

## ภาคผนวก จ-7

---

ผลการตรวจวิเคราะห์ฝุ่นละอองรวม (TSP)  
ที่ระบายออกจากปล่อง

**Report of Emission Air Quality and  
Continuous Emission Monitoring Systems Audit at  
Ratchaburi Power Plant  
Ratchaburi Power Co., Ltd.**

January 14, 24 and February 9, 2022

**Contents**

	Page
Contents	i
Index of Tables	ii
Index of figures	iii
1. Introduction	1
2. Objective	1
3. Definitions	
3.1 Reference Method (RM)	2
3.2 Relative Accuracy (RA)	2
4. Scope of the Test	
4.1 Emission Air Quality	2
4.2 Relative Accuracy Test	2
5. Reference Work Procedure	
5.1 Emission Air Quality	5
5.2 Relative Accuracy Test	6
6. Procedure of the Relative Accuracy Test Audit (RATA)	6
7. Results	
7.1 Emission Air Quality	9
7.2 Relative Accuracy Test Audit (RATA)	14
Appendix A Test Report	
Appendix B - Certificate of Accreditation SGS (Thailand) Limited ISO 9001 : 2015 Certificate of Compliance	
Appendix C Certificate of Instruments Calibration	

**Index of Tables**

Tables	Page
5.1-1 Sampling and analytical methods	5
6-1 The reference methods (RM) for the Relative Accuracy Test Audit (RATA)	6
6-2 The t-Value	8
6-3 The accepted criteria for the Relative Accuracy Test Audit (RATA)	9
7.1-1 The results of emission air quality from HRSG 11 Stack at Ratchaburi Power Plant, Ratchaburi province on January 14, 2022	11
7.1-2 The results of emission air quality from HRSG 12 Stack at Ratchaburi Power Plant, Ratchaburi province on January 14, 2022	12
7.1-3 The results of emission air quality from HRSG 21 Stack at Ratchaburi Power Plant, Ratchaburi province on February 9, 2022	13
7.1-4 The results of emission air quality from HRSG 22 Stack at Ratchaburi Power Plant, Ratchaburi province on February 9, 2022	14
7.2-1 Summary of RATA results of CEMS at HRSG11 Stack at Ratchaburi Power Plant, Ratchaburi province on January 14, 2022	15
7.2-2 Summary of RATA results of CEMS at HRSG 12 Stack at Ratchaburi Power Plant, Ratchaburi province on January 24, 2022	15
7.2-3 Summary of RATA results of CEMS at HRSG 21 Stack at Ratchaburi Power Plant, Ratchaburi province on February 9, 2022	16
7.2-4 Summary of RATA results of CEMS at HRSG 22 Stack at Ratchaburi Power Plant, Ratchaburi province on February 9, 2022	16

**Index of Figures**

Tables	Page
4-1 Sampling Location at Ratchaburi Power Co., Ltd.	3

## Report of Emission Air Quality and Continuous Emission Monitoring Systems Audit at

Ratchaburi Power Plant, Ratchaburi province

Ratchaburi Power Co., Ltd.

January 14, 24 and February 9, 2022

### 1. Introduction

The continuous emission monitoring systems (CEMS) were installed at HRSG 11, HRSG 12, HRSG 21 and HRSG 22 Stack at Ratchaburi Power Plant, Ratchaburi province according to the requirements of the installation as Performance Specification (PS), the audit of CEMS has to be performed by the third party. Thus, Ratchaburi Power Co., Ltd. has assigned SGS (Thailand) Limited to conduct the Emission Air Quality and CEMS audit during January 14, 24 and February 9, 2022. The details of all performances are shown in the next topics.

### 2. Objectives

- To monitor emission air quality from HRSG 11, HRSG 12, HRSG 21 and HRSG 22 Stack at Ratchaburi Power Plant, Ratchaburi province and compare their results with the standard criteria prescribed by the government agency.

- To certify that the continuous emission monitoring systems meet the requirements of 40 CFR 60 Appendix B, Performance Specification 2 (for NO<sub>x</sub> and SO<sub>2</sub>), Performance Specification 3 (for O<sub>2</sub>) and Performance Specification 4 (for CO) in term of the relative accuracy (RA).

### 3. Definitions

#### 3.1 Reference Method (RM)

Reference Method (RM) means the measured results of stack emission which is conducted by promulgated method for "Determination of Emission Air from Stationary Sources" according to the 40 CFR 60 Appendix A.

#### 3.2 Relative Accuracy (RA)

The absolute mean difference between the gas concentration or emission rate determined by the CEMS and the value determined by the reference method (RM), plus the 2.5% error confidence coefficient of a series of tests, divided by the mean of the RM tests or the applicable emission limit.

### 4. Scope of the Test

#### 4.1 Emission Air Quality

Performing the Emission Air Quality from HRSG 11, HRSG 12, HRSG 21 and HRSG 22 Stack at Ratchaburi Power Plant, Ratchaburi province as follow:

- HRSG 11 : January 14, 2022
- HRSG 12 : January 14, 2022
- HRSG 21 : February 9, 2022
- HRSG 22 : February 9, 2022

#### 4.2 Relative Accuracy Test

Performing the Relative Accuracy Test for the SO<sub>2</sub>, NO<sub>x</sub>, CO and O<sub>2</sub> as installed at HRSG 11, HRSG 12, HRSG 21 and HRSG 22 Stack, Ratchaburi Power Plant, Ratchaburi province as follow:

- HRSG 11 : January 14, 2022
- HRSG 12 : January 24, 2022
- HRSG 21 : February 9, 2022
- HRSG 22 : February 9, 2022

For sampling Location shown in Figure 4-1.



HRSG# 11 (January 14, 2022)



RATA (January 24, 2022)



Stack manual sampling (January 14, 2022)



HRSG# 12

Figure 4-1 Sampling Location at  
Ratchaburi Power Co., Ltd.



HRSG #21 (February 9, 2022)



HRSG# 22 (February 9, 2022)



Figure 4-1 Sampling Location at  
Ratchaburi Power Co., Ltd. (Con't)

## 5. Reference Work Procedure

### 5.1 Emission Air Quality

The sampling and analytical methods of emission air quality were performed in accordance with the standard methods accepted by Thai Regulations such as Department of Industrial Works (DIW) and then the results of emission air quality will be compared with the reference standard in accordance with the Notification of Ministry of Industry, B.E. 2547 (2004), issued under the Factory Act, B.E. 2535 (1992), dated October 7, B.E. 2547 (2004) for the New Power Plant. Details of sampling and analytical methods are shown in **Table 5.1-1**.

**Table 5.1-1 Sampling and analytical methods**

Parameters	Sampling Methods	Analytical Methods
- Total Suspended Particulates (TSP)	U.S. EPA Method 5	Gravimetric Method
- Sulfur dioxide (SO <sub>2</sub> )	U.S. EPA Method 6	Titration Method
- NO <sub>x</sub> (as NO <sub>2</sub> )	U.S. EPA Method 7	Colorimetric Method
- Carbon monoxide (CO)	U.S. EPA Method 10	Non dispersive infrared analyzer (NDIR)
- Mercury (Hg)	U.S. EPA Method 29	Cold Vapor Technique

## 5.2 Relative Accuracy Test

### Relative Accuracy Test

The Performance Specification (PS) Test Procedure is based on the U.S. EPA Regulation according to the 40 CFR 60 Appendix B as the following.

- PS-2 :The Specifications and Test Procedures for SO<sub>2</sub> and NO<sub>x</sub> Continuous Emission Monitoring Systems in Stationary Sources.
- PS-3 :The Specifications and Test Procedures for O<sub>2</sub> Continuous Emission Monitoring Systems in Stationary Sources.
- PS-4 :The Specifications and Test Procedures for CO Continuous Emission Monitoring Systems in Stationary Sources.

### 6. Procedure of the Relative Accuracy Test Audit (RATA)

The RATA test is conducted by following the procedures described in the applicable PS in Appendix B for Relative Accuracy Test Audit (RATA) as the following.

- 1) **RA Test Condition** : Conduct the RA test according to the procedure given as below, while the affected facility is operating at normal load.
- 2) **Sampling Technique for RM Tests** : for integrated samples make a sample traverse of at least 30 minutes, sampling for an equal time at each traverse point
- 3) **Number of RM Test** : Twelve (12) sets of samples of SO<sub>2</sub>, NO<sub>x</sub>, CO, and O<sub>2</sub> were collected for each CEMS unit.
- 4) **RM Test** : The reference method for determination of SO<sub>2</sub>, NO<sub>x</sub>, CO, and O<sub>2</sub>, based on the U.S. EPA, 40 CFR 60 Appendix A as per **Table 6-1**.

**Table 6-1 The reference methods (RM) for the Relative Accuracy Test Audit (RATA)**

Parameters	Reference Methods
SO <sub>2</sub>	U.S. EPA Method 6C
NO <sub>x</sub>	U.S. EPA Method 7E
CO	U.S. EPA Method 10
O <sub>2</sub>	U.S. EPA Method 3A

**Source** : - based on the U.S. EPA, 40 CFR 60 Appendix A

5) **Correlation of RM and CEMs Data** : Correlate the CEMs and the RM test data as to the time and duration by first determining from the CEMs final output (the one used for reporting) the integrated average pollutant concentration or emission rate for each pollutant RM test period. Consider system response time, and confirm that the pair of results are on a consistent moisture, temperature, and diluents' concentration basis. Then, compare each integrated CEMs value against the corresponding average RM value. For integrated sampling technique, make a direct comparison of the RM results and CEMs integrated average value.

