

Relative Accuracy Test Audit (RATA) 2023

Graphic Packaging, International, LLC

Boiler 10 (EUBOILER#10)

Project number: 60703778



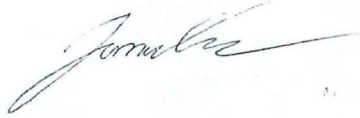
May 17, 2023

RECEIVED

JUL 18 2023

AIR QUALITY DIVISION

Quality information

| Prepared by | Checked by | Reviewed by |
|---|---|--|
|  |  |  |
| Matt McDivitt Air Quality Scientist III | Rob Sava, QSTI Env. Engineering IV | James Edmister Project Manager |

Prepared for:

Graphic Packaging, International, LLC
1500 N Pitcher Street
Kalamazoo, Michigan 49007

Prepared by:

AECOM
564 White Pond Dr
Akron, OH 44320

aecom.com

Project Manager
James Edmister
james.edmister@aecom.com

Copyright © 2023 by AECOM

All rights reserved. No part of this copyrighted work may be reproduced, distributed, or transmitted in any form or by any means without the prior written permission of AECOM.

Table of Contents

| | | |
|-----|--|-------|
| 1. | Executive Summary..... | 1-1 |
| 1.1 | Summary of Test Program..... | 1-1 |
| 1.2 | Key Personnel..... | 1-1 |
| 2. | Plant and Sample Location Description..... | 2-1 |
| 2.1 | Facility Description..... | 2-1 |
| 2.2 | Flue Gas Sampling Locations..... | 2-1 |
| 3. | Sampling and Analysis Procedures..... | 3-1 |
| 3.1 | Objectives and Test Matrix..... | 3-1 |
| 3.2 | Facility Operations..... | 3-1 |
| 3.3 | Comments / Exceptions..... | 3-1 |
| 3.4 | Summary of Results..... | 3-1 |
| 4. | Sampling and Analytical Procedures..... | 4-1 |
| 4.1 | Test Methods..... | 4-1 |
| 4.2 | Procedures..... | 4-1 |
| 4.3 | List of Sampling Equipment..... | 4-2 |
| 5. | Calculations..... | 5-1 |
| 5.1 | Calibration Error - Equation 7E-1..... | 5-1 |
| 5.2 | System Bias - Equation 7E-2..... | 5-2 |
| 5.3 | System Drift - Equation 7E-4..... | 5-3 |
| 5.4 | Effluent Concentration - Equation 7E-5b..... | 5-4 |
| 5.5 | Relative Accuracy..... | 5-5 |
| 5.6 | Volume of Water Vapor Condensed corrected to standard conditions, ft ³ - as per US EPA Method 5, Eq. 5-2. Adapted for the measurement of mass of water as opposed to the volume of water..... | 5-6 |
| 5.7 | Moisture Content, proportion, by volume as per US EPA Method 5, Eq. 5-3..... | 5-7 |
| 5.8 | Dry Gas Volume, corrected to actual conditions, ft ³ | 5-7 |
| 5.9 | Dry Gas Volume, corrected to standard conditions, ft ³ per US EPA Method 5, Eq. 5-1..... | 5-8 |
| 6. | Relative Accuracy Test Data..... | 6-1 |
| 6.1 | Carbon Dioxide Calibration Data Summary..... | 6-1 |
| 6.2 | Nitrogen Oxides Calibration Data Summary..... | 6-2 |
| 6.3 | Response Time..... | 6-3 |
| 6.4 | Relative Accuracy Corrected Concentration..... | 6-4 |
| 6.5 | Carbon Dioxide Relative Accuracy Results..... | 6-5 |
| 6.6 | Nitrogen Oxides Relative Accuracy Results..... | 6-6 |
| 6.7 | Summary Data..... | 6-7 |
| 7. | Stack Traverse Diagrams..... | 7-1 |
| 7.1 | Three-Point Traverse..... | 7-1 |
| 7.2 | Twelve-Point Traverse..... | 7-2 |
| 8. | Field Data and Calibrations..... | 8-1 |
| 9. | Process Data..... | 9-1 |
| 10. | Certificates of Analysis..... | 10-11 |

