
|---|---|
| $NO_x$ | 0.44 PPH |

**CHS, Inc. - Laurel Refinery**
**Zone D SRU**
**$O_2/NO_x$ Computer Logger Data**
**05/11/10**

| Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|
| 8:20 | 0.0 | 0.1 | Initial Calibrations/Tank IDS |
| 8:21 | 0.0 | 0.1 | |
| 8:22 | 0.0 | 0.1 | **$O_2$ Tanks** |
| 8:23 | 0.0 | 0.1 | ET0003451 @ 8.51%; Exp. 09/28/12 |
| 8:24 | 0.0 | 0.1 | ET0003519 @ 20.5%; Exp. 06/19/12 |
| 8:25 | 0.0 | 0.1 | $O_2$ Instrument: Servomex 1400 |
| 8:26 | 0.0 | 0.1 | |
| 8:27 | 0.0 | 0.1 | **$NO_x$ Tanks** |
| 8:28 | 0.0 | 0.1 | LL82176 @ 51.5 ppm; Exp. 10-19-11 |
| 8:29 | 0.0 | 0.1 | LL31587 @ 100.7 ppm; Exp. 08-11-10 |
| 8:30 | 5.7 | 0.1 | LL82188 @ 53.3 ppm; Exp. 10-29-11 |
| 8:31 | 8.5 | 0.1 | $NO_x$ Instrument: CAI 400 |
| 8:32 | 1.5 | 32.6 | |
| 8:33 | 0.0 | 51.4 | |
| 8:34 | 15.4 | 6.4 | |
| 8:35 | 20.5 | 0.1 | |
| 8:36 | 2.9 | 0.1 | |
| 8:37 | 0.0 | 70.3 | |
| 8:38 | 0.0 | 100.3 | |
| 8:39 | 0.0 | 5.8 | |
| 8:40 | 0.0 | 0.1 | |
| 8:41 | 6.1 | 0.1 | $O_2$ Response Time |
| 8:42 | 8.5 | 0.1 | |
| 8:43 | 2.2 | 0.1 | $O_2$ Response Time |
| 8:44 | 0.1 | 0.1 | |
| 8:45 | 0.1 | 0.1 | |
| 8:46 | 0.1 | 0.1 | |
| 8:47 | 0.1 | 34.8 | $NO_x$ Response Time |
| 8:48 | 0.1 | 51.3 | |
| 8:49 | 0.1 | 8.1 | $NO_x$ Response Time |
| 8:50 | 0.1 | 0.2 | |
| 8:51 | 0.0 | 0.2 | |
| 8:52 | 0.0 | 0.2 | |
| 8:53 | 0.0 | 0.2 | |
| 8:54 | 0.0 | 0.2 | |
| 8:55 | 0.0 | 0.2 | |
| 8:56 | 0.0 | 0.2 | |
| 8:57 | 0.0 | 0.2 | |
| 8:58 | 0.0 | 0.2 | |
| 8:59 | 3.8 | 5.6 | |
| 9:00 | 8.2 | 12.9 | |

**CHS, Inc. - Laurel Refinery**
**Zone D SRU**
**$O_2/NO_x$ Computer Logger Data**
**05/11/10**

| Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|
| 9:01 | 8.4 | 16.5 | |
| 9:02 | 8.0 | 13.2 | |
| 9:03 | 7.7 | 12.8 | |
| 9:04 | 7.8 | 14.1 | |
| 9:05 | 7.8 | 14.9 | |
| 9:06 | 8.0 | 15.3 | |
| 9:07 | 8.5 | 12.9 | |
| 9:08 | 7.6 | 15.9 | |
| 9:09 | 8.1 | 13.7 | |
| 9:10 | 8.1 | 12.3 | |
| 9:11 | 8.3 | 11.2 | |
| 9:12 | 7.8 | 13.3 | |
| 9:13 | 7.5 | 13.2 | |
| 9:14 | 8.2 | 14.3 | |
| 9:15 | 7.7 | 12.6 | Start Run 1 |
| 9:16 | 7.7 | 14.1 | |
| 9:17 | 7.9 | 12.6 | |
| 9:18 | 7.8 | 11.1 | |
| 9:19 | 7.9 | 11.0 | |
| 9:20 | 7.6 | 15.7 | |
| 9:21 | 7.8 | 13.7 | |
| 9:22 | 7.5 | 13.0 | |
| 9:23 | 8.1 | 12.1 | |
| 9:24 | 8.3 | 12.0 | |
| 9:25 | 7.8 | 12.0 | |
| 9:26 | 7.6 | 11.2 | |
| 9:27 | 8.2 | 13.1 | |
| 9:28 | 8.0 | 14.6 | |
| 9:29 | 7.7 | 12.9 | |
| 9:30 | 8.3 | 16.2 | |
| 9:31 | 8.3 | 14.3 | |
| 9:32 | 7.7 | 13.8 | |
| 9:33 | 8.1 | 14.1 | |
| 9:34 | 8.4 | 12.7 | |
| 9:35 | 7.6 | 15.1 | |
| 9:36 | 8.4 | 11.4 | End Run 1 |
| 9:37 | 1.7 | 3.7 | |
| 9:38 | 0.1 | 0.2 | |
| 9:39 | 4.9 | 0.2 | |
| 9:40 | 8.5 | 0.2 | |
| 9:41 | 1.0 | 34.2 | |
| 9:42 | 0.1 | 51.3 | |

**CHS, Inc. - Laurel Refinery**
**Zone D SRU**
**$O_2/NO_x$ Computer Logger Data**
**05/11/10**

| Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|
| 9:43 | 0.1 | 5.1 | |
| 9:44 | 2.3 | 12.3 | |
| 9:45 | 9.9 | 9.1 | Start Run 2 |
| 9:46 | 6.4 | 19.0 | |
| 9:47 | 10.1 | 9.0 | |
| 9:48 | 6.4 | 19.1 | |
| 9:49 | 10.0 | 9.0 | |
| 9:50 | 8.5 | 13.5 | |
| 9:51 | 8.2 | 14.0 | |
| 9:52 | 8.1 | 14.7 | |
| 9:53 | 8.6 | 12.7 | |
| 9:54 | 7.7 | 15.5 | |
| 9:55 | 8.9 | 11.9 | |
| 9:56 | 7.5 | 16.2 | |
| 9:57 | 9.0 | 11.2 | |
| 9:58 | 7.2 | 16.9 | |
| 9:59 | 9.3 | 10.6 | |
| 10:00 | 7.0 | 17.5 | |
| 10:01 | 9.2 | 10.3 | |
| 10:02 | 6.8 | 17.5 | |
| 10:03 | 9.5 | 10.0 | |
| 10:04 | 6.6 | 18.0 | |
| 10:05 | 9.5 | 9.6 | |
| 10:06 | 6.5 | 19.0 | End Run 2 |
| 10:07 | 2.3 | 3.1 | |
| 10:08 | 0.1 | 0.2 | |
| 10:09 | 5.7 | 0.2 | |
| 10:10 | 8.5 | 0.2 | |
| 10:11 | 2.0 | 32.8 | |
| 10:12 | 0.1 | 51.2 | |
| 10:13 | 0.1 | 9.0 | |
| 10:14 | 2.7 | 15.5 | |
| 10:15 | 9.9 | 9.3 | Start Run 3 |
| 10:16 | 6.6 | 18.9 | |
| 10:17 | 10.0 | 9.4 | |
| 10:18 | 6.8 | 18.7 | |
| 10:19 | 9.7 | 10.0 | |
| 10:20 | 7.0 | 17.7 | |
| 10:21 | 9.6 | 10.6 | |
| 10:22 | 7.1 | 17.6 | |
| 10:23 | 9.4 | 11.2 | |
| 10:24 | 7.5 | 16.4 | |

**CHS, Inc. - Laurel Refinery**
**Zone D SRU**
**$O_2/NO_x$ Computer Logger Data**
**05/11/10**

| Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|
| 10:25 | 9.2 | 11.6 | |
| 10:26 | 7.6 | 16.1 | |
| 10:27 | 8.9 | 12.5 | |
| 10:28 | 8.2 | 14.8 | |
| 10:29 | 8.6 | 13.9 | |
| 10:30 | 8.7 | 13.6 | |
| 10:31 | 8.5 | 14.7 | |
| 10:32 | 8.8 | 13.0 | |
| 10:33 | 8.2 | 15.4 | |
| 10:34 | 9.2 | 12.4 | |
| 10:35 | 8.0 | 16.1 | |
| 10:36 | 9.4 | 11.4 | End Run 3 |
| 10:37 | 0.9 | 4.2 | |
| 10:38 | 0.1 | 0.2 | |
| 10:39 | 5.9 | 0.2 | |
| 10:40 | 8.5 | 0.2 | |
| 10:41 | 1.7 | 30.7 | |
| 10:42 | 0.1 | 51.2 | |
| 10:43 | 0.1 | 5.6 | |
| 10:44 | 3.3 | 14.3 | |
| 10:45 | 7.5 | 14.9 | Start Run 4 |
| 10:46 | 9.4 | 8.5 | |
| 10:47 | 9.2 | 8.4 | |
| 10:48 | 8.9 | 10.1 | |
| 10:49 | 7.6 | 14.2 | |
| 10:50 | 9.5 | 8.5 | |
| 10:51 | 8.7 | 10.7 | |
| 10:52 | 7.7 | 14.1 | |
| 10:53 | 9.4 | 8.6 | |
| 10:54 | 8.7 | 11.1 | |
| 10:55 | 7.7 | 14.0 | |
| 10:56 | 9.1 | 8.4 | |
| 10:57 | 8.5 | 10.7 | |
| 10:58 | 7.8 | 13.9 | |
| 10:59 | 9.3 | 8.7 | |
| 11:00 | 7.8 | 12.8 | |
| 11:01 | 8.0 | 11.6 | |
| 11:02 | 9.2 | 8.4 | |
| 11:03 | 7.8 | 13.0 | |
| 11:04 | 8.1 | 11.7 | |
| 11:05 | 9.1 | 8.4 | |
| 11:06 | 8.1 | 12.1 | End Run 4 |

**CHS, Inc. - Laurel Refinery**
**Zone D SRU**
**$O_2/NO_x$ Computer Logger Data**
**05/11/10**

| Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|
| 11:07 | 2.6 | 4.4 | |
| 11:08 | 0.1 | 0.2 | |
| 11:09 | 3.9 | 0.2 | |
| 11:10 | 8.6 | 0.2 | |
| 11:11 | 2.2 | 37.1 | |
| 11:12 | 0.1 | 51.2 | |
| 11:13 | 0.1 | 8.5 | |
| 11:14 | 4.7 | 12.6 | |
| 11:15 | 9.6 | 9.2 | Start Run 5 |
| 11:16 | 6.6 | 17.6 | |
| 11:17 | 9.5 | 9.6 | |
| 11:18 | 6.6 | 17.5 | |
| 11:19 | 9.4 | 10.0 | |
| 11:20 | 6.9 | 17.4 | |
| 11:21 | 9.3 | 10.4 | |
| 11:22 | 7.0 | 16.5 | |
| 11:23 | 9.1 | 11.0 | |
| 11:24 | 7.3 | 16.7 | |
| 11:25 | 8.9 | 11.9 | |
| 11:26 | 7.4 | 15.8 | |
| 11:27 | 8.8 | 12.2 | |
| 11:28 | 7.6 | 15.1 | |
| 11:29 | 8.6 | 12.8 | |
| 11:30 | 7.7 | 15.1 | |
| 11:31 | 8.6 | 13.2 | |
| 11:32 | 8.0 | 14.2 | |
| 11:33 | 8.3 | 13.9 | |
| 11:34 | 8.2 | 14.1 | |
| 11:35 | 8.2 | 14.5 | |
| 11:36 | 8.4 | 13.5 | End Run 5 |
| 11:37 | 1.8 | 4.0 | |
| 11:38 | 0.0 | 0.3 | |
| 11:39 | 4.8 | 0.3 | |
| 11:40 | 8.6 | 0.2 | |
| 11:41 | 2.0 | 28.6 | |
| 11:42 | 0.1 | 51.2 | |
| 11:43 | 0.1 | 5.1 | |
| 11:44 | 4.6 | 11.8 | |
| 11:45 | 7.3 | 16.4 | Start Run 6 |
| 11:46 | 9.5 | 11.0 | |
| 11:47 | 7.2 | 17.2 | |
| 11:48 | 9.6 | 10.7 | |