6) **Calculation** : Calculate the mean difference between the RM and CEMs values in the units of the emission standard, Standard Deviation (S<sub>d</sub>), Confidence Coefficient (CC) and the Relative Accuracy (RA) as the followings.

- All data from the RM and CEMs are on a consistent dry basis and on a consistent diluents' basis and in the unit of the emission standard.
- Arithmetic Mean ( $\bar{d}$ ) : Calculate the arithmetic mean of the difference of a data set as follows:

$$\bar{d} = \frac{1}{n} \sum_{i=1}^n d_i \quad (\text{Equation 1})$$

Where : n = Number of data points.

$\sum_{i=1}^n d_i$  = Algebraic summation of the individual difference d<sub>i</sub>

- Standard Deviation (S<sub>d</sub>) : Calculate the standard deviation as follows :

$$S_d = \sqrt{\frac{\sum_{i=1}^n d_i^2 - \left[ \sum_{i=1}^n d_i \right]^2}{n-1}} \quad (\text{Equation 2})$$

- Confidence Coefficient (CC) : Calculate the 2.5% error confidence coefficient (one-tailed) as follows:

$$CC = t_{0.975} \frac{S_d}{\sqrt{n}} \quad (\text{Equation 3})$$

Where : t<sub>0.975</sub> = t-value (see **Table 6-2**)

**Table 6-2 The t-Value**

n <sup>a</sup>	t <sub>0.975</sub>	n <sup>a</sup>	t <sub>0.975</sub>	n <sup>a</sup>	t <sub>0.975</sub>
2	12.706	7	2.447	12	2.201
3	4.303	8	2.365	13	2.179
4	3.182	9	2.306	14	2.160
5	2.776	10	2.262	15	2.145
6	2.571	11	2.228	16	2.131

- Relative Accuracy (RA) : Calculate the RA of a set of data as follows:

- SO<sub>2</sub>, NO<sub>x</sub> and CO

$$RA = \frac{|\bar{d}| + |CC|}{\overline{RM}} \times 100 \quad (\text{Equation 4})$$

- O<sub>2</sub>

$$RA = |\bar{d}| \quad (\text{Equation 5})$$

Where :  $|\bar{d}|$  = Absolute value of the mean differences  
(from Equation 1)

$|CC|$  = Absolute value of the confidence coefficient  
(from Equation 3)

$\overline{RM}$  = Average RM value. In cases where the average emissions for the test are less than 50% of the applicable standard, substitute the emission standard value in the denominator of Equation 4 in place of  $\overline{RM}$ . In all other cases, use  $\overline{RM}$ .

- 7) **Accepted Criteria** : The accepted criteria of RA are shown in **Table 6-3**.

Table 6-3 The accepted criteria for the Relative Accuracy Test Audit (RATA)

Parameters	Accepted Criteria	
	Compared with RM	Compared with Standard
SO <sub>2</sub> (PS-2)	20% of RM <sup>1/</sup>	10% of Standard <sup>2/</sup>
NO <sub>x</sub> (PS-2)	20% of RM <sup>1/</sup>	10% of Standard <sup>2/</sup>
CO (PS-4)	10% of RM <sup>1/</sup>	5% of Standard <sup>3/</sup>
O <sub>2</sub> (PS-3)	1 % O <sub>2</sub> <sup>1/</sup>	-

Remarks : <sup>1/</sup> RA criteria is referred to 40CFR 60 Appendix B, U.S. EPA : Performance Specification (PS)  
<sup>2/</sup> Notification of Ministry of Industry, B.E. 2547 (2004), issued under the Factory Act, B.E. 2535 (1992), dated October 7, B.E. 2547 (2004) for the New Power Plant.  
<sup>3/</sup> Notification of the Ministry of Industry, subjected "Industrial Emission Standards", dated December 4, 2006.

## 7. Results

### 7.1 Emission Air Quality

The emission air quality of HRSG 11, HRSG 12, HRSG 21 and HRSG 22 Stack were monitored during January 14 and February 9, 2022 which calculated at 7% O<sub>2</sub> 25°C, 1 atm or 760 mm.Hg and dry basis. The details of emission air quality monitoring results can be concluded as the following.

#### HRSG 11 Stack

The Total Suspended Particulates (TSP), NO<sub>x</sub> (as NO<sub>2</sub>), SO<sub>2</sub>, CO and Mercury (Hg) of HRSG 11 Stack were monitored on January 14, 2022. It was found that TSP result was 1.56 mg/Nm<sup>3</sup>, NO<sub>x</sub> (as NO<sub>2</sub>) was 44.48 ppm at condition 7% O<sub>2</sub>. For SO<sub>2</sub>, CO and Mercury (Hg) from this stack were not detected. The detail of analysis results is shown in Table 7.1-1.

#### HRSG 12 Stack

The Total Suspended Particulates (TSP), NO<sub>x</sub> (as NO<sub>2</sub>), SO<sub>2</sub>, CO and Mercury (Hg) of HRSG 12 Stack were monitored on January, 14 2022. It was found that TSP result was 1.61 mg/Nm<sup>3</sup>, NO<sub>x</sub> (as NO<sub>2</sub>) was 72.19 ppm at condition 7% O<sub>2</sub>. For SO<sub>2</sub>, CO and Mercury (Hg) from this stack were not detected. The detail of analysis results is shown in Table 7.1-2.

#### HRSG 21 Stack

The Total Suspended Particulates (TSP), NO<sub>x</sub> (as NO<sub>2</sub>), SO<sub>2</sub>, CO and Mercury (Hg) of HRSG 21 Stack were monitored on February 9, 2022. It was found that TSP result was 1.98 mg/Nm<sup>3</sup> and NO<sub>x</sub> (as NO<sub>2</sub>) was 46.82 ppm and CO was 10.4 ppm at condition 7% O<sub>2</sub>. For SO<sub>2</sub> and Mercury (Hg) from this stack were not detected. The detail of analysis results is shown in Table 7.1-3.

#### HRSG 22 Stack

The Total Suspended Particulates (TSP), NO<sub>x</sub> (as NO<sub>2</sub>), SO<sub>2</sub>, CO and Mercury (Hg) of HRSG 22 Stack were monitored on February 9, 2022. It was found that TSP result was 1.74 mg/Nm<sup>3</sup> and NO<sub>x</sub> (as NO<sub>2</sub>) was 49.62 ppm and CO was 6.9 ppm at condition 7% O<sub>2</sub>. For SO<sub>2</sub> and Mercury (Hg) from this stack were not detected. The detail of analysis results is shown in Table 7.1-4.

When comparing emission air quality analytical results with the Emission Standard prescribed by the Notification of Ministry of Industry, B.E. 2547 (2004), issued under the Factory Act, B.E. 2535 (1992), dated October 7, B.E. 2547 (2004) for the New Power Plant, it was found that Total Suspended Particulates (TSP), NO<sub>x</sub> (as NO<sub>2</sub>), SO<sub>2</sub>, CO and Mercury (Hg) from HRSG 11, HRSG 12, HRSG 21 and HRSG 22 Stack at Ratchaburi Power Plant were within the standard criteria.

Table 7.1-1 The results of emission air quality from HRSG 11 Stack at Ratchaburi Power Plant, Ratchaburi province on January 14, 2022

Parameter	Unit	Value	Standard	Analytical Methods
Fuel Type	-	Natural Gas	-	-
Stack Diameter	cm.	697	-	-
Stack Temperature	°C	112.1	-	-
Dry Gas Temperature	°C	35.5	-	-
Absolute Stack Pressure	mm.Hg	761.2	-	-
Air Velocity	m/s	20.44	-	U.S.EPA Method 2
Volumetric Flow Rate	Nm <sup>3</sup> /hr	1,985,843	-	U.S.EPA Method 2
Moisture	%	8.72	-	U.S.EPA Method 4
O <sub>2</sub>	%	14.02	-	U.S. EPA Method 3A
CO <sub>2</sub>	%	3.96	-	-
TSP (at 7 % O <sub>2</sub> )	mg/Nm <sup>3</sup>	1.56	60 <sup>1/</sup>	U.S.EPA Method 5
NO <sub>x</sub> (as NO <sub>2</sub> ) at O <sub>2</sub> 7%	ppm	44.48	120 <sup>1/</sup> , 96 <sup>3/</sup>	U.S.EPA Method 7
SO <sub>2</sub> at O <sub>2</sub> 7%	ppm	N.D.	20 <sup>1/</sup>	U.S.EPA Method 6
CO at O <sub>2</sub> 7%	ppm	N.D.	690 <sup>2/</sup>	U.S.EPA Method 10
Mercury (Hg) at 7%O <sub>2</sub>	mg/Nm <sup>3</sup>	N.D.	2.4 <sup>2/</sup>	U.S. EPA Method 29

Remarks : - N = Normal condition means reference condition at temperature of 25 °C, pressure of 1 atm or 760 mm.Hg, and dry basis.  
- N.D. = Not Detected, detection limit at actual O<sub>2</sub> of SO<sub>2</sub> <1 ppm, Mercury (Hg) < 0.00013 mg/Nm<sup>3</sup>  
Sources : <sup>1/</sup> Notification of Ministry of Industry, B.E. 2547 (2004), issued under Factory Act B.E. 2535 (1992), dated October 7, B.E. 2547 (2004), New Power Plant.  
<sup>2/</sup> Notification of the Ministry of Industry, B.E. 2549 (2006)  
<sup>3/</sup> Emission Standard from EIA of RPCL Plant.