Figures

| | |
|--|-----|
| Figure 4-1. Sample Train Schematic | 4-3 |
|--|-----|

Tables

| | |
|--|-----|
| Table 1-1. Compliance Summary | 1-1 |
| Table 1-2. Key Personnel..... | 1-1 |
| Table 3-1. NO _x Monitoring..... | 3-1 |
| Table 3-2. CO ₂ Monitoring..... | 3-1 |
| Table 3-3. Boiler 10 Steam Flow | 3-1 |
| Table 4-1. Reference Method..... | 4-2 |
| Table 4-2. Boiler 10 CEMS Analyzers..... | 4-2 |

1. Executive Summary

1.1 Summary of Test Program

Graphic Packaging International, LLC in Kalamazoo, Michigan retained AECOM Technical Services, Inc. (AECOM) to conduct an annual quality assurance (QA) relative accuracy test audit (RATA) on the diluent carbon dioxide (CO₂) and nitrogen-oxides (NO_x) continuous emissions monitoring systems (CEMS) serving Boiler 10.

The facility operates Boiler 10, a natural gas fired boiler used to heat steam for a dryer and hot water for the paper machine, under Permit to Install (PTI) No. 133-19A.

Table 1-1 summarizes the pertinent data for this compliance event.

Table 1-1. Compliance Summary

| | |
|---------------------------------|--|
| Responsible Groups | <ul style="list-style-type: none">• Graphic Packaging International, LLC• Michigan Department of Environment, Great Lakes, and Energy (EGLE) Air Quality Division |
| Applicable Regulations | <ul style="list-style-type: none">• Permit to Install 133-19A• 40 CFR Part 60 PS 2 & 3 |
| Plant Location | <ul style="list-style-type: none">• Graphic Packaging International, LLC Kalamazoo, Michigan 49007 |
| Sampling Contractor | <ul style="list-style-type: none">• AECOM 564 White Pond Dr Akron, OH 44320 |
| Air Pollution Control Equipment | <ul style="list-style-type: none">• Low NO_x Burners and Flue Gas Recirculation |
| Emission Points | <ul style="list-style-type: none">• EUBOILER#10 |
| Pollutants/Diluent Measured | <ul style="list-style-type: none">• Nitrogen Oxides (NO_x)• Carbon Dioxide (CO₂) |
| Test Dates | <ul style="list-style-type: none">• April 18, 2023 |

1.2 Key Personnel

Names and affiliations of personnel, including their roles in the test program, are summarized in the following table (Table 1-2).

Table 1-2. Key Personnel

| Role | Name | Address | Contact Information |
|----------------------|----------------|---------------------------------------|--|
| Process Focal Point | Steven Smock | Graphic Packaging, International, LLC | 269-491-6055 steven.smock@graphicpkg.com |
| Regulatory Agency | Trevor Drost | EGLE | 517-245-5781 Drostt@michigan.gov |
| Field Team Leader | Rob Sava | AECOM | 234-425-8440 Rob.sava@aecom.com |
| Test Project Manager | James Edmister | AECOM | (585) 721-9128 James.Edmister@aecom.com |

2. Plant and Sample Location Description

2.1 Facility Description

The Boiler 10 is a natural gas fired boiler equipped with low NOx burners and flue gas recirculation with a maximum heat input of approximately 311 MMBtu/hr. This natural gas fired boiler is used to heat steam for the dryer and hot water to be used on the paper machine.

2.2 Flue Gas Sampling Locations

Sampling is conducted on the EUBOILER#10 outlet stack. The Reference Test methods for NOx and CO₂ are performed through a port that is in accordance with Performance Specification 2. The samples are withdrawn from the stack for a period of 21 minutes at the three traverse points of the measurement line that passes through the centroidal area of the stack or duct cross section. Prior to utilizing a three point traverse, a twelve point traverse was performed to verify the absence of stratification. The cross-sectional diagrams can be found in Section 7.

3. Sampling and Analysis Procedures

3.1 Objectives and Test Matrix

This testing was performed to meet the requirements of 40 CFR Part 60, Appendix B, Performance Specifications 2 and 3. The specific objectives of this test were:

- Determine the relative accuracy of the continuous CO₂ monitor systems on the EUBOILER#10 outlet stack.
- Determine the relative accuracy of the continuous NO_x monitor systems on the EUBOILER#10 outlet stack.

Tables 3-1 and 3-2 present a summary of the results for the Performance Specification Test for CEMS RATA.