**CHS, Inc. - Laurel Refinery**
**Zone D SRU**
**$O_2/NO_x$ Computer Logger Data**
**05/11/10**

| Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|
| 11:49 | 7.2 | 18.1 | |
| 11:50 | 9.8 | 10.1 | |
| 11:51 | 6.8 | 18.4 | |
| 11:52 | 10.0 | 9.8 | |
| 11:53 | 6.9 | 19.0 | |
| 11:54 | 10.3 | 9.4 | |
| 11:55 | 6.7 | 19.2 | |
| 11:56 | 10.2 | 9.6 | |
| 11:57 | 6.7 | 19.0 | |
| 11:58 | 10.3 | 9.6 | |
| 11:59 | 6.9 | 19.2 | |
| 12:00 | 10.1 | 10.0 | |
| 12:01 | 6.9 | 18.4 | |
| 12:02 | 10.0 | 10.1 | |
| 12:03 | 7.5 | 17.0 | |
| 12:04 | 9.5 | 11.2 | |
| 12:05 | 8.1 | 15.1 | |
| 12:06 | 9.0 | 12.9 | End Run 6 |
| 12:07 | 2.6 | 4.1 | |
| 12:08 | 0.0 | 0.3 | |
| 12:09 | 5.7 | 0.3 | |
| 12:10 | 8.6 | 0.3 | |
| 12:11 | 2.1 | 32.6 | |
| 12:12 | 0.1 | 51.3 | |
| 12:13 | 0.1 | 10.4 | |
| 12:14 | 2.7 | 14.2 | |
| 12:15 | 10.1 | 9.3 | Start Run 7 |
| 12:16 | 6.8 | 18.6 | |
| 12:17 | 10.1 | 9.5 | |
| 12:18 | 7.1 | 17.3 | |
| 12:19 | 9.5 | 10.2 | |
| 12:20 | 8.2 | 14.3 | |
| 12:21 | 8.6 | 13.7 | |
| 12:22 | 9.1 | 11.5 | |
| 12:23 | 7.7 | 16.4 | |
| 12:24 | 9.9 | 9.7 | |
| 12:25 | 6.9 | 18.2 | |
| 12:26 | 10.1 | 9.2 | |
| 12:27 | 6.7 | 18.6 | |
| 12:28 | 10.0 | 9.3 | |
| 12:29 | 7.2 | 17.6 | |
| 12:30 | 9.6 | 10.3 | |

**CHS, Inc. - Laurel Refinery**
**Zone D SRU**
**$O_2/NO_x$ Computer Logger Data**
**05/11/10**

| Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|
| 12:31 | 8.0 | 14.9 | |
| 12:32 | 8.9 | 12.6 | |
| 12:33 | 8.6 | 13.7 | |
| 12:34 | 8.3 | 14.4 | |
| 12:35 | 9.0 | 12.6 | |
| 12:36 | 8.0 | 15.9 | End Run 7 |
| 12:37 | 1.2 | 3.7 | |
| 12:38 | 0.0 | 0.3 | |
| 12:39 | 5.4 | 0.3 | |
| 12:40 | 8.5 | 0.3 | |
| 12:41 | 2.6 | 38.2 | |
| 12:42 | 0.0 | 51.3 | |
| 12:43 | 0.0 | 11.1 | |
| 12:44 | 3.6 | 16.1 | |
| 12:45 | 10.1 | 9.5 | Start Run 8 |
| 12:46 | 6.7 | 19.4 | |
| 12:47 | 10.4 | 9.2 | |
| 12:48 | 6.7 | 19.3 | |
| 12:49 | 10.1 | 9.6 | |
| 12:50 | 7.1 | 18.3 | |
| 12:51 | 9.9 | 10.4 | |
| 12:52 | 7.4 | 17.2 | |
| 12:53 | 9.5 | 11.4 | |
| 12:54 | 8.2 | 14.8 | |
| 12:55 | 8.8 | 13.3 | |
| 12:56 | 9.0 | 12.9 | |
| 12:57 | 8.2 | 15.4 | |
| 12:58 | 9.3 | 11.5 | |
| 12:59 | 7.8 | 16.6 | |
| 13:00 | 8.8 | 10.9 | |
| 13:01 | 7.5 | 17.4 | |
| 13:02 | 8.9 | 10.3 | |
| 13:03 | 7.1 | 17.9 | |
| 13:04 | 9.2 | 9.9 | |
| 13:05 | 7.0 | 18.7 | |
| 13:06 | 8.5 | 9.7 | End Run 8 |
| 13:07 | 2.3 | 2.6 | |
| 13:08 | 0.0 | 0.3 | |
| 13:09 | 6.3 | 0.3 | |
| 13:10 | 8.5 | 0.3 | |
| 13:11 | 2.1 | 27.9 | |
| 13:12 | 0.0 | 51.2 | |

**CHS, Inc. - Laurel Refinery**
**Zone D SRU**
**$O_2$/$NO_x$ Computer Logger Data**
**05/11/10**

| Time | $O_2$ - % v/v Dry | $NO_x$ - ppm v/v Dry | Comments |
|---|---|---|---|
| 13:13 | 0.0 | 6.8 | |
| 13:14 | 3.3 | 13.2 | |
| 13:15 | 7.5 | 17.4 | Start Run 9 |
| 13:16 | 9.8 | 11.2 | |
| 13:17 | 7.9 | 16.5 | |
| 13:18 | 9.5 | 12.3 | |
| 13:19 | 8.3 | 15.4 | |
| 13:20 | 9.4 | 13.2 | |
| 13:21 | 8.9 | 14.5 | |
| 13:22 | 9.0 | 14.6 | |
| 13:23 | 9.3 | 13.4 | |
| 13:24 | 8.6 | 15.6 | |
| 13:25 | 9.6 | 11.9 | |
| 13:26 | 7.9 | 16.9 | |
| 13:27 | 9.0 | 12.7 | |
| 13:28 | 7.8 | 11.1 | |
| 13:29 | 8.3 | 16.1 | |
| 13:30 | 7.8 | 11.0 | |
| 13:31 | 7.6 | 15.8 | |
| 13:32 | 8.7 | 11.8 | |
| 13:33 | 8.1 | 14.7 | |
| 13:34 | 8.1 | 16.4 | |
| 13:35 | 7.8 | 13.2 | |
| 13:36 | 8.2 | 14.0 | End Run 9 |
| 13:37 | 1.6 | 3.6 | |
| 13:38 | 0.0 | 0.3 | |
| 13:39 | 4.8 | 0.3 | |
| 13:40 | 8.5 | 0.2 | |
| 13:41 | 2.4 | 33.2 | |
| 13:42 | 0.0 | 51.2 | |
| 13:43 | 0.0 | 8.3 | |
| 13:44 | 0.0 | 0.3 | |
| 13:45 | 0.0 | 0.3 | |
| 13:46 | 0.0 | 0.2 | |
| 13:47 | 0.0 | 0.2 | |
| 13:48 | 0.0 | 0.2 | |
| 13:49 | 0.0 | 0.3 | |

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **1-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:15-09:36** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 347.000 | 0.43 | 2.12 | 57 | 909 | 0.6557 |
| 2 | 14 | | 0.44 | 2.12 | 58 | 909 | 0.6633 |
| 3 | 21 | | 0.45 | 2.12 | 58 | 909 | 0.6708 |
| 4 | | 362.720 | 0.45 | | | 909 | 0.6708 |
| 5 | | | 0.44 | | | 908 | 0.6633 |
| 6 | | | 0.44 | | | 908 | 0.6633 |
| 1 | | | 0.43 | | | 908 | 0.6557 |
| 2 | | | 0.43 | | | 908 | 0.6557 |
| 3 | | | 0.44 | | | 907 | 0.6633 |
| 4 | | | 0.45 | | | 907 | 0.6708 |
| 5 | | | 0.44 | | | 907 | 0.6633 |
| 6 | | | 0.43 | | | 907 | 0.6557 |

## FIELD DATA INPUT: (CONTINUED)

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.50 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 2.208 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.720 dcf | Stack Area | 3.829 sq.ft. |
| Water Volume | 47.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 7.9 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 43.75 ml |
| $\%CO_2$ Average | 3.7 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **1-SO2/GF** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.6626 "$H_2O$ |
| Avg Meter Temp. (Tm) | 58 °F | Avg Stack Temp. (Ts) | 908 °F |
| Avg Meter Temp. (Tm) | 518 °A (°R) | Avg Stack Temp. (Ts) | 1,368 °A (°R) |
| Pressure Meter (Pm) | 26.656 "Hg | Pressure Stack (Ps) | 26.478 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.135 dscf | Velocity (Vs) | 65.30 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 47.851 awcf | Volume (actual conditions) | 15,002.0 awcfm |
| Volume Water | | | 12,972.2 adcfm |
| Vapor, Vw(std) | 2.212 scf | Volume (std. conditions) | 307,448.6 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 5,124.1 wscfm |
| Moisture (Bws) | 0.1353 | | 265,850.8 dscf/hr |
| Percent Moisture | 13.53 %v | | 4,430.8 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 28.91 lb/lb-mole | Dry Basis | 13.3 ppmv d |
| Wet (Ms) | 27.43 lb/lb-mole | Wet Basis | 13.3 ppmv a |
| | | $SO_2$ Concentration | 2.200E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.58 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: Zone D SRU
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #:
DATE: 5/11/10
START TIME: 915
END TIME: 936

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.50 BAROMETRIC PRESSURE ("Hg)

- 170 PITOT
- 3R METER BOX
- .99 Y FACTOR
- 15 TRAIN LEAK TEST VACUUM, ("Hg)
- 001 TRAIN LEAK TEST, (ft³/min)
- .30 STATIC PRESSURE ("H2O)

- NOZZLE # 21
- NOZZLE DIA.
- M T/C READOUT
- PRE 14 POST
- PRE 003 POST
- 26.51 STACK DIMENSIONS

TEST TIME

| Sample Point | Time (min) | Dry Gas Meter Reading (ft³) | Pitot Reading ^P( "H₂O) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 347.000 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 57 | 5 | — | 43 | 884 | 3.7 | |
| 2 | 14 | | | 2.12 | 58 | 5 | | 41 | 909 | | |
| 3 | 21 | 362.720 | | 2.12 | 58 | 5 | | 42 | 873 | | |
| | | +15.720 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 909 | | |
| 2 | | | .44 | | | | | | 909 | | |
| 3 | | | .45 | | | | | | 909 | | |
| 4 | | | .45 | | | | | | 909 | | |
| 5 | | | .44 | | | | | | 908 | | |
| 6 | | | .44 | | | | | | 908 | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 908 | | |
| 2 | | | .43 | | | | | | 908 | | |
| 3 | | | .44 | | | | | | 908 | | |
| 4 | | | .45 | | | | | | 908 | | |
| 5 | | | .44 | | | | | | 908 | | |
| 6 | | | .43 | | | | | | 908 | | |

Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 1 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5/11/10 |
| SOURCE TESTED: | Zone D SRU | | |
| Weighed By: | JW | Balance Level: ✓ | Balance Zeroed: ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 650 |
| Initial Weight | 623 |
| Weight Gain | + 27. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 657 |
| Initial Weight | 651 |
| Weight Gain | + 6. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 504 |
| Initial Weight | 503 |
| Weight Gain | + 1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 807 |
| Initial Weight | 794 |
| Weight Gain | + 13. |