Table 7.1-2 The results of emission air quality from HRSG 12 Stack at Ratchaburi Power Plant, Ratchaburi province on January 14, 2022

Parameter	Unit	Value	Standard	Analytical Methods
Fuel Type	-	Natural Gas	-	-
Stack Diameter	cm.	697	-	-
Stack Temperature	°C	98.1	-	-
Dry Gas Temperature	°C	30.0	-	-
Absolute Stack Pressure	mm.Hg	760.9	-	-
Air Velocity	m/s	21.52	-	U.S.EPA Method 2
Volumetric Flow Rate	Nm <sup>3</sup> /hr	2,141,515	-	U.S.EPA Method 2
Moisture	%	9.85	-	U.S.EPA Method 4
O <sub>2</sub>	%	13.58	-	U.S. EPA Method 3A
CO <sub>2</sub>	%	4.21	-	-
TSP (at 7 % O <sub>2</sub> )	mg/Nm <sup>3</sup>	1.61	60 <sup>1/</sup>	U.S.EPA Method 5
NO <sub>x</sub> (as NO <sub>2</sub> ) at O <sub>2</sub> 7%	ppm	72.19	120 <sup>1/</sup> , 96 <sup>3/</sup>	U.S.EPA Method 7
SO <sub>2</sub> at O <sub>2</sub> 7%	ppm	N.D.	20 <sup>1/</sup>	U.S.EPA Method 6
CO at O <sub>2</sub> 7%	ppm	N.D.	690 <sup>2/</sup>	U.S.EPA Method 10
Mercury (Hg) at O <sub>2</sub> 7%	mg/Nm <sup>3</sup>	N.D.	2.4 <sup>2/</sup>	U.S. EPA Method 29

Remarks : - N = Normal condition means reference condition at temperature of 25 °C, pressure of 1 atm or 760 mm.Hg, and dry basis.  
- N.D. = Not Detected, detection limit at actual O<sub>2</sub> of SO<sub>2</sub> <1 ppm and Mercury (Hg) < 0.00015 mg/Nm<sup>3</sup>

Sources : <sup>1/</sup> Notification of Ministry of Industry, B.E. 2547 (2004), issued under Factory Act B.E. 2535 (1992), dated October 7, B.E. 2547 (2004), New Power Plant.  
<sup>2/</sup> Notification of the Ministry of Industry, B.E. 2549 (2006)  
<sup>3/</sup> Emission Standard from EIA of RPCL Plant.

**Table 7.1-3 The results of emission air quality from HRSG 21 Stack at Ratchaburi Power Plant, Ratchaburi province on February 9, 2022**

Parameter	Unit	Value	Standard	Analytical Methods
Fuel Type	-	Natural Gas	-	-
Stack Diameter	cm.	697	-	-
Stack Temperature	°C	95.9	-	-
Dry Gas Temperature	°C	35.1	-	-
Absolute Stack Pressure	mm.Hg	757.8	-	-
Air Velocity	m/s	14.75	-	U.S.EPA Method 2
Volumetric Flow Rate	Nm <sup>3</sup> /hr	1,469,368	-	U.S.EPA Method 2
Moisture	%	9.93	-	U.S.EPA Method 4
O <sub>2</sub>	%	13.83	-	U.S. EPA Method 3A
CO <sub>2</sub>	%	3.88	-	-
TSP (at 7 % O <sub>2</sub> )	mg/Nm <sup>3</sup>	1.98	60 <sup>1/2</sup>	U.S.EPA Method 5
NO <sub>x</sub> (as NO <sub>2</sub> ) at O <sub>2</sub> 7%	ppm	46.82	120 <sup>1/2</sup> , 96 <sup>3/2</sup>	U.S.EPA Method 7
SO <sub>2</sub> at O <sub>2</sub> 7%	ppm	N.D.	20 <sup>1/2</sup>	U.S.EPA Method 6
CO at O <sub>2</sub> 7%	ppm	10.4.	690 <sup>2/2</sup>	U.S.EPA Method 10
Mercury (Hg) at O <sub>2</sub> 7%	mg/Nm <sup>3</sup>	N.D.	2.4 <sup>2/2</sup>	U.S. EPA Method 29

**Remarks :** - N = Normal condition means reference condition at temperature of 25 °C, pressure of 1 atm or 760 mm.Hg, and dry basis.  
- N.D. = Not Detected, detection limit at actual O<sub>2</sub> of SO<sub>2</sub> <1 ppm and Mercury (Hg) < 0.00075 mg/Nm<sup>3</sup>

**Sources :** <sup>1/</sup> Notification of Ministry of Industry, B.E. 2547 (2004), issued under Factory Act B.E. 2535 (1992), dated October 7, B.E. 2547 (2004), New Power Plant.  
<sup>2/</sup> Notification of the Ministry of Industry, B.E. 2549 (2006)  
<sup>3/</sup> Emission Standard from EIA of RPCL Plant.

**Table 7.1-4 The results of emission air quality from HRSG 22 Stack at Ratchaburi Power Plant, Ratchaburi province on February 9, 2022**

Parameter	Unit	Value	Standard	Analytical Methods
Fuel Type	-	Natural Gas	-	-
Stack Diameter	cm.	697	-	-
Stack Temperature	°C	101.8	-	-
Dry Gas Temperature	°C	37.9	-	-
Absolute Stack Pressure	mm.Hg	757.9	-	-
Air Velocity	m/s	15.84	-	U.S.EPA Method 2
Volumetric Flow Rate	Nm <sup>3</sup> /hr	1,561,477	-	U.S.EPA Method 2
Moisture	%	9.43	-	U.S.EPA Method 4
O <sub>2</sub>	%	13.87	-	U.S. EPA Method 3A
CO <sub>2</sub>	%	4.20	-	-
TSP (at 7 % O <sub>2</sub> )	mg/Nm <sup>3</sup>	1.74	60 <sup>1/2</sup>	U.S.EPA Method 5
NO <sub>x</sub> (as NO <sub>2</sub> ) at O <sub>2</sub> 7%	ppm	49.62	120 <sup>1/2</sup> , 96 <sup>3/2</sup>	U.S.EPA Method 7
SO <sub>2</sub> at O <sub>2</sub> 7%	ppm	N.D.	20 <sup>1/2</sup>	U.S.EPA Method 6
CO at O <sub>2</sub> 7%	ppm	6.9	690 <sup>2/2</sup>	U.S.EPA Method 10
Mercury (Hg) at O <sub>2</sub> 7%	mg/Nm <sup>3</sup>	N.D.	2.4 <sup>2/2</sup>	U.S. EPA Method 29

**Remarks :** - N = Normal condition means reference condition at temperature of 25 °C, pressure of 1 atm or 760 mm.Hg, and dry basis.  
- N.D. = Not Detected, detection limit at actual O<sub>2</sub> of SO<sub>2</sub> <1 ppm and Mercury (Hg) < 0.00070 mg/Nm<sup>3</sup>

**Sources :** <sup>1/</sup> Notification of Ministry of Industry, B.E. 2547 (2004), issued under Factory Act B.E. 2535 (1992), dated October 7, B.E. 2547 (2004), New Power Plant.  
<sup>2/</sup> Notification of the Ministry of Industry, B.E. 2549 (2006)  
<sup>3/</sup> Emission Standard from EIA of RPCL Plant.

## 7.2 Relative Accuracy Test Audit (RATA)

The summary of RATA results of CEMs has installed at HRSG 11, HRSG 12, HRSG 21 and HRSG 22 Stack at Ratchaburi Power Plant, Ratchaburi province conducted during January 14, 24 and February 9, 2022 and it was found that the RATA of SO<sub>2</sub>, NO<sub>x</sub>, CO and O<sub>2</sub> met the RA accepted criteria of U.S. EPA regulated in 40 CFR 60 Appendix B, Performance Specification 2, 3 and 4 (PS-2, PS-3 and PS-4). The details are shown in **Table 7.2-1-7.2-4**.