3.2 Facility Operations

During the relative accuracy test, the plant is operating Boiler 10 greater than 50 percent load. The operating rate for this unit is determined based on the steam lb/hr rate presented in Table 3-3.

3.3 Comments / Exceptions

As allowed by 40 CFR Part 60, this Performance Specification Test consisted of a minimum of 9 RM tests used for RA calculations. Ten sets of RM tests were performed. Since this option was selected, a maximum of one set of the test results may be rejected so long as the total number of test results used to determine the RA was greater than or equal to nine. All data was reported, including the rejected data.

3.4 Summary of Results

Table 3-1. NO_x Monitoring

| Test Type | NO _x Monitor Results (%) | Allowable | Pass/Fail |
|------------------------------|-------------------------------------|---|-----------|
| Relative Accuracy (ppmv) | 0.9% | No greater than 20.0% of mean value of RM | Pass |
| Relative Accuracy (lb/mmBTU) | 3.3% | No greater than 20.0% of mean value of RM | Pass |

Table 3-2. CO₂ Monitoring

| Test Type | CO ₂ Monitor Results (%) | Allowable | Pass/Fail |
|-------------------|-------------------------------------|---|-----------|
| Relative Accuracy | 1.6% | No greater than 20.0% of mean value of RM | Pass |

Table 3-3. Boiler 10 Steam Flow

| EUBOILER#10 | |
|-------------|---------------------------|
| RATA Run # | Run Average Steam (lb/hr) |
| RATA 1 | 115139.70 |
| RATA 2 | 114211.90 |
| RATA 3 | 124791.40 |
| RATA 4 | 125141.10 |
| RATA 5 | 125441.80 |
| RATA 6 | 126109.40 |
| RATA 7 | 128270.60 |
| RATA 8 | 129739.70 |
| RATA 9 | 128698.00 |
| RATA 10 | 131912.40 |
| Average | 124945.60 |

4. Sampling and Analytical Procedures

4.1 Test Methods

The relative accuracies of Graphic Packaging's CEMS was determined by comparison to EPA methods for measurement of each component gas. The performance specifications (PS) required the use of the following methods:

- PS 2 – Method 7E for NO_x; and
- PS 3 – Method 3A for CO₂.

4.2 Procedures

The above methods were performed using mobile continuous emission monitors. Gas was withdrawn from the stack and transported to monitors located at ground level. A stainless-steel probe was inserted into the stack and used to collect sample gas. A Teflon sample line, heated at an adequate temperature to keep water in vapor form, transported sample gas from the probe to the gas conditioner followed by the analyzers. The analyzers were kept at a constant temperature inside the mobile laboratory.

Sample gas was collected continuously from the stack for a period of 21 minutes per run. Samples were taken at three traverse points of the measurement line that passes through the centroidal area of the stack or duct cross section. At the mobile laboratory, the stack gas was routed to a condenser and then transported to the analyzers for analysis.

The Relative Accuracy Tests were conducted by comparison of the CEMS response to a value measured by a Performance Test Method (PTM) which, in this case, was Method 7E for Nitrogen Oxide and Method 3A for CO₂.

EPA Method 3A (Gas Analysis for the Determination of Dry Molecular Weight)

EPA Method 3A (Instrumental Method) was utilized to determine the diluent during each run on the outlet.

An analyzer measured CO₂ content using nondispersive infrared (NDIR) sensors. Gas is pushed through a light tube where the analyzer measures the absorption of light characteristic to CO₂.

EPA Method 7E (Determination of Nitrogen Oxides)

EPA Method 7E was utilized to determine nitrogen oxide concentrations during each run on the outlet.

A NOx analyzer was used to monitor the concentration of NOx during each run. A sample of the effluent gas was continuously sampled and conveyed to an analyzer for measuring the concentration of NOx. The gas stream was directed through a NO₂ convertor to convert NO₂ to NO concentration. The analyzer yielded results of a total result of NOx. See Figure 4-1 for a sampling train schematic.

EPA Method 4 (Moisture)

A calibrated Method 5 console was used to pull stack gas samples from a single point through a Method 5 probe equipped with a liner to determine percent moisture of the stack gas. Stack gas is bubbled through two impingers containing water, one empty impinger, and one impinger containing silica gel. All of the impingers are weighed prior to sampling. The impinger train is kept iced in order to knock out all moisture in the stack gas. After the final leak check following each run, the exterior of the impingers are dried off and the impingers weighed to determine percent moisture. Field data sheets and calculations of percent moisture are included in the report field section. The final average moisture content during all runs is used to correct the CEMS values to a "wet" basis.