**Total Mass of Moisture Captured:** + 47. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **2-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **09:45-10:06** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 364.300 | 0.44 | 2.12 | 59 | 893 | 0.6633 |
| 2 | 14 | | 0.43 | 2.12 | 59 | 893 | 0.6557 |
| 3 | 21 | | 0.44 | 2.12 | 59 | 894 | 0.6633 |
| 4 | | 379.950 | 0.45 | | | 894 | 0.6708 |
| 5 | | | 0.45 | | | 894 | 0.6708 |
| 6 | | | 0.44 | | | 893 | 0.6633 |
| 1 | | | 0.43 | | | 893 | 0.6557 |
| 2 | | | 0.44 | | | 893 | 0.6633 |
| 3 | | | 0.44 | | | 892 | 0.6633 |
| 4 | | | 0.45 | | | 892 | 0.6708 |
| 5 | | | 0.45 | | | 892 | 0.6708 |
| 6 | | | 0.46 | | | 891 | 0.6782 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.50 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 2.208 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.650 dcf | Stack Area | 3.829 sq.ft. |
| Water Volume | 49.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 8.2 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 43.75 ml |
| $\%CO_2$ Average | 3.8 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **2-SO2/GF** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.6658 "$H_2O$ |
| Avg Meter Temp. (Tm) | 59 °F | Avg Stack Temp. (Ts) | 893 °F |
| Avg Meter Temp. (Tm) | 519 °A (°R) | Avg Stack Temp. (Ts) | 1,353 °A (°R) |
| Pressure Meter (Pm) | 26.656 "Hg | Pressure Stack (Ps) | 26.478 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.045 dscf | Velocity (Vs) | 65.29 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 47.337 awcf | Volume (actual conditions) | 14,999.7 awcfm |
| Volume Water | | | 12,884.7 adcfm |
| Vapor, Vw(std) | 2.306 scf | Volume (std. conditions) | 310,809.5 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 5,180.2 wscfm |
| Moisture (Bws) | 0.1410 | | 266,985.4 dscf/hr |
| Percent Moisture | 14.10 %v | | 4,449.8 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 28.94 lb/lb-mole | Dry Basis | 13.4 ppmv d |
| Wet (Ms) | 27.40 lb/lb-mole | Wet Basis | 13.4 ppmv a |
| | | $SO_2$ Concentration | 2.200E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.59 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: Zone D SRU
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 2
DATE: 5/11/10
START TIME: 945
END TIME: 1086

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.52 BAROMETRIC PRESSURE ("Hg)
- 170 PITOT
- BR METER BOX
- .84 Y FACTOR
- -.30 STATIC PRESSURE ("H2O)
- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 14 POST
- TRAIN LEAK TEST, ($ft^3$/min) .001 PRE .002 POST
- 26.53 STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3C4.300 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 59 | 5 | | 43 | 914 | 3.8 | |
| 2 | 14 | | | 2.12 | 59 | 5 | | 44 | 893 | | |
| 3 | 21 | 329.950 | | 2.12 | 59 | 5 | | 44 | 885 | | |
| | | +15.650 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .44 | | | | | | 893 | | |
| 2 | | | .43 | | | | | | 893 | | |
| 3 | | | .44 | | | | | | 894 | | |
| 4 | | | .45 | | | | | | 894 | | |
| 5 | | | .45 | | | | | | 894 | | |
| 6 | | | .44 | | | | | | 893 | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 893 | | |
| 2 | | | .44 | | | | | | 893 | | |
| 3 | | | .44 | | | | | | 892 | | |
| 4 | | | .45 | | | | | | 892 | | |
| 5 | | | .45 | | | | | | 892 | | |
| 6 | | | .46 | | | | | | 891 | | |

Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 2 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5/11/18 |
| SOURCE TESTED: | Zone D SRU | | |
| Weighed By: | JW | Balance Level: | ✓ |
| Balance Zeroed: | ✓ | | |

**Weight (grams)**

**Impinger #1**

Final Weight 672
Initial Weight 643
Weight Gain +29.

**Impinger #2**

Final Weight 625
Initial Weight 618
Weight Gain +7.

**Impinger #3**

Final Weight 498
Initial Weight 496
Weight Gain +2.

**Impinger #4 (if applicable)**

Final Weight
Initial Weight
Weight Gain

**Silica Gel Impinger**

Final Weight 821
Initial Weight 810
Weight Gain +11.

**Total Mass of Moisture Captured:** +49. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **3-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:15-10:36** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 381.500 | 0.45 | 2.12 | 59 | 882 | 0.6708 |
| 2 | 14 | | 0.44 | 2.12 | 60 | 882 | 0.6633 |
| 3 | 21 | | 0.44 | 2.12 | 60 | 883 | 0.6633 |
| 4 | | 397.080 | 0.43 | | | 883 | 0.6557 |
| 5 | | | 0.44 | | | 883 | 0.6633 |
| 6 | | | 0.45 | | | 883 | 0.6708 |
| 1 | | | 0.43 | | | 883 | 0.6557 |
| 2 | | | 0.45 | | | 883 | 0.6708 |
| 3 | | | 0.44 | | | 884 | 0.6633 |
| 4 | | | 0.44 | | | 884 | 0.6633 |
| 5 | | | 0.45 | | | 884 | 0.6708 |
| 6 | | | 0.44 | | | 884 | 0.6633 |

## FIELD DATA INPUT: (CONTINUED)

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.50 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 2.208 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.580 dcf | Stack Area | 3.829 sq.ft. |
| Water Volume | 48.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 8.5 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 45.63 ml |
| $\%CO_2$ Average | 3.7 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **3-SO2/GF** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.6645 "$H_2O$ |
| Avg Meter Temp. (Tm) | 60 °F | Avg Stack Temp. (Ts) | 883 °F |
| Avg Meter Temp. (Tm) | 520 °A (°R) | Avg Stack Temp. (Ts) | 1,343 °A (°R) |
| Pressure Meter (Pm) | 26.656 "Hg | Pressure Stack (Ps) | 26.478 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.955 dscf | Velocity (Vs) | 64.91 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 46.594 awcf | Volume (actual conditions) | 14,912.4 awcfm |
| Volume Water | | | 12,835.1 adcfm |
| Vapor, Vw(std) | 2.259 scf | Volume (std. conditions) | 311,301.3 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 5,188.4 wscfm |
| Moisture (Bws) | 0.1393 | | 267,937.0 dscf/hr |
| Percent Moisture | 13.93 %v | | 4,465.6 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 28.93 lb/lb-mole | Dry Basis | 14.0 ppmv d |
| Wet (Ms) | 27.41 lb/lb-mole | Wet Basis | 14.0 ppmv a |
| | | $SO_2$ Concentration | 2.300E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.62 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS — RUN #: 3
PLANT LOCATION: Laurel — DATE: 5/11/10
SOURCE TESTED: D SKU — START TIME: 1015
METER BOX OPERATOR: JW — TECHNICIANS: DW — END TIME: 1036

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.52 BAROMETRIC PRESSURE ("Hg)

- 120 PITOT
- SK METER BOX
- .99 Y FACTOR
- -.30 STATIC PRESSURE ("H2O)

- NOZZLE # 21 — TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 13 POST
- TRAIN LEAK TEST, ($ft^3$/min) 001 PRE 003 POST
- 26.51 STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 381.500 | | | | | | | | | |
| 1 | 2 | | | 2.12 | 59 | 5 | — | 44 | 865 | 3.7 | |
| 2 | 14 | | | 2.12 | 60 | 5 | | 44 | 916 | | |
| 3 | 21 | 397.080 | | 2.12 | 60 | 5 | | 45 | 882 | | |
| | ↘ | +15.580 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .45 | | | | | | 882 | | |
| 2 | | | .44 | | | | | | 882 | | |
| 3 | | | .44 | | | | | | 883 | | |
| 4 | | | .43 | | | | | | 883 | | |
| 5 | | | .44 | | | | | | 883 | | |
| 6 | | | .45 | | | | | | 883 | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 883 | | |
| 2 | | | .45 | | | | | | 883 | | |
| 3 | | | .44 | | | | | | 884 | | |
| 4 | | | .44 | | | | | | 884 | | |
| 5 | | | .45 | | | | | | 884 | | |
| 6 | | | .44 | | | | | | 884 | | |

Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 3 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5/11/10 |
| SOURCE TESTED: | Zone D SRU | | |
| Weighed By: | JW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 647 |
| Initial Weight | 619 |
| Weight Gain | + 28. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 649 |
| Initial Weight | 641 |
| Weight Gain | + 8. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 506 |
| Initial Weight | 504 |
| Weight Gain | + 2. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 817 |
| Initial Weight | 807 |
| Weight Gain | + 10. |

**Total Mass of Moisture Captured:** + 48. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **4-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **10:45-11:06** |
| **Source:** | **Zone D SRU** | **Date:** | **05/03/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft.) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 398.500 | 0.43 | 2.12 | 60 | 889 | 0.6557 |
| 2 | 14 | | 0.44 | 2.12 | 61 | 889 | 0.6633 |
| 3 | 21 | | 0.45 | 2.12 | 61 | 888 | 0.6708 |
| 4 | | 414.110 | 0.45 | | | 888 | 0.6708 |
| 5 | | | 0.44 | | | 888 | 0.6633 |
| 6 | | | 0.43 | | | 889 | 0.6557 |
| 1 | | | 0.43 | | | 889 | 0.6557 |
| 2 | | | 0.44 | | | 889 | 0.6633 |
| 3 | | | 0.44 | | | 890 | 0.6633 |
| 4 | | | 0.45 | | | 890 | 0.6708 |
| 5 | | | 0.44 | | | 890 | 0.6633 |
| 6 | | | 0.45 | | | 890 | 0.6708 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.50 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 2.208 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.610 dcf | Stack Area | 3.829 sq.ft. |
| Water Volume | 50.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 8.5 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 50.0 ml |
| $\%CO_2$ Average | 3.7 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **4-SO2/GF** |
| **Source:** | **Zone D SRU** | **Date:** | **05/03/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.6639 "$H_2O$ |
| Avg Meter Temp. (Tm) | 61 °F | Avg Stack Temp. (Ts) | 889 °F |
| Avg Meter Temp. (Tm) | 521 °A (°R) | Avg Stack Temp. (Ts) | 1,349 °A (°R) |
| Pressure Meter (Pm) | 26.656 "Hg | Pressure Stack (Ps) | 26.478 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.955 dscf | Velocity (Vs) | 65.07 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 47.076 awcf | Volume (actual conditions) | 14,949.2 awcfm |
| Volume Water | | | 12,792.0 adcfm |
| Vapor, Vw(std) | 2.354 scf | Volume (std. conditions) | 310,680.7 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 5,178.0 wscfm |
| Moisture (Bws) | 0.1443 | | 265,849.5 dscf/hr |
| Percent Moisture | 14.43 %v | | 4,430.8 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 28.93 lb/lb-mole | Dry Basis | 15.4 ppmv d |
| Wet (Ms) | 27.35 lb/lb-mole | Wet Basis | 15.4 ppmv a |
| | | $SO_2$ Concentration | 2.600E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.69 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION Laurel
SOURCE TESTED D SRU
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 4
DATE: 5/11/10
START TIME: 1045
END TIME: 1126

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.52 BAROMETRIC PRESSURE ("Hg)