**Table 7.2-1 Summary of RATA results of CEMs at HRSG 11 Stack at Ratchaburi Power Plant, Ratchaburi province on January 14, 2022**

Parameters	Units	CEMS	RM (by SGS)	Diff.	CC	RA%	RA Acceptance Criteria	Passed or Not
NO <sub>x</sub> at 7%O <sub>2</sub> (compared with RM)	ppm	59.72	56.34	-3.38	3.51	12.24%	20% <sup>1/2</sup>	passed
O <sub>2</sub> (compared with RM)	%	13.84	13.85	0.01	-	0.01%	1% <sup>1/2</sup>	passed
SO <sub>2</sub> at 7%O <sub>2</sub> (compared with Emission standard 20 ppm)	ppm	3.66	2.14	-1.52	0.24	8.82%	10% <sup>2/2</sup>	passed
CO at 7%O <sub>2</sub> (compared with Emission standard 690 ppm)	ppm	5.81	0.30	-5.51	0.29	0.84%	5% <sup>3/2</sup>	passed

**Remarks :** <sup>1/</sup> RA Criteria is referred to 40CFR 60 Appendix B, U.S. EPA : Performance Specification (PS)  
<sup>2/</sup> RA value was compared with Notification of Ministry of Industry, B.E. 2547 (2004), issued under Factory Act B.E. 2535 (1992), dated October 7, B.E. 2547 (2004), New Power Plant or Ratchaburi Power Plant Criteria  
<sup>3/</sup> RA value was compared with the emission standard according to the Notification of the Ministry of Industry, subjected "Industrial Emission Standards", dated December 4, 2006

**Table 7.2-2 Summary of RATA results of CEMs at HRSG 12 Stack at Ratchaburi Power Plant, Ratchaburi province on January 24, 2022**

Parameters	Units	CEMS	RM (by SGS)	Diff.	CC	RA%	RA Acceptance Criteria	Passed or Not
NO <sub>x</sub> at 7%O <sub>2</sub> (compared with RM)	ppm	65.33	69.00	3.67	0.76	6.42%	20% <sup>1/2</sup>	passed
O <sub>2</sub> (compared with RM)	%	13.64	13.38	-0.26	-	0.26%	1% <sup>1/2</sup>	passed
SO <sub>2</sub> at 7%O <sub>2</sub> (compared with Emission standard 20 ppm)	ppm	1.78	1.17	-0.62	0.05	3.31%	10 % <sup>2/2</sup>	passed
CO at 7%O <sub>2</sub> (compared with Emission standard 690 ppm)	ppm	3.52	0.87	-2.65	0.18	0.41%	5% <sup>1/2</sup>	passed

**Remarks :** <sup>1/</sup> RA Criteria is referred to 40CFR 60 Appendix B, U.S. EPA : Performance Specification (PS)  
<sup>2/</sup> RA value was compared with Notification of Ministry of Industry, B.E. 2547 (2004), issued under Factory Act B.E. 2535 (1992), dated October 7, B.E. 2547 (2004), New Power Plant or Ratchaburi Power Plant Criteria  
<sup>3/</sup> RA value was compared with the emission standard according to the Notification of the Ministry of Industry, subjected "Industrial Emission Standards", dated December 4, 2006

**Table 7.2-3 Summary of RATA results of CEMs at HRSG 21 Stack at Ratchaburi Power Plant, Ratchaburi province on February 9, 2022**

Parameters	Units	CEMS	RM (by SGS)	Diff.	CC	RA%	RA Acceptance Criteria	Passed or Not
NO <sub>x</sub> at 7%O <sub>2</sub> (compared with Emission Standard 96 ppm)	ppm	48.15	45.66	-2.49	0.62	3.24%	10% <sup>1/2</sup>	passed
O <sub>2</sub> (compared with RM)	%	13.80	13.70	-0.10	-	0.10%	1% <sup>1/2</sup>	passed
SO <sub>2</sub> at 7%O <sub>2</sub> (compared with Emission standard 20 ppm)	ppm	1.41	1.36	-0.06	0.12	0.91%	10 % <sup>2/2</sup>	passed
CO at 7%O <sub>2</sub> (compared with Emission standard 690 ppm)	ppm	6.53	6.05	-0.49	0.49	0.14%	5% <sup>3/2</sup>	passed

**Remarks :** <sup>1/</sup> RA Criteria is referred to 40CFR 60 Appendix B, U.S. EPA : Performance Specification (PS)  
<sup>2/</sup> RA value was compared with Notification of Ministry of Industry, B.E. 2547 (2004), issued under Factory Act B.E. 2535 (1992), dated October 7, B.E. 2547 (2004), New Power Plant or Ratchaburi Power Plant Criteria  
<sup>3/</sup> RA value was compared with the emission standard according to the Notification of the Ministry of Industry, subjected "Industrial Emission Standards", dated December 4, 2006

**Table 7.2-4 Summary of RATA results of CEMs at HRSG 22 Stack at Ratchaburi Power Plant, Ratchaburi province on February 9, 2022**

Parameters	Units	CEMS	RM (by SGS)	Diff.	CC	RA%	RA Acceptance Criteria	Passed or Not
NO <sub>x</sub> at 7%O <sub>2</sub> (compared with Emission standard 96 ppm)	ppm	49.43	46.87	-2.56	0.30	2.98%	10% <sup>2/2</sup>	passed
O <sub>2</sub> (compared with RM)	%	13.83	13.84	0.01	-	0.01%	1% <sup>1/2</sup>	passed
SO <sub>2</sub> at 7%O <sub>2</sub> (compared with Emission standard 20 ppm)	ppm	1.68	1.46	-0.21	0.11	1.60%	10 % <sup>2/2</sup>	passed
CO at 7%O <sub>2</sub> (compared with Emission standard 690 ppm)	ppm	8.93	8.70	-0.23	0.46	0.10%	5% <sup>1/2</sup>	passed

**Remarks :** <sup>1/</sup> RA Criteria is referred to 40CFR 60 Appendix B, U.S. EPA : Performance Specification (PS)  
<sup>2/</sup> RA value was compared with Notification of Ministry of Industry, B.E. 2547 (2004), issued under Factory Act B.E. 2535 (1992), dated October 7, B.E. 2547 (2004), New Power Plant or Ratchaburi Power Plant Criteria  
<sup>3/</sup> RA value was compared with the emission standard according to the Notification of the Ministry of Industry, subjected "Industrial Emission Standards", dated December 4, 2006

## Appendix A Test Report

## Emission Air Quality

- HRSG 11



Report No. : 2022-5003483 / 002-1 (Page 1 of 1) Issued date : January 26, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panitchakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1099

### Analysis Report

SAMPLE DESIGNATED AS : Emission Air Quality  
SAMPLING LOCATION : HRSG 11,  
Ratchaburi Power Plant, Ratchaburi province  
SAMPLING DATE : January 14, 2022  
SAMPLING TIME : 11:20-13:57 hr.  
SAMPLING BY : Suphachai Pisanpracharak  
(9-197-9-8553)

Parameter	Unit	Value	Standard	Analytical Methods
Fuel Type	-	Natural Gas	-	-
Stack Diameter	cm.	697	-	-
Stack Temperature	°C	112.1	-	-
Dry Gas Temperature	°C	35.5	-	-
Absolute Stack Pressure	mm.Hg	761.2	-	-
Air Velocity	m/s	20.44	-	U.S.EPA Method 2
Volumetric Flow Rate at actual O <sub>2</sub>	Nm <sup>3</sup> /hr, dry	1,985,843	-	U.S.EPA Method 2
Moisture	%	8.72	-	U.S.EPA Method 4
O <sub>2</sub>	%	14.02	-	-
CO <sub>2</sub>	%	3.96	-	U.S. EPA Method 3A
TSP at 7 % O <sub>2</sub>	mg/Nm <sup>3</sup>	1.56	80 <sup>1)</sup>	U.S.EPA Method 5
NO <sub>x</sub> (as NO <sub>2</sub> ) at 7 % O <sub>2</sub>	ppm	44.48	120 <sup>1)</sup> , 96 <sup>2)</sup>	U.S.EPA Method 7
SO <sub>2</sub> at 7% O <sub>2</sub>	ppm	N.D.	20 <sup>1)</sup>	U.S.EPA Method 6
CO at 7% O <sub>2</sub>	ppm	N.D.	690 <sup>2)</sup>	U.S.EPA Method 10
Mercury (Hg) at 7%O <sub>2</sub>	mg/Nm <sup>3</sup>	N.D.	2.4 <sup>2)</sup>	U.S. EPA Method 29

Remarks : - N = Normal condition means reference condition at temperature of 25 °C, pressure of 1 atm or 760 mm Hg, and dry basis.  
- N.D. = Not Detected, detection limit at actual O<sub>2</sub> of SO<sub>2</sub> <1 ppm; CO < 1 ppm  
and Mercury (Hg) < 0.00013 mg/Nm<sup>3</sup>

Sources : <sup>1)</sup> Notification of Ministry of Industry, B.E. 2547 (2004), issued under Factory Act B.E. 2535 (1992), dated October 7, B.E. 2547 (2004), New Power Plant.  
<sup>2)</sup> Notification of the Ministry of Industry, B.E. 2549 (2006)  
<sup>3)</sup> Emission Standard of Ratchaburi Power Plant.

Thapsan Y.  
(Thapsan Yommana)  
License ID: 7-1979-8538  
Technical Manager



TY/SCW/MI

This document is issued by the Company under its General Conditions of Service which apply to all services provided by the Company. It is the property of the Company and shall remain the property of the Company. Any reproduction or distribution of this document without the written or electronic approval of the Company is prohibited. The Company is not responsible for any loss or damage to the original or copy of this document. The Company is not responsible for any loss or damage to the original or copy of this document. The Company is not responsible for any loss or damage to the original or copy of this document.