4.3 List of Sampling Equipment

Tables 4-1 and 4-2 list the reference method analyzers used for the test and Boiler 10 analyzers while Figure 4-1 displays the sample system diagram.

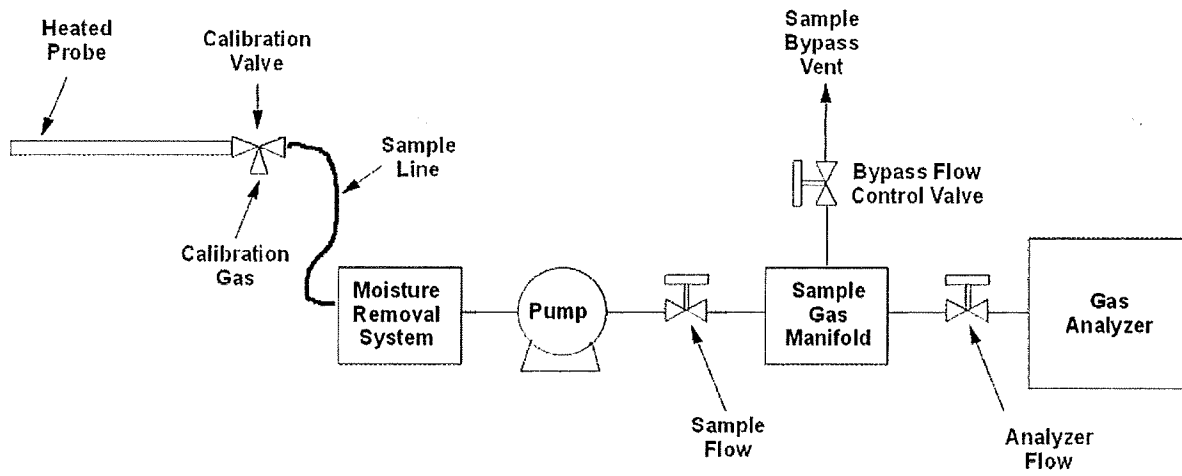
Table 4-1. Reference Method

| Reference Method | Equipment | ID # | Span |
|------------------------------|------------------------|-----------|-----------|
| Method 3A (CO ₂) | SERVOMEX 1440 Analyzer | OXC-A1603 | 18.95 % |
| Method 7E (NO _x) | THERMO 42i-HL Analyzer | NOX F1901 | 60.71 ppm |

Table 4-2. Boiler 10 CEMS Analyzers

| Constituent | Unit | Manufacturer | Model | Serial # | Span |
|-----------------|-------|--------------|---------------|------------|-------|
| Nitrogen Oxides | ppmv | Thermo | iQ Series 42 | 1202759350 | 0-100 |
| Carbon Dioxide | vol % | Thermo | iQ Series 410 | 1202759352 | 0-25 |

Figure 4-1. Sample Train Schematic



Relative Accuracy Test Audit (RATA) 2023

Graphic Packaging, International, LLC

Boiler 11 (EUBOILER#11)

Project number: 60703778

May 17, 2023

Quality information

Prepared by



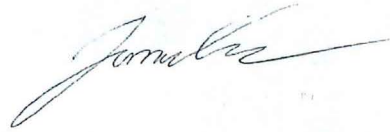
Matt McDivitt
Air Quality Scientist III

Checked by



Rob Sava, QSTI
Env. Engineering IV

Reviewed by



James Edmister
Project Manager

Prepared for:

Graphic Packaging, International, LLC
1500 N Pitcher Street
Kalamazoo, Michigan 49007

Prepared by:

AECOM
564 White Pond Dr
Akron, OH 44320

aecom.com

Project Manager
James Edmister
james.edmister@aecom.com

Copyright © 2023 by AECOM

All rights reserved. No part of this copyrighted work may be reproduced, distributed, or transmitted in any form or by any means without the prior written permission of AECOM.