- 170 PITOT
- SR METER BOX
- .84 Y FACTOR
- .30 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- 15 PRE / 13 POST — TRAIN LEAK TEST VACUUM, ("Hg)
- 000 PRE / 000 POST — TRAIN LEAK TEST, ($ft^3$/min)
- 26.51 STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 398.500 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 60 | 5 | — | 45 | 889 | 3.7 | |
| 2 | 14 | | | 2.12 | 61 | 5 | | 45 | 912 | | |
| 3 | 21 | 414.110 | | 2.12 | 61 | 5 | | 46 | 893 | | |
| | ↘ | +15.610 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 889 | | |
| 2 | | | .44 | | | | | | 889 | | |
| 3 | | | .45 | | | | | | 888 | | |
| 4 | | | .45 | | | | | | 888 | | |
| 5 | | | .44 | | | | | | 888 | | |
| 6 | | | .43 | | | | | | 889 | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 889 | | |
| 2 | | | .44 | | | | | | 889 | | |
| 3 | | | .44 | | | | | | 890 | | |
| 4 | | | .45 | | | | | | 890 | | |
| 5 | | | .44 | | | | | | 890 | | |
| 6 | | | .45 | | | | | | 890 | | |

Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 4 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5/11/10 |
| SOURCE TESTED: | Zone D SRU | | |
| Weighed By: | JW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 6664 |
| Initial Weight | 6372 |
| Weight Gain | +292. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 630 |
| Initial Weight | 622 |
| Weight Gain | +8. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 499 |
| Initial Weight | 498 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 816 |
| Initial Weight | 802 |
| Weight Gain | +14. |

**Total Mass of Moisture Captured:** +50. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **5-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:15-11:36** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 415.600 | 0.43 | 2.12 | 61 | 874 | 0.6557 |
| 2 | 14 | | 0.44 | 2.12 | 61 | 874 | 0.6633 |
| 3 | 21 | | 0.44 | 2.12 | 61 | 874 | 0.6633 |
| 4 | | 431.340 | 0.45 | | | 874 | 0.6708 |
| 5 | | | 0.44 | | | 874 | 0.6633 |
| 6 | | | 0.45 | | | 873 | 0.6708 |
| 1 | | | 0.43 | | | 873 | 0.6557 |
| 2 | | | 0.44 | | | 873 | 0.6633 |
| 3 | | | 0.45 | | | 873 | 0.6708 |
| 4 | | | 0.44 | | | 873 | 0.6633 |
| 5 | | | 0.45 | | | 873 | 0.6708 |
| 6 | | | 0.46 | | | 873 | 0.6782 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.50 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 2.208 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.740 dcf | Stack Area | 3.829 sq.ft. |
| Water Volume | 51.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 8.1 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 49.38 ml |
| $\%CO_2$ Average | 3.6 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **5-SO2/GF** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.6658 "$H_2O$ |
| Avg Meter Temp. (Tm) | 61 °F | Avg Stack Temp. (Ts) | 873 °F |
| Avg Meter Temp. (Tm) | 521 °A (°R) | Avg Stack Temp. (Ts) | 1,333 °A (°R) |
| Pressure Meter (Pm) | 26.656 "Hg | Pressure Stack (Ps) | 26.478 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.072 dscf | Velocity (Vs) | 64.92 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 46.988 awcf | Volume (actual conditions) | 14,914.7 awcfm |
| Volume Water | | | 12,740.1 adcfm |
| Vapor, Vw(std) | 2.401 scf | Volume (std. conditions) | 313,685.0 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 5,228.1 wscfm |
| Moisture (Bws) | 0.1458 | | 267,949.7 dscf/hr |
| Percent Moisture | 14.58 %v | | 4,465.8 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 28.90 lb/lb-mole | Dry Basis | 15.1 ppmv d |
| Wet (Ms) | 27.31 lb/lb-mole | Wet Basis | 15.1 ppmv a |
| | | $SO_2$ Concentration | 2.500E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.67 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: D SRU
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 5
DATE: 5/11/18
START TIME: 1115
END TIME: 1136

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.50 BAROMETRIC PRESSURE ("Hg)

- 170 PITOT
- 8R METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 14 POST
- TRAIN LEAK TEST, ($ft^3$/min) 000 PRE 001 POST
- -.30 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- 26.5 STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 415.000 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 61 | 5 | — | 46 | 871 | 3.6 | |
| 2 | 14 | | | 2.12 | 61 | 5 | | 46 | 874 | | |
| 3 | 21 | 431.340 | | 2.12 | 61 | 5 | | 46 | 882 | | |
| | — | +15.340 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 874 | | |
| 2 | | | .44 | | | | | | 874 | | |
| 3 | | | .44 | | | | | | 874 | | |
| 4 | | | .45 | | | | | | 874 | | |
| 5 | | | .44 | | | | | | 874 | | |
| 6 | | | .45 | | | | | | 873 | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 873 | | |
| 2 | | | .44 | | | | | | 873 | | |
| 3 | | | .45 | | | | | | 873 | | |
| 4 | | | .44 | | | | | | 873 | | |
| 5 | | | .45 | | | | | | 873 | | |
| 6 | | | .46 | | | | | | 873 | | |

Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 5 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5/11/10 |
| SOURCE TESTED: | Zone D SRU | | |
| Weighed By: | JW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 644 |
| Initial Weight | 615 |
| Weight Gain | +29. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 644 |
| Initial Weight | 636 |
| Weight Gain | +8. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 505 |
| Initial Weight | 503 |
| Weight Gain | +2. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 813 |
| Initial Weight | 801 |
| Weight Gain | +12. |

**Total Mass of Moisture Captured:** +51. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **6-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **11:45-12:06** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 432.800 | 0.45 | 2.12 | 61 | 916 | 0.6708 |
| 2 | 14 | | 0.44 | 2.12 | 62 | 916 | 0.6633 |
| 3 | 21 | | 0.44 | 2.12 | 63 | 915 | 0.6633 |
| 4 | | 448.600 | 0.43 | | | 915 | 0.6557 |
| 5 | | | 0.45 | | | 915 | 0.6708 |
| 6 | | | 0.45 | | | 915 | 0.6708 |
| 1 | | | 0.43 | | | 915 | 0.6557 |
| 2 | | | 0.44 | | | 914 | 0.6633 |
| 3 | | | 0.44 | | | 914 | 0.6633 |
| 4 | | | 0.45 | | | 915 | 0.6708 |
| 5 | | | 0.44 | | | 915 | 0.6633 |
| 6 | | | 0.46 | | | 915 | 0.6782 |

## FIELD DATA INPUT: (CONTINUED)

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.50 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 2.208 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.800 dcf | Stack Area | 3.829 sq.ft. |
| Water Volume | 49.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 8.4 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 50.0 ml |
| $\%CO_2$ Average | 3.5 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **6-SO2/GF** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.6658 "$H_2O$ |
| Avg Meter Temp. (Tm) | 62 °F | Avg Stack Temp. (Ts) | 915 °F |
| Avg Meter Temp. (Tm) | 522 °A (°R) | Avg Stack Temp. (Ts) | 1,375 °A (°R) |
| Pressure Meter (Pm) | 26.656 "Hg | Pressure Stack (Ps) | 26.478 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.098 dscf | Velocity (Vs) | 65.86 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 48.266 awcf | Volume (actual conditions) | 15,130.7 awcfm |
| Volume Water | | | 13,003.3 adcfm |
| Vapor, Vw(std) | 2.306 scf | Volume (std. conditions) | 308,506.6 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 5,141.8 wscfm |
| Moisture (Bws) | 0.1406 | | 265,130.6 dscf/hr |
| Percent Moisture | 14.06 %v | | 4,418.8 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 28.90 lb/lb-mole | Dry Basis | 15.2 ppmv d |
| Wet (Ms) | 27.37 lb/lb-mole | Wet Basis | 15.2 ppmv a |
| | | $SO_2$ Concentration | 2.500E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.66 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: D SRU
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 6
DATE: 5/11/10
START TIME: 1145
END TIME: 1206

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.52 BAROMETRIC PRESSURE ("Hg)
- 1.70 PITOT
- SR METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg)
- TRAIN LEAK TEST, ($ft^3$/min)
- -.38 STATIC PRESSURE ("H2O)
- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- 15 PRE 12 POST
- .002 PRE .002 POST
- 26.5" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ΔP( "$H_2O$) | Meter ΔH | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 432.800 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 61 | 5 | — | 45 | 916 | 3.5 | |
| 2 | 14 | | | 2.12 | 62 | 5 | | 46 | 88? | | |
| 3 | 21 | 448.600 | | 2.12 | 63 | 5 | | 46 | 883 | | |
| | | +15.800 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .45 | | | | | | 916 | | |
| 2 | | | .44 | | | | | | 916 | | |
| 3 | | | .44 | | | | | | 915 | | |
| 4 | | | .43 | | | | | | 915 | | |
| 5 | | | .45 | | | | | | 915 | | |
| 6 | | | .45 | | | | | | 915 | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 915 | | |
| 2 | | | .44 | | | | | | 914 | | |
| 3 | | | .44 | | | | | | 914 | | |
| 4 | | | .45 | | | | | | 915 | | |
| 5 | | | .44 | | | | | | 915 | | |
| 6 | | | .46 | | | | | | 915 | | |

Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 6 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5/11/10 |
| SOURCE TESTED: | Zone D SRU | | |
| Weighed By: | JW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 668 |
| Initial Weight | 640 |
| Weight Gain | +28. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 628 |
| Initial Weight | 619 |
| Weight Gain | +9. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 500 |
| Initial Weight | 499 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 827 |
| Initial Weight | 816 |
| Weight Gain | +11. |

**Total Mass of Moisture Captured:** +49. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **7-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:15-12:36** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 450.000 | 0.43 | 2.12 | 62 | 879 | 0.6557 |
| 2 | 14 | | 0.44 | 2.12 | 63 | 879 | 0.6633 |
| 3 | 21 | | 0.45 | 2.12 | 63 | 879 | 0.6708 |
| 4 | | 465.850 | 0.44 | | | 879 | 0.6633 |
| 5 | | | 0.44 | | | 878 | 0.6633 |
| 6 | | | 0.43 | | | 878 | 0.6557 |
| 7 | | | 0.43 | | | 878 | 0.6557 |
| 8 | | | 0.44 | | | 878 | 0.6633 |
| 1 | | | 0.44 | | | 877 | 0.6633 |
| 2 | | | 0.45 | | | 877 | 0.6708 |
| 3 | | | 0.44 | | | 877 | 0.6633 |
| 4 | | | 0.43 | | | 877 | 0.6557 |

## FIELD DATA INPUT: (CONTINUED)

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.50 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 2.208 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.850 dcf | Stack Area | 3.829 sq.ft. |
| Water Volume | 47.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| %$O_2$ Average | 8.5 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 48.75 ml |
| %$CO_2$ Average | 3.5 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **7-SO2/GF** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.6620 "$H_2O$ |
| Avg Meter Temp. (Tm) | 63 °F | Avg Stack Temp. (Ts) | 878 °F |
| Avg Meter Temp. (Tm) | 523 °A (°R) | Avg Stack Temp. (Ts) | 1,338 °A (°R) |
| Pressure Meter (Pm) | 26.656 "Hg | Pressure Stack (Ps) | 26.478 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.116 dscf | Velocity (Vs) | 64.54 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 46.748 awcf | Volume (actual conditions) | 14,827.4 awcfm |
| Volume Water | | | 12,818.3 adcfm |
| Vapor, Vw(std) | 2.212 scf | Volume (std. conditions) | 310,683.5 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 5,178.1 wscfm |
| Moisture (Bws) | 0.1355 | | 268,585.9 dscf/hr |
| Percent Moisture | 13.55 %v | | 4,476.4 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 28.90 lb/lb-mole | Dry Basis | 14.8 ppmv d |
| Wet (Ms) | 27.42 lb/lb-mole | Wet Basis | 14.8 ppmv a |
| | | $SO_2$ Concentration | 2.500E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.67 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: D SRU
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 2
DATE: 5/11/18
START TIME: 1215
END TIME: 1236