E 240640

SGS (Thailand) Limited | Environment, Health and Safety | 160 Rangsit Road | Chongpradeng, Yomaha, Bangkok 10110  
T +66 (0)2 576 18 11 F +66 (0)2 576 02 22 www.sgs.com

## Relative Accuracy Test Audit (RATA)

- HRSG 11





Report No. : 2022-5003483 / 001-1 (Page 1 of 4) Issued date: January 22, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

### Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : NO<sub>x</sub> MEASUREMENT DATE : January 14, 2022  
MEASUREMENT LOCATION : HRSG 11, MEASURED BY : Supachai Pisanpracharak  
Ratchaburi Power Co., Ltd., Ratchaburi Province

No.	Date (dd/mm/yy)	Time	Loading condition (MW) <sup>2)</sup>	NO <sub>x</sub>				Diff
				Raw Data (at actual O <sub>2</sub> )		Corrected Value (at 7%O <sub>2</sub> )		
				CEMs	RM	CEMs	RM	
				ppm	ppm	ppm	ppm	
1	14/01/2022	11:00-11:29	205.18	29.81	31.71	58.42	61.94	3.53
2	14/01/2022	11:30-11:59	160.41	22.63	22.21	45.70	44.57	-1.13
3	14/01/2022	12:00-12:29	169.13	23.60	19.92	47.69	40.57	-7.12
4	14/01/2022	12:30-12:59	174.50	24.15	21.52	48.68	43.60	-5.08
5	14/01/2022	13:00-13:29	175.45	24.04	20.99	48.62	42.73	-5.88
6 <sup>1)</sup>	14/01/2022	13:30-13:59	205.89	30.57	23.75	59.73	47.48	-12.24
7	14/01/2022	14:00-14:29	242.05	39.58	32.39	76.65	63.16	-13.49
8	14/01/2022	14:30-14:59	240.70	39.04	36.37	75.81	70.54	-5.27
9	14/01/2022	15:00-15:29	241.00	39.24	35.40	76.10	68.78	-7.31
10	14/01/2022	15:30-15:59	240.51	38.76	35.29	75.22	68.58	-6.63
11 <sup>1)</sup>	14/01/2022	16:00-16:29	240.31	39.07	34.96	75.87	67.96	-7.91
12	14/01/2022	16:30-16:59	206.72	31.10	33.74	61.29	65.74	4.45
Average						59.72	56.34	-3.38
Confidence Coefficient								3.51
Relative Accuracy (Compared with RM)								12.24%
Relative Accuracy Criteria <sup>1)</sup> (Compared with RM)								20%

Remarks : \* Sample with \* is rejected data  
\* Emission standard of NO<sub>x</sub> at 7% O<sub>2</sub> = 96 ppm  
Source : 1) RA Criteria of NO<sub>x</sub> is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 2 (PS-2).  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.



Thipsan Y.  
(Thipsan Yommana)  
Technical Manager

TY/SC/WWI

Unless otherwise stated the result shown in this test report refers only to the sample(s) tested.

This document is issued by the Company under its General Conditions of Service printed overleaf. Attention is drawn to the limitation of liability, indemnification and disclaimer clauses set forth therein.

Any matter of this document is intended to be confidential and shall remain the property of the Company. It is to be used only for the purpose for which it is issued and shall not be used for any other purpose without the prior written consent of the Company. The Company's sole responsibility is to the Client and the document shall not be used as a basis for any other action or claim. Any unauthorized alteration, forgery or falsification of the content or signature of this document is prohibited and shall be treated as an offence under the law.

E 240632

SGS (Thailand) Limited Environment, Health and Safety 101 Nangliang Road, Chongnong Yommaraj Bangkok 10110  
T +66 (0)2 678 1813 F +66 (0)2 678 0522 www.sgs.com

Member of the SGS Group



Report No. : 2022-5003483 / 001-1 (Page 2 of 4) Issued date: January 22, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

### Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : O<sub>2</sub> MEASUREMENT DATE : January 14, 2022  
MEASUREMENT LOCATION : HRSG 11, MEASURED BY : Supachai Pisanpracharak  
Ratchaburi Power Co., Ltd., Ratchaburi Province

No.	Date (dd/mm/yy)	Time	Loading condition (MW) #	O <sub>2</sub>		Diff
				CEMs	RM	
				%	%	
1	14/01/2022	11:00-11:29	205.18	13.81	13.78	-0.02
2	14/01/2022	11:30-11:59	160.41	14.02	13.97	-0.04
3	14/01/2022	12:00-12:29	169.13	14.02	14.08	0.06
4	14/01/2022	12:30-12:59	174.50	14.00	14.04	0.03
5	14/01/2022	13:00-13:29	175.45	14.03	14.07	0.05
6	14/01/2022	13:30-13:59	205.89	13.78	13.95	0.16
7	14/01/2022	14:00-14:29	242.05	13.72	13.77	0.05
8	14/01/2022	14:30-14:59	240.70	13.74	13.73	-0.01
9	14/01/2022	15:00-15:29	241.00	13.73	13.75	0.01
10	14/01/2022	15:30-15:59	240.51	13.74	13.75	0.01
11	14/01/2022	16:00-16:29	240.31	13.74	13.75	0.01
12	14/01/2022	16:30-16:59	206.72	13.85	13.77	-0.08
Average				13.84	13.85	0.01
Relative Accuracy (Compared with RM)						0.01%
Relative Accuracy Criteria <sup>1)</sup> (Compared with RM)						1%

Remark : \* Sample with \* is rejected data  
Source : 1) RA Criteria of O<sub>2</sub> is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 3 (PS-3).  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.



Thipsan Y.  
(Thipsan Yommana)  
Technical Manager

TY/SC/WWI

Unless otherwise stated the result shown in this test report refers only to the sample(s) tested.

This document is issued by the Company under its General Conditions of Service printed overleaf. Attention is drawn to the limitation of liability, indemnification and disclaimer clauses set forth therein.

Any matter of this document is intended to be confidential and shall remain the property of the Company. It is to be used only for the purpose for which it is issued and shall not be used for any other purpose without the prior written consent of the Company. The Company's sole responsibility is to the Client and the document shall not be used as a basis for any other action or claim. Any unauthorized alteration, forgery or falsification of the content or signature of this document is prohibited and shall be treated as an offence under the law.

E 240633

SGS (Thailand) Limited Environment, Health and Safety 101 Nangliang Road, Chongnong Yommaraj Bangkok 10110  
T +66 (0)2 678 1813 F +66 (0)2 678 0522 www.sgs.com

Member of the SGS Group



Report No. : 2022-5003483 / 001-1 (Page 3 of 4) Issued date: January 22, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

### Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : SO<sub>2</sub> MEASUREMENT DATE : January 14, 2022  
MEASUREMENT LOCATION : HRSG 11, MEASURED BY : Supachai Pisanpracharak  
Ratchaburi Power Co., Ltd., Ratchaburi Province

No.	Date (dd/mm/yy)	Time	Loading condition (MW) <sup>2)</sup>	SO <sub>2</sub>				Diff
				Raw Data (at actual O <sub>2</sub> )		Corrected Value (at 7%O <sub>2</sub> )		
				CEMs	RM	CEMs	RM	
				ppm	ppm	ppm	ppm	
1	14/01/2022	11:00-11:29	205.18	1.86	1.47	3.64	2.87	-0.78
2	14/01/2022	11:30-11:59	160.41	1.91	1.18	3.86	2.38	-1.49
3	14/01/2022	12:00-12:29	169.13	1.91	1.03	3.87	2.10	-1.77
4	14/01/2022	12:30-12:59	174.50	1.82	1.00	3.66	2.03	-1.63
5	14/01/2022	13:00-13:29	175.45	1.77	1.08	3.59	2.19	-1.40
6	14/01/2022	13:30-13:59	205.89	1.77	1.01	3.46	2.02	-1.44
7	14/01/2022	14:00-14:29	242.05	1.81	0.94	3.50	1.84	-1.66
8 <sup>a)</sup>	14/01/2022	14:30-14:59	240.70	1.87	0.93	3.63	1.81	-1.83
9	14/01/2022	15:00-15:29	241.00	1.88	0.88	3.65	1.91	-1.74
10	14/01/2022	15:30-15:59	240.51	1.90	0.98	3.68	1.90	-1.79
11 <sup>a)</sup>	14/01/2022	16:00-16:29	240.31	1.91	0.94	3.70	1.83	-1.87
12 <sup>a)</sup>	14/01/2022	16:30-16:59	206.72	1.92	0.84	3.78	1.63	-2.15
Average						3.66	2.14	-1.52
Confidence Coefficient								0.24
Relative Accuracy (Compared with Emission Standard, 20 ppm)								8.82%
Relative Accuracy Criteria <sup>1)</sup> (Compared with Emission Standard, 20 ppm)								10 %

Remarks : \* Sample with \* is rejected data  
\* Emission standard of SO<sub>2</sub> at 7% O<sub>2</sub> = 20 ppm  
Source : 1) RA Criteria of SO<sub>2</sub> is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 2 (PS-2) and compared with the emission standard of the plant.  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.



Thipsan Y.  
(Thipsan Yommana)  
Technical Manager

TY/SC/WWI

Unless otherwise stated the result shown in this test report refers only to the sample(s) tested.

This document is issued by the Company under its General Conditions of Service printed overleaf. Attention is drawn to the limitation of liability, indemnification and disclaimer clauses set forth therein.

Any matter of this document is intended to be confidential and shall remain the property of the Company. It is to be used only for the purpose for which it is issued and shall not be used for any other purpose without the prior written consent of the Company. The Company's sole responsibility is to the Client and the document shall not be used as a basis for any other action or claim. Any unauthorized alteration, forgery or falsification of the content or signature of this document is prohibited and shall be treated as an offence under the law.