Table of Contents

| | | |
|-----|--|------|
| 1. | Executive Summary..... | 1-1 |
| 1.1 | Summary of Test Program..... | 1-1 |
| 1.2 | Key Personnel..... | 1-1 |
| 2. | Plant and Sampling Location Description..... | 2-1 |
| 2.1 | Facility Description..... | 2-1 |
| 2.2 | Flue Gas Sampling Locations..... | 2-1 |
| 3. | Sampling and Analysis Procedures..... | 3-1 |
| 3.1 | Objectives and Test Matrix..... | 3-1 |
| 3.2 | Facility Operations..... | 3-1 |
| 3.3 | Comments / Exceptions..... | 3-1 |
| 3.4 | Summary of Results..... | 3-1 |
| 4. | Sampling and Analytical Procedures..... | 4-1 |
| 4.1 | Test Methods..... | 4-1 |
| 4.2 | Procedures..... | 4-1 |
| 4.3 | List of Sampling Equipment..... | 4-2 |
| 5. | Calculations..... | 5-1 |
| 5.1 | Calibration Error - Equation 7E-1..... | 5-1 |
| 5.2 | System Bias - Equation 7E-2..... | 5-2 |
| % | 5-2 | |
| 5.3 | System Drift - Equation 7E-4..... | 5-3 |
| 5.4 | Effluent Concentration - Equation 7E-5b..... | 5-4 |
| 5.5 | Relative Accuracy..... | 5-5 |
| 5.6 | Volume of Water Vapor Condensed corrected to standard conditions, ft ³ - as per US EPA Method 5, Eq. 5-2. Adapted for the measurement of mass of water as opposed to the volume of water..... | 5-6 |
| 5.7 | Moisture Content, proportion, by volume as per US EPA Method 5, Eq. 5-3..... | 5-7 |
| 5.8 | Dry Gas Volume, corrected to actual conditions, ft ³ | 5-7 |
| 5.9 | Dry Gas Volume, corrected to standard conditions, ft ³ as per US EPA Method 5, Eq. 5-1..... | 5-8 |
| 6. | Relative Accuracy Test Data..... | 6-1 |
| 6.1 | Carbon Dioxide Calibration Data Summary..... | 6-1 |
| 6.2 | Nitrogen Oxides Calibration Data Summary..... | 6-2 |
| 6.3 | Response Time..... | 6-3 |
| 6.4 | Relative Accuracy Corrected Concentration..... | 6-4 |
| 6.5 | Carbon Dioxide Relative Accuracy Results..... | 6-5 |
| 6.6 | Nitrogen Oxides Relative Accuracy Results..... | 6-6 |
| 6.7 | Summary Data..... | 6-7 |
| 7. | Stack Traverse Diagrams..... | 7-1 |
| 7.1 | Three-Point Traverse..... | 7-1 |
| 7.2 | Twelve-Point Traverse..... | 7-2 |
| 8. | Field Data and Calibrations..... | 8-1 |
| 9. | Process Data..... | 9-1 |
| 10. | Certificates of Analysis..... | 10-1 |

Figures

| | |
|--|-----|
| Figure 4-1. Sample Train Schematic | 4-3 |
|--|-----|

Tables

| | |
|--|-----|
| Table 1-1. Compliance Summary | 1-1 |
| Table 1-2. Key Personnel..... | 1-1 |
| Table 3-1. NO _x Monitoring..... | 3-1 |
| Table 3-2. CO ₂ Monitoring..... | 3-1 |
| Table 3-3. Boiler 11 Steam Flow..... | 3-1 |
| Table 4-1. Reference Method..... | 4-2 |
| Table 4-2. Boiler 11 CEMS Analyzers..... | 4-2 |

1. Executive Summary

1.1 Summary of Test Program

Graphic Packaging International, LLC in Kalamazoo, Michigan retained AECOM Technical Services, Inc. (AECOM) to conduct an annual quality assurance (QA) relative accuracy test audit (RATA) on the diluent carbon dioxide (CO₂) and nitrogen-oxides (NO_x) continuous emissions monitoring systems (CEMS) serving Boiler 10.

The facility operates Boiler 11, a natural gas fired boiler used to heat steam for a dryer and hot water for the paper machine, under Permit to Install (PTI) No. 133-19A.

Table 1-1 summarizes the pertinent data for this compliance event.