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.55 BAROMETRIC PRESSURE ("Hg)

- 170 PITOT
- SR METER BOX
- .99 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg)
- TRAIN LEAK TEST, ($ft^3$/min)
- -.30 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- 15 PRE 13 POST
- 000 PRE 002 POST
- 26.51 STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 450.000 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 62 | 5 | — | 45 | 882 | 3.5 | |
| 2 | 14 | | | 2.12 | 63 | 5 | | 45 | 912 | | |
| 3 | 21 | 465.850 | | 2.12 | 63 | 5 | | 45 | 879 | | |
| | | +15.850 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 879 | | |
| 2 | | | .44 | | | | | | 879 | | |
| 3 | | | .45 | | | | | | 879 | | |
| 4 | | | .44 | | | | | | 879 | | |
| 5 | | | .44 | | | | | | 878 | | |
| 6 | | | .43 | | | | | | 878 | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 878 | | |
| 2 | | | .44 | | | | | | 878 | | |
| 3 | | | .44 | | | | | | 877 | | |
| 4 | | | .45 | | | | | | 877 | | |
| 5 | | | .44 | | | | | | 877 | | |
| 6 | | | .43 | | | | | | 877 | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

Updated 10/05/09 af

EEMC

## MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 2 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5/11/10 |
| SOURCE TESTED: | Zone D SRU | | |
| Weighed By: | JW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 650 |
| Initial Weight | 620 |
| Weight Gain | +30. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 651 |
| Initial Weight | 646 |
| Weight Gain | +5. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 507 |
| Initial Weight | 505 |
| Weight Gain | +2. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 823 |
| Initial Weight | 813 |
| Weight Gain | +10. |

**Total Mass of Moisture Captured:** +47. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **8-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **12:45-13:06** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 467.400 | 0.44 | 2.12 | 63 | 910 | 0.6633 |
| 2 | 14 | | 0.43 | 2.12 | 63 | 910 | 0.6557 |
| 3 | 21 | | 0.44 | 2.12 | 64 | 910 | 0.6633 |
| 4 | | 483.180 | 0.44 | | | 910 | 0.6633 |
| 5 | | | 0.45 | | | 909 | 0.6708 |
| 6 | | | 0.44 | | | 909 | 0.6633 |
| 7 | | | 0.43 | | | 909 | 0.6557 |
| 8 | | | 0.44 | | | 909 | 0.6633 |
| 1 | | | 0.44 | | | 908 | 0.6633 |
| 2 | | | 0.45 | | | 908 | 0.6708 |
| 3 | | | 0.44 | | | 908 | 0.6633 |
| 4 | | | 0.45 | | | 908 | 0.6708 |

## FIELD DATA INPUT: (CONTINUED)

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.50 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 2.208 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.780 dcf | Stack Area | 3.829 sq.ft. |
| Water Volume | 50.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| $\%O_2$ Average | 8.5 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 48.75 ml |
| $\%CO_2$ Average | 3.6 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **8-SO2/GF** |
| **Source:** | **Zone D SRU** | **Date:** | **05/11/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.6639 "$H_2O$ |
| Avg Meter Temp. (Tm) | 63 °F | Avg Stack Temp. (Ts) | 909 °F |
| Avg Meter Temp. (Tm) | 523 °A (°R) | Avg Stack Temp. (Ts) | 1,369 °A (°R) |
| Pressure Meter (Pm) | 26.656 "Hg | Pressure Stack (Ps) | 26.478 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 14.053 dscf | Velocity (Vs) | 65.55 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 48.065 awcf | Volume (actual conditions) | 15,059.5 awcfm |
| Volume Water | | | 12,898.5 adcfm |
| Vapor, Vw(std) | 2.354 scf | Volume (std. conditions) | 308,400.2 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 5,140.0 wscfm |
| Moisture (Bws) | 0.1435 | | 264,144.8 dscf/hr |
| Percent Moisture | 14.35 %v | | 4,402.4 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 28.92 lb/lb-mole | Dry Basis | 14.9 ppmv d |
| Wet (Ms) | 27.35 lb/lb-mole | Wet Basis | 14.9 ppmv a |
| | | $SO_2$ Concentration | 2.500E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.66 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION Laurel
SOURCE TESTED D SRU
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 8
DATE: 5/11/10
START TIME: 1245
END TIME: 1306

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.58 BAROMETRIC PRESSURE ("Hg)
- 170 PITOT
- SR METER BOX
- .99 Y FACTOR
- —.30 STATIC PRESSURE ("H2O)
- ——— NOZZLE # 21 TEST TIME
- ——— NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM, ("Hg) 15 PRE 12 POST
- TRAIN LEAK TEST, ($ft^3$/min) .001 PRE .003 POST
- 26.5" STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 467.480 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 63 | 5 | — | 45 | 872 | 3.6 | |
| 2 | 14 | | | 2.12 | 63 | 5 | | 46 | 910 | | |
| 3 | 21 | 483.180 | | 2.12 | 64 | 5 | | 46 | 893 | | |
| | | +15.780 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .44 | | | | | | 910 | | |
| 2 | | | .43 | | | | | | 910 | | |
| 3 | | | .44 | | | | | | 910 | | |
| 4 | | | .44 | | | | | | 910 | | |
| 5 | | | .45 | | | | | | 909 | | |
| 6 | | | .44 | | | | | | 909 | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 909 | | |
| 2 | | | .44 | | | | | | 909 | | |
| 3 | | | .44 | | | | | | 908 | | |
| 4 | | | .45 | | | | | | 908 | | |
| 5 | | | .44 | | | | | | 908 | | |
| 6 | | | .45 | | | | | | 908 | | |

Updated 10/05/09 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 8 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5/11/10 |
| SOURCE TESTED: | Zone D SRU | | |
| Weighed By: | JW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 668 |
| Initial Weight | 639 |
| Weight Gain | + 29. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 632 |
| Initial Weight | 625 |
| Weight Gain | + 7. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 502 |
| Initial Weight | 500 |
| Weight Gain | + 2. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 811 |
| Initial Weight | 799 |
| Weight Gain | + 12. |

+ 50.

**Total Mass of Moisture Captured:** _____ grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

**EPA Methods #1-4 &6**
**Field Data & Calculations**
**$SO_2$/Gas Flow/Moisture**

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **9-$SO_2$/GF** |
| **Location:** | **Laurel, Montana** | **Time:** | **13:15-13:36** |
| **Source:** | **Zone D SRU** | **Date:** | **05/03/10** |

| Sample Point # | Clock Time (min.) | Meter Reading (cu.ft. ) | Delta P ("$H_2O$) | Delta H ("$H_2O$) | Meter Temp. °F | Stack Temp. °F | SQRT Delta P |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 484.700 | 0.43 | 2.12 | 64 | 869 | 0.6557 |
| 2 | 14 | | 0.44 | 2.12 | 64 | 869 | 0.6633 |
| 3 | 21 | | 0.44 | 2.12 | 64 | 869 | 0.6633 |
| 4 | | 500.430 | 0.45 | | | 869 | 0.6708 |
| 5 | | | 0.44 | | | 870 | 0.6633 |
| 6 | | | 0.45 | | | 870 | 0.6708 |
| 1 | | | 0.43 | | | 870 | 0.6557 |
| 2 | | | 0.43 | | | 870 | 0.6557 |
| 3 | | | 0.44 | | | 870 | 0.6633 |
| 4 | | | 0.44 | | | 871 | 0.6633 |
| 5 | | | 0.45 | | | 871 | 0.6708 |
| 6 | | | 0.44 | | | 871 | 0.6633 |

**FIELD DATA INPUT: (CONTINUED)**

| | | | |
|---|---|---|---|
| Barometric Pressure (Pb) | 26.50 "Hg | Stack Dimensional Data: | |
| Static Pressure | -0.30 "$H_2O$ | Circular | |
| Meter Cal. Factor | 0.99 Y | Diameter | 2.208 ft |
| Pitot Factor (cp) | 0.84 | Rectangular | |
| Total Test Time | 21 min | Width | 0.000 ft |
| Sample Time Interval | 7 min | Length | 0.000 ft |
| Meter Volume (Vm) | 15.730 dcf | Stack Area | 3.829 sq.ft. |
| Water Volume | 49.0 ml | | |
| Method 3A | | $SO_2$ Analysis Titration | |
| %$O_2$ Average | 8.5 %v dry | Normality $Ba^{++}$ Solution | 0.0101 N |
| Orsat | | Vol. $Ba^{++}$ Solution | 45.0 ml |
| %$CO_2$ Average | 3.7 %v dry | | |

| | | | |
|---|---|---|---|
| **Client:** | **CHS, Inc. - Laurel Refinery** | **Test #:** | **9-SO2/GF** |
| **Source:** | **Zone D SRU** | **Date:** | **05/03/10** |

## FIELD DATA AVERAGES/CALCULATIONS

| | | | |
|---|---|---|---|
| Average Delta H | 2.12 "$H_2O$ | Average SQRT Dp | 0.6633 "$H_2O$ |
| Avg Meter Temp. (Tm) | 64 °F | Avg Stack Temp. (Ts) | 870 °F |
| Avg Meter Temp. (Tm) | 524 °A (°R) | Avg Stack Temp. (Ts) | 1,330 °A (°R) |
| Pressure Meter (Pm) | 26.656 "Hg | Pressure Stack (Ps) | 26.478 "Hg |
| Standard Meter | | Stack Gas: | |
| Volume, Vm(std) | 13.982 dscf | Velocity (Vs) | 64.52 fps |
| Actual Meter | | | |
| Volume, Vm(actual) | 46.356 awcf | Volume (actual conditions) | 14,822.8 awcfm |
| Volume Water | | | 12,723.9 adcfm |
| Vapor, Vw(std) | 2.306 scf | Volume (std. conditions) | 312,455.4 wscf/hr |
| | | (@ 68 °F & 29.92"Hg) | 5,207.6 wscfm |
| Moisture (Bws) | 0.1416 | | 268,211.7 dscf/hr |
| Percent Moisture | 14.16 %v | | 4,470.2 dscfm |
| Gas Density | | $SO_2$ Emissions | |
| Dry (Md) | 28.93 lb/lb-mole | Dry Basis | 13.8 ppmv d |
| Wet (Ms) | 27.38 lb/lb-mole | Wet Basis | 13.8 ppmv a |
| | | $SO_2$ Concentration | 2.300E-06 lbs/dscf |
| | | $SO_2$ Mass Emissions | 0.62 lbs/hr |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION Laurel
SOURCE TESTED D3RU
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 9
DATE: 5/11/10
START TIME: 1315
END TIME: 1336

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.50 BAROMETRIC PRESSURE ("Hg)

- 170 PITOT
- BR METER BOX
- .99 Y FACTOR
- 15 PRE / 14 POST
- 000 PRE / 002 POST
- -.30 STATIC PRESSURE ("H2O)

- NOZZLE # 21 TEST TIME
- NOZZLE DIA.
- M T/C READOUT
- TRAIN LEAK TEST VACUUM ("Hg)
- TRAIN LEAK TEST (ft3/min)
- 26.511 STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 484.700 | | | | | | | | | |
| 1 | 7 | | | 2.12 | 64 | 5 | — | 46 | 869 | 3.7 | |
| 2 | 14 | | | 2.12 | 64 | 5 | | 46 | 884 | | |
| 3 | 21 | 500.430 | | 2.12 | 64 | 5 | | 46 | 873 | | |
| | | +15.730 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 869 | | |
| 2 | | | .44 | | | | | | 869 | | |
| 3 | | | .44 | | | | | | 869 | | |
| 4 | | | .45 | | | | | | 869 | | |
| 5 | | | .44 | | | | | | 870 | | |
| 6 | | | .45 | | | | | | 870 | | |
| | | | | | | | | | | | |
| 1 | | | .43 | | | | | | 870 | | |
| 2 | | | .43 | | | | | | 870 | | |
| 3 | | | .44 | | | | | | 870 | | |
| 4 | | | .44 | | | | | | 871 | | |
| 5 | | | .45 | | | | | | 871 | | |
| 6 | | | .44 | | | | | | 871 | | |