E 240634

SGS (Thailand) Limited Environment, Health and Safety 101 Nangliang Road, Chongnong Yommaraj Bangkok 10110  
T +66 (0)2 678 1813 F +66 (0)2 678 0522 www.sgs.com

Member of the SGS Group



Report No. : 2022-5003483 / 001-1 (Page 4 of 4) Issued date: January 22, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

### Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : CO MEASUREMENT DATE : January 14, 2022  
MEASUREMENT LOCATION : HRSG 11, MEASURED BY : Supachai Pisanpracharak  
Ratchaburi Power Co., Ltd., Ratchaburi Province

No.	Date (dd/mm/yy)	Time	Loading condition (MW) <sup>2)</sup>	CO				Diff
				Raw Data (at actual O <sub>2</sub> )		Corrected Value (at 7%O <sub>2</sub> )		
				CEMs	RM	CEMs	RM	
				ppm	ppm	ppm	ppm	
1	14/01/2022	11:00-11:29	205.18	2.97	0.00	5.81	0.00	-5.81
2*	14/01/2022	11:30-11:59	160.41	4.02	0.82	8.12	1.85	-6.46
3	14/01/2022	12:00-12:29	169.13	3.60	1.33	7.27	2.72	-4.55
4*	14/01/2022	12:30-12:59	174.50	3.11	0.00	6.28	0.00	-6.28
5*	14/01/2022	13:00-13:29	175.45	3.16	0.00	6.38	0.00	-6.38
6	14/01/2022	13:30-13:59	205.89	2.85	0.00	5.58	0.00	-5.58
7	14/01/2022	14:00-14:29	242.05	2.81	0.00	5.44	0.00	-5.44
8	14/01/2022	14:30-14:59	240.70	2.88	0.00	5.59	0.00	-5.59
9	14/01/2022	15:00-15:29	241.00	2.88	0.00	5.58	0.00	-5.58
10	14/01/2022	15:30-15:59	240.51	2.91	0.00	5.65	0.00	-5.65
11	14/01/2022	16:00-16:29	240.31	2.85	0.00	5.53	0.00	-5.53
12	14/01/2022	16:30-16:59	206.72	2.96	0.00	5.83	0.00	-5.83
Average						5.81	0.30	-5.51
Confidence Coefficient								0.29
Relative Accuracy (Compared with Emission Standard 690 ppm)								0.84%
Relative Accuracy Criteria <sup>1)</sup> (Compared with Emission Standard 690 ppm)								5%

Remarks : \* Sample with \* is rejected data  
Source : 1) RA Criteria of CO is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 4 (PS-4) and compared with Industrial Emission Standards, Notification of the Ministry of Industry, B.E. 2549 (2006).  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.



Thipsan Y.  
(Thipsan Yommana)  
Technical Manager

TY/SC/WWI

Unless otherwise stated the result shown in this test report refers only to the sample(s) tested.

This document is issued by the Company under its General Conditions of Service printed overleaf. Attention is drawn to the limitation of liability, indemnification and disclaimer clauses set forth therein.

Any matter of this document is intended to be confidential and shall remain the property of the Company. It is to be used only for the purpose for which it is issued and shall not be used for any other purpose without the prior written consent of the Company. The Company's sole responsibility is to the Client and the document shall not be used as a basis for any other action or claim. Any unauthorized alteration, forgery or falsification of the content or signature of this document is prohibited and shall be treated as an offence under the law.

E 240635

SGS (Thailand) Limited Environment, Health and Safety 101 Nangliang Road, Chongnong Yommaraj Bangkok 10110  
T +66 (0)2 678 1813 F +66 (0)2 678 0522 www.sgs.com

Member of the SGS Group



## Emission Air Quality

### - HRSG 12



Report No. : 2022-5003483 / 002-2 (Page 1 of 1) Issued date : January 28, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1080

### Analysis Report

SAMPLE DESIGNATED AS : Emission Air Quality  
SAMPLING LOCATION : HRSG 12  
Ratchaburi Power Plant, Ratchaburi province

SAMPLING DATE : January 14, 2022  
SAMPLING TIME : 10:25-13:00 hr.  
SAMPLING BY : Weeradach Konrang  
(7-197-8-5547)

Parameter	Unit	Value	Standard	Analytical Methods
Fuel Type	-	Natural Gas	-	-
Stack Diameter	cm.	897	-	-
Stack Temperature	°C	98.1	-	-
Dry Gas Temperature	°C	30.0	-	-
Absolute Stack Pressure	mm.Hg	760.9	-	-
Air Velocity	m/s	21.52	-	U.S.EPA Method 2
Volumetric Flow Rate at actual O <sub>2</sub>	Nm <sup>3</sup> /hr, dry	2,141.515	-	U.S.EPA Method 2
Moisture	%	9.85	-	U.S.EPA Method 4
O <sub>2</sub>	%	13.58	-	-
CO <sub>2</sub>	%	4.21	-	U.S. EPA Method 3A
TSP at 7 % O <sub>2</sub>	mg/Nm <sup>3</sup>	1.61	60 <sup>1)</sup>	U.S.EPA Method 5
NO <sub>x</sub> (as NO <sub>2</sub> ) at 7 % O <sub>2</sub>	ppm	72.19	120 <sup>1)</sup> 96 <sup>2)</sup>	U.S.EPA Method 7
SO <sub>2</sub> at 7% O <sub>2</sub>	ppm	N.D.	20 <sup>1)</sup>	U.S.EPA Method 6
CO at 7% O <sub>2</sub>	ppm	N.D.	890 <sup>2)</sup>	U.S.EPA Method 10
Mercury (Hg) at 7%O <sub>2</sub>	mg/Nm <sup>3</sup>	N.D.	2.4 <sup>2)</sup>	U.S. EPA Method 29

Remarks : - N = Normal condition means reference condition at temperature of 25 °C, pressure of 1 atm or 760 mm.Hg, and dry basis.  
- N.D. = Not Detected, detection limit at actual O<sub>2</sub> of SO<sub>2</sub> <1 ppm, CO <1 ppm and Mercury (Hg) < 0.00015 mg/Nm<sup>3</sup>

Sources : <sup>1)</sup> Notification of Ministry of Industry, B.E. 2547 (2004), issued under Factory Act B.E. 2535 (1992), dated October 7, B.E. 2547 (2004), New Power Plant.  
<sup>2)</sup> Notification of the Ministry of Industry, B.E. 2549 (2006)  
<sup>3)</sup> Emission Standard of Ratchaburi Power Plant.



Thipsan Yommana  
(Thipsan Yommana)  
License ID: 9-1978-8538  
Technical Manager

This document is issued by the Company under its General Conditions of Sale (see back cover). Attention is drawn to the limitation of liability, indemnification and jurisdiction clauses.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its inspection only and within the limits of Client's instructions. It does not constitute a warranty or responsibility on the part of the Company for any damage or loss resulting from the use of the information contained herein, or from any action taken or not taken based on the information contained herein. Any person who uses the information contained herein for any purpose other than that for which it was intended, or who uses the information for any purpose other than that for which it was intended, does so at their own risk and without the liability of the Company.

E 240641

SGS (Thailand) Limited | Environment, Health and Safety | 101 Naraditwong Road | Chongnonsiri Yomasa Bangkok 10110  
T +66 (0)2 678 18 13 F +66 (0)2 678 08 22 www.sgs.com



Report No. : 2022-5003483 / 001-2 (Page 1 of 4) Issued date : January 28, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1080

### Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : NO<sub>x</sub>  
MEASUREMENT LOCATION : HRSG 12  
Ratchaburi Power Co., Ltd., Ratchaburi Province

MEASUREMENT DATE : January 24, 2022  
MEASURED BY : Supachai Pisanpracharak

No.	Date (dd/mm/yy)	Time	Loading condition (MW) <sup>2)</sup>	NO <sub>x</sub>				Diff
				Raw Data (at actual O <sub>2</sub> )		Corrected Value (at 7%O <sub>2</sub> )		
				CEMs	RM	CEMs	RM	
				ppm	ppm	ppm	ppm	
1	24/01/2022	09:10-09:30	251.575	34.81	38.10	65.85	69.33	3.48
2	24/01/2022	09:40-10:09	250.331	34.76	38.18	65.89	69.69	3.80
3	24/01/2022	10:10-10:39	248.769	35.17	38.35	66.72	70.04	3.33
4	24/01/2022	10:40-11:09	247.150	35.44	39.11	67.28	71.49	4.21
5	24/01/2022	11:10-11:39	246.031	35.62	39.33	67.70	71.89	4.19
6	24/01/2022	11:40-12:09	244.680	36.08	39.60	68.66	72.46	3.80
7*	24/01/2022	12:10-12:39	244.632	36.55	40.65	69.64	74.51	4.87
8	24/01/2022	12:40-13:09	244.136	37.11	41.00	70.77	75.20	4.43
9	24/01/2022	13:10-13:39	242.493	38.07	42.10	72.81	77.32	4.51
10*	24/01/2022	13:40-14:09	226.753	34.79	42.44	67.65	78.37	10.72
11*	24/01/2022	14:10-14:39	159.509	20.74	28.97	42.48	55.96	13.48
12	24/01/2022	14:40-15:09	161.426	20.70	21.37	42.30	43.56	1.25
Average						65.33	69.00	3.67
Confidence Coefficient								0.76
Relative Accuracy (Compared with RM)								6.42%
Relative Accuracy Criteria <sup>3)</sup> (Compared with RM)								20%

Remarks : \* Sample with \* is rejected data  
- Emission standard of NO<sub>x</sub> = 96 ppm  
Source : <sup>1)</sup> RA Criteria of NO<sub>x</sub> is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 2 (PS-2)  
<sup>2)</sup> Loading Condition data was from Ratchaburi Power Co., Ltd.