Table 1-1. Compliance Summary

| | |
|---------------------------------|--|
| Responsible Groups | <ul style="list-style-type: none">• Graphic Packaging International, LLC• Michigan Department of Environment, Great Lakes, and Energy (EGLE) Air Quality Division |
| Applicable Regulations | <ul style="list-style-type: none">• Permit to Install 133-19A• 40 CFR Part 60 PS 2 & 3 |
| Plant Location | <ul style="list-style-type: none">• Graphic Packaging International, LLC Kalamazoo, Michigan 49007 |
| Sampling Contractor | <ul style="list-style-type: none">• AECOM 564 White Pond Dr Akron, OH 44320 |
| Air Pollution Control Equipment | <ul style="list-style-type: none">• Low NO_x Burners and Flue Gas Recirculation |
| Emission Points | <ul style="list-style-type: none">• EUBOILER#11 |
| Pollutants/Diluent Measured | <ul style="list-style-type: none">• Nitrogen Oxides (NO_x)• Carbon Dioxide (CO₂) |
| Test Dates | <ul style="list-style-type: none">• April 18, 2023 |

1.2 Key Personnel

Names and affiliations of personnel, including their roles in the test program, are summarized in the following table (Table 1-2).

Table 1-2. Key Personnel

| Role | Name | Address | Contact Information |
|----------------------|----------------|---------------------------------------|--|
| Process Focal Point | Steven Smock | Graphic Packaging, International, LLC | 269-491-6055 steven.smock@graphicpkg.com |
| Regulatory Agency | Trevor Drost | EGLE | 517-245-5781 Drostt@michigan.gov |
| Field Team Leader | Rob Sava | AECOM | 234-425-8440 Rob.sava@aecom.com |
| Test Project Manager | James Edmister | AECOM | (585) 721-9128 James.Edmister@aecom.com |

2. Plant and Sampling Location Description

2.1 Facility Description

The EUBOILER#11 is a natural gas fired boiler equipped with low NO_x burners and flue gas recirculation with a maximum heat input of approximately 311 MMBtu/hr. This natural gas fired boiler is used to heat steam for the dryer and hot water to be used on the paper machine.

2.2 Flue Gas Sampling Locations

Sampling is conducted on the EUBOILER#11 outlet stack. The Reference Test methods for NO_x and CO₂ are performed through a port that is in accordance with Performance Specification 2. The samples are withdrawn from the stack for a period of 21 minutes at the three traverse points of the measurement line that passes through the centroidal area of the stack or duct cross section. Prior to utilizing a three point traverse, a twelve point traverse was performed to verify the absence of stratification. The cross-sectional diagrams can be found in Section 7.

3. Sampling and Analysis Procedures

3.1 Objectives and Test Matrix

This testing was performed to meet the requirements of 40 CFR Part 60, Appendix B, Performance Specifications 2 and 3. The specific objectives of this test were:

- Determine the relative accuracy of the continuous CO₂ monitor systems on the EUBOILER#11 outlet stack.
- Determine the relative accuracy of the continuous NO_x monitor systems on the EUBOILER#11 outlet stack.

Tables 3-1 and 3-2 present a summary of the results for the Performance Specification Test for CEMS RATA.

3.2 Facility Operations

During the relative accuracy test, the plant is operating Boiler 11 greater than 50 percent load. The operating rate for this unit is determined based on the steam lb/hr rate presented in Table 3-3.

3.3 Comments / Exceptions

As allowed by 40 CFR Part 60, this Performance Specification Test consisted of a minimum of 9 RM tests used for RA calculations. Ten sets of RM tests were performed. Since this option was selected, a maximum of one set of the test results may be rejected so long as the total number of test results used to determine the RA was greater than or equal to nine. All data was reported, including the rejected data.

3.4 Summary of Results

Table 3-1. NO_x Monitoring

| Test Type | NO _x Monitor Results (%) | Allowable | Pass/Fail |
|------------------------------|-------------------------------------|---|-----------|
| Relative Accuracy (ppmv) | 3.7% | No greater than 20.0% of mean value of RM | Pass |
| Relative Accuracy (lb/mmBTU) | 5.2% | No greater than 20.0% of mean value of RM | Pass |

Table 3-2. CO₂ Monitoring

| Test Type | CO ₂ Monitor Results (%) | Allowable | Pass/Fail |
|-------------------|-------------------------------------|---|-----------|
| Relative Accuracy | 3.2% | No greater than 20.0% of mean value of RM | Pass |