Revised 5-10-07 af

EEMC

# MOISTURE DETERMINATION

| | | | |
|---|---|---|---|
| COMPANY NAME: | CHS | RUN # | 9 |
| PLANT LOCATION: | Laurel | TEST DATE: | 5/11/10 |
| SOURCE TESTED: | Zone D SRU | | |
| Weighed By: | JW | Balance Level: | ✓ |
| | | Balance Zeroed: | ✓ |

**Weight (grams)**

**Impinger #1**

| | |
|---|---|
| Final Weight | 653 |
| Initial Weight | 623 |
| Weight Gain | +30. |

**Impinger #2**

| | |
|---|---|
| Final Weight | 645 |
| Initial Weight | 638 |
| Weight Gain | +2. |

**Impinger #3**

| | |
|---|---|
| Final Weight | 504 |
| Initial Weight | 503 |
| Weight Gain | +1. |

**Impinger #4 (if applicable)**

| | |
|---|---|
| Final Weight | |
| Initial Weight | |
| Weight Gain | |

**Silica Gel Impinger**

| | |
|---|---|
| Final Weight | 801 |
| Initial Weight | 290 |
| Weight Gain | +11. |

**Total Mass of Moisture Captured:** +49. grams

Notes:

WorldDrive01:/Forms/Forms/Moisture4.xls
Revised 6/20/07 jmf

EEMC

# ORSAT SHEET

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: Zone D SRU
TEST DATE: 5/11/10

| | Gas | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| Run # 1 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 3.7 | 3.8 | 3.7 | 3.7 |
| | $O_2$ | | | | |
| Run # 2 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 3.8 | 3.8 | 3.7 | 3.8 |
| | $O_2$ | | | | |
| Run # 3 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 3.7 | 3.7 | 3.8 | 3.7 |
| | $O_2$ | | | | |
| Run # 4 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 3.7 | 3.7 | 3.7 | 3.7 |
| | $O_2$ | | | | |
| Run # 5 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 3.7 | 3.6 | 3.6 | 3.6 |
| | $O_2$ | | | | |
| Run # 6 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 3.5 | 3.6 | 3.5 | 3.5 |
| | $O_2$ | | | | |
| Run # 7 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 3.5 | 3.5 | 3.6 | 3.5 |
| | $O_2$ | | | | |
| Run # 8 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 3.6 | 3.6 | 3.6 | 3.6 |
| | $O_2$ | | | | |
| Run # 9 | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | 3.6 | 3.7 | 3.7 | 3.7 |
| | $O_2$ | | | | |
| Run # | Total $CO_2 + O_2$ | | | | |
| | $CO_2$ | | | | |
| | $O_2$ | | | | |

Notes:

WorldDrive01:\Forms\Forms\Orsat3.xls
Revised 4/12/07 jmf

EEMC

# $SO_2$ ANALYSIS TITRATION

COMPANY NAME: Cenex DATE: 5-11-10

SOURCE TESTED: Zone D SRV Normality $Ba(ClO_4)_2$ : .0101

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Run # | Blank | Total Volume | | Dilution: | | | |
| Aliquot (ml.) | 20 | Ba++ (ml.) | 0 | Blank (ml.) | | Total Titration: | 0 |
| | | | | | | | |
| Run # | 1 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 20 | Ba++ (ml.) | 1.75 | Blank (ml.) | 0 | Total Titration: | 43.75 |
| | | | 1.75 | | | | |
| Run # | 2 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 20 | Ba++ (ml.) | 1.75 | Blank (ml.) | 0 | Total Titration: | 43.75 |
| | | | 1.75 | | | | |
| Run # | 3 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 20 | Ba++ (ml.) | 1.85 | Blank (ml.) | 0 | Total Titration: | 45.63 |
| | | | 1.8 | | | | |
| Run # | 4 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 20 | Ba++ (ml.) | 2.0 | Blank (ml.) | 0 | Total Titration: | 50.0 |
| | | | 2.0 | | | | |
| Run # | 5 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 20 | Ba++ (ml.) | 1.95 | Blank (ml.) | 0 | Total Titration: | 49.38 |
| | | | 2.0 | | | | |
| Run # | 6 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 20 | Ba++ (ml.) | 2.0 | Blank (ml.) | 0 | Total Titration: | 50.0 |
| | | | 2.0 | | | | |
| Run # | 7 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 20 | Ba++ (ml.) | 1.95 | Blank (ml.) | 0 | Total Titration: | 48.75 |
| | | | 1.95 | | | | |
| Run # | 8 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 20 | Ba++ (ml.) | 1.95 | Blank (ml.) | 0 | Total Titration: | 48.75 |
| | | | 1.95 | | | | |
| Run # | 9 | Total Volume | 500 | Dilution: | - | | |
| Aliquot (ml.) | 20 | Ba++ (ml.) | 1.8 | Blank (ml.) | 0 | Total Titration: | 45.0 |
| | | | 1.8 | | | | |

WorldDrive01:\Forms\Forms\SO2 Analysis Titration1.xls
Revised 06/25/07 jmf

**EPA METHOD #11**
**HYDROGEN SULFIDE EMISSIONS**
**FIELD AND LABORATORY DATA AND CALCULATIONS**

| | | | |
|---|---|---|---|
| **CLIENT:** | **CHS, Inc. - Laurel Refinery** | **RUN #:** | **1-$H_2S$** |
| **LOCATION:** | **Laurel, Montana** | **TIME:** | **08:45-08:55** |
| **SOURCE:** | **Zone A $H_2S$ Monitor** | **DATE:** | **05/12/10** |

## FIELD DATA

Meter Volume

| | | | |
|---|---|---|---|
| Final Volume: | 253.01 | liters | Meter Temperature: |
| Initial Volume: | 243.00 | liters | 49.5 °F |
| Difference (Vm) = | 10.01 | liters | 9.7 °C |
| Meter Factor (Y): | 0.98 | (1L) | |
| Barometric Pressure: | 26.59 | "Hg | |
| | 675.39 | mm Hg | |

## LAB DATA

| | |
|---|---|
| Thiosulfate Normality: | 0.0100 |
| Iodine Normality: | 0.0100 |

| | | |
|---|---|---|
| Iodine Volume: | 25.0 | ml |
| Sample Thio Volume: | 24.20 | ml |
| Blank Thio Volume: | 24.80 | ml |

## CALCULATED RESULTS

| | | |
|---|---|---|
| Vm (std) = | 9.04 | std cubic liters |
| $C(H_2S)$ = | 11.31 | mg/dscm |
| PPM $H_2S$ = | 7.98 | ppm v/v dry |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: Zone A H2S Monitor
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #:
DATE: 5/12/10
START TIME: 845
END TIME: 855

EQUIPMENT / IDENTIFICATION CHECKS:

- / PITOTS, PRE-TEST
- / PITOTS, POST-TEST
- ___ ORSAT SAMPLING SYSTEM
- ___ TEDLAR BAG
- / THERMOCOUPLE @ °F
- 26.54 BAROMETRIC PRESSURE ("Hg)

- PITOT
- 11 METER BOX
- .98 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg) 10
- TRAIN LEAK TEST, ($ft^3$/min) 00
- STATIC PRESSURE ("H2O)

- NOZZLE # 10 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- PRE 10 POST
- PRE 00 POST
- STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading (~~ft³~~) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 243.00 | | | | | | | | | |
| | 5 | | | | 49 | | | | | | |
| | 10 | 253.01 | | | 50 | | | | | | |
| | | | | | | | | | | | |
| | | +10.01 | liter | | | | | | | | |

Updated 10/05/09 af

**EPA METHOD #11**
**HYDROGEN SULFIDE EMISSIONS**
**FIELD AND LABORATORY DATA AND CALCULATIONS**

| | | | |
|---|---|---|---|
| **CLIENT:** | **CHS, Inc. - Laurel Refinery** | **RUN #:** | **2-$H_2S$** |
| **LOCATION:** | **Laurel, Montana** | **TIME:** | **09:15-09:25** |
| **SOURCE:** | **Zone A $H_2S$ Monitor** | **DATE:** | **05/12/10** |

## FIELD DATA

Meter Volume

| | | | |
|---|---|---|---|
| Final Volume: | 263.97 liters | Meter Temperature: | |
| Initial Volume: | 254.00 liters | | 50.0 °F |
| Difference (Vm) = | 9.97 liters | | 10.0 °C |
| Meter Factor (Y): | 0.98 (1L) | | |
| Barometric Pressure: | 26.59 " Hg | | |
| | 675.39 mm Hg | | |

## LAB DATA

| | |
|---|---|
| Thiosulfate Normality: | 0.0100 |
| Iodine Normality: | 0.0100 |
| Iodine Volume: | 25.0 ml |
| Sample Thio Volume: | 24.10 ml |
| Blank Thio Volume: | 24.80 ml |

## CALCULATED RESULTS

| | | |
|---|---|---|
| Vm (std) = | 8.99 | std cubic liters |
| C($H_2S$) = | 13.27 | mg/dscm |
| PPM $H_2S$ = | 9.37 | ppm v/v dry |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: Zone A H2S
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 2
DATE: 5/12/18
START TIME: 915
END TIME: 925

EQUIPMENT / IDENTIFICATION CHECKS:

| | | | | | |
|---|---|---|---|---|---|
| ___ | PITOTS, PRE-TEST | ___ | PITOT | ___ | NOZZLE # 10 TEST TIME |
| ___ | PITOTS, POST-TEST | 1.6 | METER BOX | ___ | NOZZLE DIA. |
| ___ | ORSAT SAMPLING SYSTEM | .98 | Y FACTOR | ___ | T/C READOUT |
| ___ | TEDLAR BAG | | TRAIN LEAK TEST VACUUM, ("Hg) | 10 | PRE 10 POST |
| ___ | THERMOCOUPLE @ °F | | TRAIN LEAK TEST, (ft³/min) | 00 | PRE 00 POST |
| 26.59 | BAROMETRIC PRESSURE ("Hg) | ___ | STATIC PRESSURE ("H2O) | ___ | STACK DIMENSIONS |

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ΔP( "$H_2O$) | Meter ΔH | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 254.00 | | | | | | | | | |
| | 5 | | | | 50 | | | | | | |
| | 10 | 263.92 | | | 50 | | | | | | |
| | | | | | | | | | | | |
| | | +9.92 | | | | | | | | | |

**EPA METHOD #11**
**HYDROGEN SULFIDE EMISSIONS**
**FIELD AND LABORATORY DATA AND CALCULATIONS**

| | | | |
|---|---|---|---|
| **CLIENT:** | **CHS, Inc. - Laurel Refinery** | **RUN #:** | **3-$H_2S$** |
| **LOCATION:** | **Laurel, Montana** | **TIME:** | **09:45-09:55** |
| **SOURCE:** | **Zone A $H_2S$ Monitor** | **DATE:** | **05/12/10** |

## FIELD DATA

Meter Volume

| | | | |
|---|---|---|---|
| Final Volume: | 274.98 liters | Meter Temperature: | |
| Initial Volume: | 265.00 liters | | 50.5 °F |
| Difference (Vm) = | 9.98 liters | | 10.3 °C |
| Meter Factor (Y): | 0.98 (1L) | | |
| Barometric Pressure: | 26.59 "Hg | | |
| | 675.39 mm Hg | | |