Thipsan Yommana  
(Thipsan Yommana)  
Technical Manager

TVSCWIIW

Unless otherwise stated the result shown in this test report refers only to the sample(s) tested.

This document is issued by the Company under its General Conditions of Sale (see back cover). Attention is drawn to the limitation of liability, indemnification and jurisdiction clauses.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its inspection only and within the limits of Client's instructions. It does not constitute a warranty or responsibility on the part of the Company for any damage or loss resulting from the use of the information contained herein, or from any action taken or not taken based on the information contained herein. Any person who uses the information contained herein for any purpose other than that for which it was intended, or who uses the information for any purpose other than that for which it was intended, does so at their own risk and without the liability of the Company.

E 240636

SGS (Thailand) Limited | Environment, Health and Safety | 101 Naraditwong Road | Chongnonsiri Yomasa Bangkok 10110  
T +66 (0)2 678 18 13 F +66 (0)2 678 08 22 www.sgs.com

## Relative Accuracy Test Audit (RATA)

### - HRSG 12





Report No. : 2022-5003483 / 001-2 (Page 2 of 4)

Issued date: January 28, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljirak  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

## Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : O<sub>2</sub>  
MEASUREMENT LOCATION : HRSG 12, Ratchaburi Power Co., Ltd., Ratchaburi Province  
MEASUREMENT DATE : January 24, 2022  
MEASURED BY : Supachai Pisanpracharak

No.	Date (dd/mm/yy)	Time	Loading condition (MW) #	O <sub>2</sub>		Diff
				CEMs %	RM %	
1	24/01/2022	09:10-09:39	251.575	13.55	13.26	-0.29
2	24/01/2022	09:40-10:09	250.331	13.57	13.29	-0.28
3	24/01/2022	10:10-10:39	248.769	13.57	13.29	-0.28
4	24/01/2022	10:40-11:09	247.150	13.58	13.30	-0.28
5	24/01/2022	11:10-11:39	246.031	13.59	13.30	-0.29
6	24/01/2022	11:40-12:09	244.680	13.60	13.30	-0.29
7	24/01/2022	12:10-12:39	244.632	13.61	13.32	-0.29
8	24/01/2022	12:40-13:09	244.136	13.61	13.32	-0.29
9*	24/01/2022	13:10-13:39	242.493	13.63	13.33	-0.30
10*	24/01/2022	13:40-14:09	226.753	13.75	13.37	-0.38
11*	24/01/2022	14:10-14:39	159.509	14.11	13.70	-0.41
12	24/01/2022	14:40-15:09	161.426	14.10	14.08	-0.02
Average				13.64	13.38	-0.26
Relative Accuracy (Compared with RM)						0.26%
Relative Accuracy Criteria <sup>1)</sup> (Compared with RM)						1%

Remark : \* Sample with \* is rejected data  
Source : 1) RA Criteria of O<sub>2</sub> is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 3 (PS-3)  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.

SGS (THAILAND) LIMITED  
Thipsan Y.  
(Thipsan Yommana)  
Technical Manager

TYS/CWW/I

Unless otherwise stated the result shown in this test report refers only to the sample(s) tested.

This document is issued by the Company under its General Conditions of Service printed separately. Attention is drawn to the limitation of liability, indemnification and jurisdiction clause set forth therein.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its examination only, and does not constitute a statement of fact. The Company is not responsible for the data and the document does not constitute a statement of fact. The Company is not responsible for the data and the document does not constitute a statement of fact. The Company is not responsible for the data and the document does not constitute a statement of fact.

E 240637

SGS (Thailand) Limited | Environment, Health and Safety | 180 Nonglukchao Road | Chongnonsi Yomana Bangkok 10110  
T +66 (0)2 678 1811 F +66 (0)2 678 0022 www.sgs.com

© All rights reserved.



Report No. : 2022-5003483 / 001-2 (Page 3 of 4)

Issued date: January 28, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljirak  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

## Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : SO<sub>2</sub>  
MEASUREMENT LOCATION : HRSG 12, Ratchaburi Power Co., Ltd., Ratchaburi Province  
MEASUREMENT DATE : January 24, 2022  
MEASURED BY : Supachai Pisanpracharak

No.	Date (dd/mm/yy)	Time	Loading condition (MW) <sup>2</sup>	SO <sub>2</sub>				Diff
				Raw Data (at actual O <sub>2</sub> )		Corrected Value (at 7%O <sub>2</sub> )		
				CEMs <sup>1</sup>	RM	CEMs <sup>1</sup>	RM	
				ppm	ppm	ppm	ppm	
1	24/01/2022	09:10-09:39	251.575	0.87	0.61	1.65	1.12	-0.54
2	24/01/2022	09:40-10:09	250.331	0.87	0.57	1.65	1.04	-0.61
3	24/01/2022	10:10-10:39	248.769	0.87	0.61	1.64	1.12	-0.53
4	24/01/2022	10:40-11:09	247.150	0.88	0.58	1.66	1.06	-0.61
5	24/01/2022	11:10-11:39	246.031	0.89	0.56	1.69	1.02	-0.66
6	24/01/2022	11:40-12:09	244.680	0.87	0.52	1.65	0.95	-0.70
7*	24/01/2022	12:10-12:39	244.632	0.89	0.50	1.70	0.91	-0.78
8	24/01/2022	12:40-13:09	244.136	0.96	0.62	1.82	1.14	-0.68
9*	24/01/2022	13:10-13:39	242.493	1.01	0.65	1.93	1.19	-0.75
10*	24/01/2022	13:40-14:09	226.753	1.04	0.65	2.02	1.20	-0.83
11	24/01/2022	14:10-14:39	159.509	1.07	0.81	2.18	1.57	-0.61
12	24/01/2022	14:40-15:09	161.426	1.03	0.73	2.10	1.48	-0.62
Average						1.78	1.17	-0.62
Confidence Coefficient								0.95
Relative Accuracy (Compared with Emission Standard, 20 ppm)								3.31%
Relative Accuracy Criteria <sup>1)</sup> (Compared with Emission Standard, 20 ppm)								10 %

Remark : \* Sample with \* is rejected data  
Source : 1) RA Criteria of SO<sub>2</sub> is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 2 (PS-2) and compared with the emission standard for new power plant Notification of Ministry of Industry, B.E. 2547 (2004).  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.

SGS (THAILAND) LIMITED  
Thipsan Y.  
(Thipsan Yommana)  
Technical Manager

TYS/CWW/I

Unless otherwise stated the result shown in this test report refers only to the sample(s) tested.

This document is issued by the Company under its General Conditions of Service printed separately. Attention is drawn to the limitation of liability, indemnification and jurisdiction clause set forth therein.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its examination only, and does not constitute a statement of fact. The Company is not responsible for the data and the document does not constitute a statement of fact. The Company is not responsible for the data and the document does not constitute a statement of fact. The Company is not responsible for the data and the document does not constitute a statement of fact.

E 240638

SGS (Thailand) Limited | Environment, Health and Safety | 180 Nonglukchao Road | Chongnonsi Yomana Bangkok 10110  
T +66 (0)2 678 1811 F +66 (0)2 678 0022 www.sgs.com

© All rights reserved.



Report No. : 2022-5003483 / 001-2 (Page 4 of 4)

Issued date: January 28, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljirak  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

## Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : CO  
MEASUREMENT LOCATION : HRSG 12, Ratchaburi Power Co., Ltd., Ratchaburi Province  
MEASUREMENT DATE : January 24, 2022  
MEASURED BY : Supachai Pisanpracharak

No.	Date (dd/mm/yy)	Time	Loading condition (MW) <sup>#</sup>	CO				Diff
				Raw Data (at actual O <sub>2</sub> )		Corrected Value (at 7%O <sub>2</sub> )		
				CEMs	RM	CEMs	RM	
				ppm	ppm	ppm	ppm	
1	24/01/2022	09:10-09:39	251.575	2.01	0.89	3.80	1.62	-2.18
2	24/01/2022	09:40-10:09	250.331	1.87	0.48	3.55	0.87	-2.68
3	24/01/2022	10:10-10:39	248.769	1.88	0.45	3.57	0.81	-2.76
4	24/01/2022	10:40-11:09	247.150	1.83	0.52	3.47	0.95	-2.52
5	24/01/2022	11:10-11:39	246.031	1.81	0.43	3.45	0.79	-2.66
6	24/01/2022	11:40-12:09	244.680	1.80	0.43	3.42	0.78	-2.65
7	24/01/2022	12:10-12:39	244.632	1.76	0.42	3.35	0.78	-2.57
8	24/01/2022	12:40-13:09	244.136	1.82	0.35	3.48	0.84	-2.84
9*	24/01/2022	13:10-13:39	242.493	1.92	0.14	3.67	0.27	-3.40
10	24/01/2022	13:40-14:09	226.753	1.85	0.32	3.59	0.59	-3.00
11*	24/01/2022	14:10-14:39	159.509	2.61	0.81	5.35	1.57	-3.78
12*	24/01/2022	14:40-15:09	161.426	3.00	1.31	6.13	2.68	-3.45
Average						3.52	0.87	-2.65
Confidence Coefficient								0.18
Relative Accuracy (Compared with Emission Standard 690 ppm)								0.41%
Relative Accuracy Criteria <sup>1)</sup> (Compared with Emission Standard 690 ppm)								5%

Remark : \* Sample with \* is rejected data  
Source : 1) RA Criteria of CO is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 4 (PS-4) and compared with Industrial Emission Standards, Notification of the Ministry of Industry, B.E. 2549 (2006).  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.