Table 3-3. Boiler 11 Steam Flow

| EUBOILER#11 | |
|--------------------|---------------------------|
| RATA Run # | Run Average Steam (lb/hr) |
| RATA 1 | 150684.30 |
| RATA 2 | 150447.00 |
| RATA 3 | 150302.40 |
| RATA 4 | 151397.90 |
| RATA 5 | 152879.00 |
| RATA 6 | 150316.60 |
| RATA 7 | 148848.50 |
| RATA 8 | 152308.70 |
| RATA 9 | 150675.00 |
| RATA 10 | 151960.50 |
| Average | 150981.99 |

4. Sampling and Analytical Procedures

4.1 Test Methods

The relative accuracies of Graphic Packaging's CEMS was determined by comparison to EPA methods for measurement of each component gas. The performance specifications (PS) required the use of the following methods:

- PS 2 – Method 7E for NO_x; and
- PS 3 – Method 3A for CO₂.

4.2 Procedures

The above methods were performed using mobile continuous emission monitors. Gas was withdrawn from the stack and transported to monitors located at ground level. A stainless-steel probe was inserted into the stack and used to collect sample gas. A Teflon sample line, heated at an adequate temperature to keep water in vapor form, transported sample gas from the probe to the gas conditioner followed by the analyzers. The analyzers were kept at a constant temperature inside the mobile laboratory.

Sample gas was collected continuously from the stack for a period of 21 minutes per run. Samples were taken at three traverse points of the measurement line that passes through the centroidal area of the stack or duct cross section. At the mobile laboratory, the stack gas was routed to a condenser and then transported to the analyzers for analysis.

The Relative Accuracy Tests were conducted by comparison of the CEMS response to a value measured by a Performance Test Method (PTM) which, in this case, was Method 7E for Nitrogen Oxide and Method 3A for CO₂.

EPA Method 3A (Gas Analysis for the Determination of Dry Molecular Weight)

EPA Method 3A (Instrumental Method) was utilized to determine the diluent during each run on the outlet.

An analyzer measured CO₂ content using nondispersive infrared (NDIR) sensors. Gas is pushed through a light tube where the analyzer measures the absorption of light characteristic to CO₂.

EPA Method 7E (Determination of Nitrogen Oxides)

EPA Method 7E was utilized to determine nitrogen oxide concentrations during each run on the outlet.

A NOx analyzer was used to monitor the concentration of NOx during each run. A sample of the effluent gas was continuously sampled and conveyed to an analyzer for measuring the concentration of NOx. The gas stream was directed through a NO₂ convertor to convert NO₂ to NO concentration. The analyzer yielded results of a total result of NOx. See Figure 4-1 for a sampling train schematic.

EPA Method 4 (Moisture)

A calibrated Method 5 console was used to pull stack gas samples from a single point through a Method 5 probe equipped with a liner to determine percent moisture of the stack gas. Stack gas is bubbled through two impingers containing water, one empty impinger, and one impinger containing silica gel. All of the impingers are weighed prior to sampling. The impinger train is kept iced in order to knock out all moisture in the stack gas. After the final leak check following each run, the exterior of the impingers are dried off and the impingers weighed to determine percent moisture. Field data sheets and calculations of percent moisture are included in the report field section. The final average moisture content during all runs is used to correct the CEMS values to a "wet" basis.

4.3 List of Sampling Equipment

Tables 4-1 and 4-2 list the reference method analyzers used for the test and Boiler 11 analyzers while Figure 4-1 displays the sample system diagram.

Table 4-1. Reference Method

| Reference Method | Equipment | ID # | Span |
|------------------------------|------------------------|-----------|-----------|
| Method 3A (CO ₂) | SERVOMEX 1440 Analyzer | OXC-A1603 | 18.95 % |
| Method 7E (NO _x) | THERMO 42i-HL Analyzer | NOX F1901 | 60.71 ppm |

Table 4-2. Boiler 11 CEMS Analyzers

| Constituent | Unit | Manufacturer | Model | Serial # | Span |
|-----------------|-------|--------------|---------------|------------|-------|
| Nitrogen Oxides | ppmv | Thermo | iQ Series 42 | 1202759349 | 0-100 |
| Carbon Dioxide | vol % | Thermo | iQ Series 410 | 1202759351 | 0-25 |

Figure 4-1. Sample Train Schematic