## LAB DATA

| | |
|---|---|
| Thiosulfate Normality: | 0.0100 |
| Iodine Normality: | 0.0100 |
| Iodine Volume: | 25.0 ml |
| Sample Thio Volume: | 24.05 ml |
| Blank Thio Volume: | 24.80 ml |

## CALCULATED RESULTS

| | | |
|---|---|---|
| Vm (std) = | 8.99 | std cubic liters |
| $C(H_2S)$ = | 14.22 | mg/dscm |
| PPM $H_2S$ = | 10.04 | ppm v/v dry |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: Zone A H2S
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 3
DATE: 5/12/10
START TIME: 945
END TIME: 955

EQUIPMENT / IDENTIFICATION CHECKS:

| | | | | | |
|---|---|---|---|---|---|
| | PITOTS, PRE-TEST | | PITOT | | NOZZLE # 10 TEST TIME |
| | PITOTS, POST-TEST | 1L | METER BOX | | NOZZLE DIA. |
| / | ORSAT SAMPLING SYSTEM | .98 | Y FACTOR | | T/C READOUT |
| | TEDLAR BAG | | TRAIN LEAK TEST VACUUM, ("Hg) | 10 | PRE 10 POST |
| / | THERMOCOUPLE @ °F | | TRAIN LEAK TEST, ($ft^3$/min) | 00 | PRE 00 POST |
| 26.59 | BAROMETRIC PRESSURE ("Hg) | | STATIC PRESSURE ("H2O) | | STACK DIMENSIONS |

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 265.00 | | | | | | | | | |
| | 5 | | | | 50 | | | | | | |
| | 10 | 274.98 | | | 51 | | | | | | |
| | | | | | | | | | | | |
| | | +9.98 | | | | | | | | | |

Updated 10/05/09 af

**EPA METHOD #11**
**HYDROGEN SULFIDE EMISSIONS**
**FIELD AND LABORATORY DATA AND CALCULATIONS**

| | | | |
|---|---|---|---|
| **CLIENT:** | **CHS, Inc. - Laurel Refinery** | **RUN #:** | **4-$H_2S$** |
| **LOCATION:** | **Laurel, Montana** | **TIME:** | **10:50-11:00** |
| **SOURCE:** | **Zone A $H_2S$ Monitor** | **DATE:** | **05/12/10** |

## FIELD DATA

Meter Volume

| | | | |
|---|---|---|---|
| Final Volume: | 286.02 liters | Meter Temperature: | |
| Initial Volume: | 276.00 liters | | 51.0 °F |
| Difference (Vm) = | 10.02 liters | | 10.6 °C |
| Meter Factor (Y): | 0.98 (1L) | | |
| Barometric Pressure: | 26.59 "Hg | | |
| | 675.39 mm Hg | | |

## LAB DATA

| | |
|---|---|
| Thiosulfate Normality: | 0.0100 |
| Iodine Normality: | 0.0100 |
| Iodine Volume: | 25.0 ml |
| Sample Thio Volume: | 23.95 ml |
| Blank Thio Volume: | 24.80 ml |

## CALCULATED RESULTS

| | | |
|---|---|---|
| Vm (std) = | 9.02 | std cubic liters |
| C($H_2S$) = | 16.06 | mg/dscm |
| PPM $H_2S$ = | 11.34 | ppm v/v dry |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: Zone A H2S
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 4
DATE: 5/12/10
START TIME: 1050
END TIME: 1180

EQUIPMENT / IDENTIFICATION CHECKS:

- / PITOTS, PRE-TEST
- / PITOTS, POST-TEST
- / ORSAT SAMPLING SYSTEM
- / TEDLAR BAG
- / THERMOCOUPLE @ °F
- 26.59 BAROMETRIC PRESSURE ("Hg)
- PITOT
- 1.48 METER BOX
- .98 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg) 10
- TRAIN LEAK TEST, ($ft^3$/min) 00
- STATIC PRESSURE ("H2O)
- NOZZLE # 10 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- PRE 10 POST
- PRE 00 POST
- STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 276.00 | | | | | | | | | |
| | 5 | | | | 51 | | | | | | |
| | 10 | 286.02 | | | 51 | | | | | | |
| | | | | | | | | | | | |
| | | +10.02 | | | | | | | | | |

Updated 10/05/09 af

**EPA METHOD #11**
**HYDROGEN SULFIDE EMISSIONS**
**FIELD AND LABORATORY DATA AND CALCULATIONS**

| | | | |
|---|---|---|---|
| **CLIENT:** | **CHS, Inc. - Laurel Refinery** | **RUN #:** | **5-$H_2S$** |
| **LOCATION:** | **Laurel, Montana** | **TIME:** | **11:20-11:30** |
| **SOURCE:** | **Zone A $H_2S$ Monitor** | **DATE:** | **05/12/10** |

## FIELD DATA

Meter Volume

| | | | |
|---|---|---|---|
| Final Volume: | 296.96 | liters | Meter Temperature: |
| Initial Volume: | 287.00 | liters | 51.5 °F |
| Difference (Vm) = | 9.96 | liters | 10.8 °C |
| Meter Factor (Y): | 0.98 | (1L) | |
| Barometric Pressure: | 26.59 | "Hg | |
| | 675.39 | mm Hg | |

## LAB DATA

| | |
|---|---|
| Thiosulfate Normality: | 0.0100 |
| Iodine Normality: | 0.0100 |

| | | |
|---|---|---|
| Iodine Volume: | 25.0 | ml |
| Sample Thio Volume: | 24.05 | ml |
| Blank Thio Volume: | 24.80 | ml |

## CALCULATED RESULTS

| | | |
|---|---|---|
| Vm (std) = | 8.96 | std cubic liters |
| $C(H_2S)$ = | 14.26 | mg/dscm |
| PPM $H_2S$ = | 10.07 | ppm v/v dry |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: Zone A H2S
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 5
DATE: 5/12/10
START TIME: 1120
END TIME: 1130

EQUIPMENT / IDENTIFICATION CHECKS:

| | | | | | |
|---|---|---|---|---|---|
| | PITOTS, PRE-TEST | | PITOT | | NOZZLE # 10 TEST TIME |
| | PITOTS, POST-TEST | 1.6 | METER BOX | | NOZZLE DIA. |
| | ORSAT SAMPLING SYSTEM | .98 | Y FACTOR | | T/C READOUT |
| | TEDLAR BAG | | TRAIN LEAK TEST VACUUM, ("Hg) | 10 | PRE 10 POST |
| | THERMOCOUPLE @ °F | | TRAIN LEAK TEST, (ft³/min) | 00 | PRE 00 POST |
| 26.5 | BAROMETRIC PRESSURE ("Hg) | | STATIC PRESSURE ("H2O) | | STACK DIMENSIONS |

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 287.00 | | | | | | | | | |
| | 5 | | | | 51 | | | | | | |
| | 10 | 296.96 | | | 52 | | | | | | |
| | | +9.96 | | | | | | | | | |

Updated 10/05/09 af

**EPA METHOD #11**
**HYDROGEN SULFIDE EMISSIONS**
**FIELD AND LABORATORY DATA AND CALCULATIONS**

| | | | |
|---|---|---|---|
| **CLIENT:** | **CHS, Inc. - Laurel Refinery** | **RUN #:** | **6-$H_2S$** |
| **LOCATION:** | **Laurel, Montana** | **TIME:** | **11:50-12:00** |
| **SOURCE:** | **Zone A $H_2S$ Monitor** | **DATE:** | **05/12/10** |

## FIELD DATA

Meter Volume

| | | | |
|---|---|---|---|
| Final Volume: | 307.99 | liters | Meter Temperature: |
| Initial Volume: | 298.00 | liters | 52.0 °F |
| Difference (Vm) = | 9.99 | liters | 11.1 °C |
| Meter Factor (Y): | 0.98 | (1L) | |
| Barometric Pressure: | 26.59 | "Hg | |
| | 675.39 | mm Hg | |

## LAB DATA

| | |
|---|---|
| Thiosulfate Normality: | 0.0100 |
| Iodine Normality: | 0.0100 |
| Iodine Volume: | 25.0 ml |
| Sample Thio Volume: | 24.10 ml |
| Blank Thio Volume: | 24.80 ml |

## CALCULATED RESULTS

| | | |
|---|---|---|
| Vm (std) = | 8.97 | std cubic liters |
| $C(H_2S)$ = | 13.30 | mg/dscm |
| PPM $H_2S$ = | 9.39 | ppm v/v dry |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION Laurel
SOURCE TESTED Zone A H2S
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 6
DATE: 5/12/10
START TIME: 1150
END TIME: 1200

EQUIPMENT / IDENTIFICATION CHECKS:

- / PITOTS, PRE-TEST
- / PITOTS, POST-TEST
- ORSAT SAMPLING SYSTEM
- TEDLAR BAG
- / THERMOCOUPLE @ °F
- 26.59 BAROMETRIC PRESSURE ("Hg)
- PITOT
- 16 METER BOX
- .98 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg) 10 PRE 10 POST
- TRAIN LEAK TEST, ($ft^3$/min) 00 PRE 00 POST
- STATIC PRESSURE ("H2O)
- NOZZLE # 10 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 298.00 | | | | | | | | | |
| | 5 | | | | 52 | | | | | | |
| | 10 | 307.99 | | | 52 | | | | | | |
| | | | | | | | | | | | |
| | | +9.99 | | | | | | | | | |

**EPA METHOD #11**
**HYDROGEN SULFIDE EMISSIONS**
**FIELD AND LABORATORY DATA AND CALCULATIONS**

| | | | |
|---|---|---|---|
| **CLIENT:** | **CHS, Inc. - Laurel Refinery** | **RUN #:** | **7-$H_2S$** |
| **LOCATION:** | **Laurel, Montana** | **TIME:** | **12:20-12:30** |
| **SOURCE:** | **Zone A $H_2S$ Monitor** | **DATE:** | **05/12/10** |

## FIELD DATA

Meter Volume

| | | | |
|---|---|---|---|
| Final Volume: | 319.00 | liters | Meter Temperature: |
| Initial Volume: | 309.00 | liters | 52.5 °F |
| Difference (Vm) = | 10.00 | liters | 11.4 °C |
| Meter Factor (Y): | 0.98 | (1L) | |
| Barometric Pressure: | 26.59 | "Hg | |
| | 675.39 | mm Hg | |

## LAB DATA

| | |
|---|---|
| Thiosulfate Normality: | 0.0100 |
| Iodine Normality: | 0.0100 |

| | | |
|---|---|---|
| Iodine Volume: | 25.0 | ml |
| Sample Thio Volume: | 24.05 | ml |
| Blank Thio Volume: | 24.80 | ml |

## CALCULATED RESULTS

| | | |
|---|---|---|
| Vm (std) = | 8.97 | std cubic liters |
| $C(H_2S)$ = | 14.25 | mg/dscm |
| PPM $H_2S$ = | 10.06 | ppm v/v dry |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION: Laurel
SOURCE TESTED: Zone A H2S
METER BOX OPERATOR: JW
TECHNICIANS: PW

RUN #: 2
DATE: 5/12/10
START TIME: 1228
END TIME: 1230

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- 26.59 BAROMETRIC PRESSURE ("Hg)

PITOT
METER BOX 1.5
Y FACTOR .98
TRAIN LEAK TEST VACUUM, ("Hg) 18
TRAIN LEAK TEST, (ft³/min) 00
STATIC PRESSURE ("H2O)

NOZZLE # 10
NOZZLE DIA.
T/C READOUT
PRE 18 POST 18
PRE 00 POST 00
STACK DIMENSIONS

TEST TIME

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ΔP( "$H_2O$) | Meter ΔH | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 309.00 | | | | | | | | | |
| | 5 | | | | 52 | | | | | | |
| | 10 | 319.00 | | | 53 | | | | | | |
| | ↓ | | | | | | | | | | |
| | ↓ | +10.00 | | | | | | | | | |

**EPA METHOD #11**
**HYDROGEN SULFIDE EMISSIONS**
**FIELD AND LABORATORY DATA AND CALCULATIONS**

| | | | |
|---|---|---|---|
| **CLIENT:** | **CHS, Inc. - Laurel Refinery** | **RUN #:** | **8-$H_2S$** |
| **LOCATION:** | **Laurel, Montana** | **TIME:** | **12:50-13:00** |
| **SOURCE:** | **Zone A $H_2S$ Monitor** | **DATE:** | **05/12/10** |

## FIELD DATA

Meter Volume

| | | | |
|---|---|---|---|
| Final Volume: | 329.97 liters | Meter Temperature: | |
| Initial Volume: | 320.00 liters | | 53.0 °F |
| Difference (Vm) = | 9.97 liters | | 11.7 °C |
| Meter Factor (Y): | 0.98 (1L) | | |
| Barometric Pressure: | 26.59 "Hg | | |
| | 675.39 mm Hg | | |

## LAB DATA

| | |
|---|---|
| Thiosulfate Normality: | 0.0100 |
| Iodine Normality: | 0.0100 |
| Iodine Volume: | 25.0 ml |
| Sample Thio Volume: | 24.00 ml |
| Blank Thio Volume: | 24.80 ml |

## CALCULATED RESULTS

| | | |
|---|---|---|
| Vm (std) = | 8.94 | std cubic liters |
| $C(H_2S)$ = | 15.25 | mg/dscm |
| PPM $H_2S$ = | 10.76 | ppm v/v dry |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION Laurel
SOURCE TESTED Zone A H2S
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 8
DATE: 5/12/10
START TIME: 1250
END TIME: 1300

EQUIPMENT / IDENTIFICATION CHECKS:

- / PITOTS, PRE-TEST
- / PITOTS, POST-TEST
- / ORSAT SAMPLING SYSTEM
- / TEDLAR BAG
- / THERMOCOUPLE @ °F
- 28.59 BAROMETRIC PRESSURE ("Hg)
- PITOT
- 16 METER BOX
- .93 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg) 10
- TRAIN LEAK TEST, (ft³/min) 00
- STATIC PRESSURE ("H2O)
- NOZZLE # 10 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- PRE 10 POST
- PRE 00 POST
- STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ^P( "$H_2O$) | Meter ^H | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 320.00 | | | | | | | | | |
| | 5 | | | | 53 | | | | | | |
| | 10 | 329.92 | | | 53 | | | | | | |
| | | | | | | | | | | | |
| | | +9.92 | | | | | | | | | |

Updated 10/05/09 af

**EPA METHOD #11**
**HYDROGEN SULFIDE EMISSIONS**
**FIELD AND LABORATORY DATA AND CALCULATIONS**

| | | | |
|---|---|---|---|
| **CLIENT:** | **CHS, Inc. - Laurel Refinery** | **RUN #:** | **9-$H_2S$** |
| **LOCATION:** | **Laurel, Montana** | **TIME:** | **13:20-13:30** |
| **SOURCE:** | **Zone A $H_2S$ Monitor** | **DATE:** | **05/12/10** |

## FIELD DATA

Meter Volume

| | | | |
|---|---|---|---|
| Final Volume: | 340.98 liters | Meter Temperature: | |
| Initial Volume: | 331.00 liters | | 53.0 °F |
| Difference (Vm) = | 9.98 liters | | 11.7 °C |
| Meter Factor (Y): | 0.98 (1L) | | |
| Barometric Pressure: | 26.59 "Hg | | |
| | 675.39 mm Hg | | |

## LAB DATA

| | |
|---|---|
| Thiosulfate Normality: | 0.0100 |
| Iodine Normality: | 0.0100 |
| Iodine Volume: | 25.0 ml |
| Sample Thio Volume: | 24.00 ml |
| Blank Thio Volume: | 24.80 ml |

## CALCULATED RESULTS

| | | |
|---|---|---|
| Vm (std) = | 8.94 | std cubic liters |
| $C(H_2S)$ = | 15.25 | mg/dscm |
| PPM $H_2S$ = | 10.76 | ppm v/v dry |

# PARTICULATE FIELD DATA

COMPANY NAME: CHS
PLANT LOCATION Laurel
SOURCE TESTED Zone A H2S
METER BOX OPERATOR: JW
TECHNICIANS: DW

RUN #: 9
DATE: 5/12/10
START TIME: 1320
END TIME: 1330

EQUIPMENT / IDENTIFICATION CHECKS:

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ °F
- PITOT
- IC METER BOX
- .98 Y FACTOR
- TRAIN LEAK TEST VACUUM, ("Hg) 10 PRE 10 POST
- TRAIN LEAK TEST, ($ft^3$/min) 00 PRE 00 POST
- 26.51 BAROMETRIC PRESSURE ("Hg)
- STATIC PRESSURE ("H2O)
- NOZZLE # 10 TEST TIME
- NOZZLE DIA.
- T/C READOUT
- STACK DIMENSIONS

| Sample Point | Time (min) | Dry Gas Meter Reading ($ft^3$) | Pitot Reading ΔP( "$H_2O$) | Meter ΔH | Meter Temp. Tm (°F) | Pump Vacuum (Hg) | Filter Box (°F) | Imp. Exit (°F) | Stack Temp. (°F) | % CO2 | % O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 331.00 | | | | | | | | | |
| | 5 | | | | 53 | | | | | | |
| | 10 | 340.98 | | | 53 | | | | | | |
| | | | | | | | | | | | |
| | | +9.98 | | | | | | | | | |

EEMC

Date 5-12-10

# Laboratory Analysis
## $H_2S$ Determination

Plant Name Cenex
Source Zone A Fuel Gas

$CdSO_4N$ = _____

Run # 1

Total Sample Vol. total Dilution _____ Vol. of $I_2$ (ml.) 25

| Aliquot | Thiosulfate Vol. Used (ml.) | Aliquot Factor | Total Titration (ml.) |
|---|---|---|---|
| 1. Sample | _____ | _____ | 24.2 |
| 2. Blank | _____ | _____ | 24.8 |
| 3. | _____ | _____ | _____ |

X 1-3 = _____

Run # 2

Total Sample Vol. total Dilution _____ Vol. of $I_2$ (ml.) 25

| Aliquot | Thiosulfate Vol. Used (ml.) | Aliquot Factor | Total Titration (ml.) |
|---|---|---|---|
| 1. Sample | _____ | _____ | 24.1 |
| 2. Blank | _____ | _____ | 24.8 |
| 3. | _____ | _____ | _____ |

X 1-3 = _____

Run # 3

Total Sample Vol. total Dilution _____ Vol. of $I_2$ (ml.) 25

| Aliquot | Thiosulfate Vol. Used (ml.) | Aliquot Factor | Total Titration (ml.) |
|---|---|---|---|
| 1. Sample | _____ | _____ | 24.05 |
| 2. Blank | _____ | _____ | 24.8 |
| 3. | _____ | _____ | _____ |

X 1-3 = _____

Revised 5-08-07 af

EEMC

Date 5-12-10

# Laboratory Analysis
# $H_2S$ Determination

Plant Name Cenex
Source Zone A Fuel Gas

$CdSO_4N$ = _____

Run # 4

Total Sample Vol. total Dilution _____ Vol. of $I_2$ (ml.) 25

| Aliquot | Thiosulfate Vol. Used (ml.) | Aliquot Factor | Total Titration (ml.) |
|---|---|---|---|
| 1. Sample | _____ | _____ | 23.95 |
| 2. Blank | _____ | _____ | 24.8 |
| 3. | _____ | _____ | _____ |

X 1-3 = _____

Run # 5

Total Sample Vol. total Dilution _____ Vol. of $I_2$ (ml.) 25

| Aliquot | Thiosulfate Vol. Used (ml.) | Aliquot Factor | Total Titration (ml.) |
|---|---|---|---|
| 1. Sample | _____ | _____ | 24.05 |
| 2. Blank | _____ | _____ | 24.8 |
| 3. | _____ | _____ | _____ |

X 1-3 = _____

Run # 6

Total Sample Vol. total Dilution _____ Vol. of $I_2$ (ml.) 25

| Aliquot | Thiosulfate Vol. Used (ml.) | Aliquot Factor | Total Titration (ml.) |
|---|---|---|---|
| 1. Sample | _____ | _____ | 24.1 |
| 2. Blank | _____ | _____ | 24.8 |
| 3. | _____ | _____ | _____ |

X 1-3 = _____

Revised 5-08-07 af

EEMC

Date 5-12-10

# Laboratory Analysis
# $H_2S$ Determination

Plant Name Cenex
Source Zone A Fuel Gas

$CdSO_4N$ = _____

Run # 7

Total Sample Vol. total Dilution _____ Vol. of $I_2$ (ml.) 25

| Aliquot | Thiosulfate Vol. Used (ml.) | Aliquot Factor | Total Titration (ml.) |
|---|---|---|---|
| 1. Sample | _____ | _____ | 24.05 |
| 2. Blank | _____ | _____ | 24.8 |
| 3. | _____ | _____ | _____ |

X 1-3 = _____

Run # 8

Total Sample Vol. total Dilution _____ Vol. of $I_2$ (ml.) 25

| Aliquot | Thiosulfate Vol. Used (ml.) | Aliquot Factor | Total Titration (ml.) |
|---|---|---|---|
| 1. Sample | _____ | _____ | 24.0 |
| 2. Blank | _____ | _____ | 24.8 |
| 3. | _____ | _____ | _____ |

X 1-3 = _____

Run # 9

Total Sample Vol. total Dilution _____ Vol. of $I_2$ (ml.) 25

| Aliquot | Thiosulfate Vol. Used (ml.) | Aliquot Factor | Total Titration (ml.) |
|---|---|---|---|
| 1. Sample | _____ | _____ | 24.0 |
| 2. Blank | _____ | _____ | 24.8 |
| 3. | _____ | _____ | _____ |

X 1-3 = _____

Revised 5-08-07 af

EPA METHOD #11

HYDROGEN SULFIDE CALCULATIONS

Date 5-11-10

Source Cemex Zone A Fuel Gas

Standardization of the Na2S203 Solution

| | Run #1 | Run #2 | Run #3 |
|---|---|---|---|
| Volume of K2Cr204 (ml) | 50 | 50 | 50 |
| Weight of K2Cr204 (g) | 2.0004 | 2.0004 | 2.0004 |
| Volume of NaS203 (ml) | 40.85 | 40.75 | 40.75 |

Ns = (2.039) (Wt. of K2Cr204) / (Volume of NaS203)

R#1 Ns = (2.039) ( 2.0004 ) / ( 40.85 ) = .09985
R#2 Ns = (2.039) ( 2.0004 ) / ( 40.75 ) = .10009
R#3 Ns = (2.039) ( 2.0004 ) / ( 40.75 ) = .10009
Mean Ns R#1-#3 .1000 as per Method

Standardization of the I2 Solution

| | Run #1 | Run #2 | Run #3 |
|---|---|---|---|
| Volume of I2 (ml) | 25 | 25 | 25 |
| Volume of Na2S203 (ml) | 25.0 | 25.10 | 24.95 |
| Nt of NaS203 (ml) | .0100* | .0100* | .0100* |

*Solution made by diluting 0.10267 N thiosulfate solution 1 to 10 ratio.

Ni = (Nt) (Vol. of Na2S203) / (Vol. of I2)

R#1 Ni = ( .0100 ) ( 25.00 ) / ( 25 ) = .01000
R#2 Ni = ( .0100 ) ( 25.10 ) / ( 25 ) = .01004
R#3 Ni = ( .0100 ) ( 24.95 ) / ( 25 ) = .00998
Mean Ni R#2-#3 .0100 as per Method

Revised 01-08-09 af