SGS (THAILAND) LIMITED  
Thipsan Y.  
(Thipsan Yommana)  
Technical Manager

TYS/CWW/I

Unless otherwise stated the result shown in this test report refers only to the sample(s) tested.

This document is issued by the Company under its General Conditions of Service printed separately. Attention is drawn to the limitation of liability, indemnification and jurisdiction clause set forth therein.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its examination only, and does not constitute a statement of fact. The Company is not responsible for the data and the document does not constitute a statement of fact. The Company is not responsible for the data and the document does not constitute a statement of fact. The Company is not responsible for the data and the document does not constitute a statement of fact.

E 240639

SGS (Thailand) Limited | Environment, Health and Safety | 180 Nonglukchao Road | Chongnonsi Yomana Bangkok 10110  
T +66 (0)2 678 1811 F +66 (0)2 678 0022 www.sgs.com

© All rights reserved.

## Emission Air Quality

- HRSG 21





Report No. : 2022-5003483 / 002-3 (Page 1 of 1) Issued date : February 28, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljanus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tal, Phra Khanong, Bangkok 10280  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

### Analysis Report

SAMPLE DESIGNATED AS : Emission Air Quality  
SAMPLING LOCATION : HRSG 21,  
Ratchaburi Power Plant, Ratchaburi province  
SAMPLING DATE : February 9, 2022  
SAMPLING TIME : 10:30-13:40 hr.  
SAMPLING BY : Preeda Ketpatum  
(9-197-R-8550)

Parameter	Unit	Value	Standard	Analytical Methods
Fuel Type	-	Natural Gas	-	-
Stack Diameter	cm.	697	-	-
Stack Temperature	°C	95.9	-	-
Dry Gas Temperature	°C	35.1	-	-
Absolute Stack Pressure	mm.Hg	757.8	-	-
Air Velocity	m/s	14.75	-	U.S.EPA Method 2
Volumetric Flow Rate at actual O <sub>2</sub>	Nm <sup>3</sup> /hr, dry	1,469,368	-	U.S.EPA Method 2
Moisture	%	9.93	-	U.S.EPA Method 4
O <sub>2</sub>	%	13.83	-	U.S. EPA Method 3A
CO <sub>2</sub>	%	3.88	-	-
TSP at 7 % O <sub>2</sub>	mg/Nm <sup>3</sup>	1.98	60 <sup>1)</sup>	U.S.EPA Method 5
NO <sub>x</sub> (as NO <sub>2</sub> ) at 7 % O <sub>2</sub>	ppm	46.82	120 <sup>1)</sup> 96 <sup>2)</sup>	U.S.EPA Method 7
SO <sub>2</sub> at 7% O <sub>2</sub>	ppm	N.D.	20 <sup>1)</sup>	U.S.EPA Method 6
CO at 7% O <sub>2</sub>	ppm	10.4	890 <sup>2)</sup>	U.S.EPA Method 10
Mercury (Hg) at 7%O <sub>2</sub>	mg/Nm <sup>3</sup>	N.D.	2.4 <sup>2)</sup>	U.S. EPA Method 29

Remarks : - N = Normal condition means reference condition at temperature of 25 °C, pressure of 1 atm or 760 mm.Hg, and dry basis.  
- N.D. = Not Detected, detection limit at actual O<sub>2</sub> of SO<sub>2</sub> <1 ppm and Mercury (Hg) < 0.00075 mg/Nm<sup>3</sup>  
Sources : 1) Notification of Ministry of Industry, B.E. 2547 (2004), issued under Factory Act B.E. 2535 (1992), dated October 7, B.E. 2547 (2004), New Power Plant.  
2) Notification of the Ministry of Industry, B.E. 2549 (2006)  
3) Emission Standard of Ratchaburi Power Plant.



TIPO/WIWI

E 242710

SGS (Thailand) Limited Environment, Health and Safety 101 Nangloechai Road, Chongnonsiri, Yomasa, Bangkok 10120  
t +66 (0)2 678 18 13 f +66 (0)2 678 06 22 www.sgs.com

Member of the SGS Group



Report No. : 2022-5003483 / 001-3 (Page 1 of 4) Issued date : February 24, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljanus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tal, Phra Khanong, Bangkok 10280  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

### Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : NO<sub>x</sub>  
MEASUREMENT LOCATION : HRSG 21,  
Ratchaburi Power Co., Ltd., Ratchaburi Province  
MEASUREMENT DATE : February 9, 2022  
MEASURED BY : Phatsakorn Soonthornwiphat

No.	Date (dd/mm/yy)	Time	Loading condition (MW) <sup>2)</sup>	NO <sub>x</sub>				Diff
				Raw Data (at actual O <sub>2</sub> )		Corrected Value (at 7%O <sub>2</sub> )		
				CEMs	RM	CEMs	RM	
				ppm	ppm	ppm	ppm	
1	09/02/2022	10:16-10:45	162.15	24.47	23.73	47.08	46.03	-1.95
2	09/02/2022	10:46-11:15	161.94	24.83	23.47	48.77	45.43	-3.34
3*	09/02/2022	11:16-11:45	163.92	24.37	22.90	47.91	44.38	-3.54
4*	09/02/2022	11:46-12:15	160.32	24.67	23.15	48.42	44.68	-3.75
5	09/02/2022	12:16-12:45	163.21	24.65	23.26	48.39	44.86	-3.53
6	09/02/2022	12:46-13:15	163.81	24.30	22.97	47.71	44.40	-3.31
7*	09/02/2022	13:16-13:45	162.05	24.77	23.23	48.74	45.01	-3.73
8	09/02/2022	13:46-14:15	163.11	24.43	23.36	48.03	45.15	-2.88
9	09/02/2022	14:16-14:45	163.24	24.23	23.37	47.56	45.14	-2.42
10	09/02/2022	14:46-15:15	171.29	24.17	23.48	47.37	45.34	-2.02
11	09/02/2022	15:16-15:45	187.95	25.40	24.93	48.80	47.21	-1.59
12	09/02/2022	15:46-16:15	187.97	25.47	25.02	48.72	47.38	-1.34
Average						48.15	45.66	-2.49
Confidence Coefficient								0.62
Relative Accuracy (Compared with Emission standard NO <sub>x</sub> = 96 ppm)								3.24%
Relative Accuracy Criteria <sup>1)</sup> (Compared with Emission standard NO <sub>x</sub> = 96 ppm)								10%

Remarks : \* Sample with \* is rejected data  
- Emission standard of NO<sub>x</sub> at 7% O<sub>2</sub> = 96 ppm  
Source : 1) RA Criteria of NO<sub>x</sub> is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 2 (PS-2) and compared with emission standard of the plant.  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.



TIPO/WIWI

Unless otherwise stated, the results shown in this report are traceable to the standards listed below.

This document is issued to the Company under the General Conditions of Service (referred to as "General Conditions") which are available on the SGS website and can be downloaded from the SGS website.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of the assessment and does not constitute a warranty of the Company's results. The Company's sole responsibility is to the Client and this document does not constitute a warranty of the Company's results. The Company's sole responsibility is to the Client and this document does not constitute a warranty of the Company's results. The Company's sole responsibility is to the Client and this document does not constitute a warranty of the Company's results.

E 242702

SGS (Thailand) Limited Environment, Health and Safety 101 Nangloechai Road, Chongnonsiri, Yomasa, Bangkok 10120  
t +66 (0)2 678 18 13 f +66 (0)2 678 06 22 www.sgs.com

Member of the SGS Group



Report No. : 2022-5003483 / 001-3 (Page 2 of 4) Issued date : February 24, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljanus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tal, Phra Khanong, Bangkok 10280  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

### Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : O<sub>2</sub>  
MEASUREMENT LOCATION : HRSG 21,  
Ratchaburi Power Co., Ltd., Ratchaburi Province  
MEASUREMENT DATE : February 9, 2022  
MEASURED BY : Phatsakorn Soonthornwiphat

No.	Date (dd/mm/yy)	Time	Loading condition (MW) <sup>2)</sup>	O <sub>2</sub>		Diff
				CEMs	RM	
				%	%	
1	09/02/2022	10:16-10:45	162.15	13.81	13.73	-0.08
2	09/02/2022	10:46-11:15	161.94	13.82	13.72	-0.10
3	09/02/2022	11:16-11:45	163.92	13.83	13.73	-0.10
4*	09/02/2022	11:46-12:15	160.32	13.82	13.70	-0.12
5*	09/02/2022	12:16-12:45	163.21	13.82	13.69	-0.12
6	09/02/2022	12:46-13:15	163.81	13.82	13.71	-0.11
7	09/02/2022	13:16-13:45	162.05	13.84	13.73	-0.11
8*	09/02/2022	13:46-14:15	163.11	13.83	13.71	-0.12
9	09/02/2022	14:16-14:45	163.24	13.82	13.70	-0.11
10	09/02/2022	14:46-15:15	171.29	13.81	13.70	-0.10
11	09/02/2022	15:16-15:45	187.95	13.67	13.56	-0.10
12	09/02/2022	15:46-16:15	187.97	13.63	13.56	-0.07
Average				13.80	13.70	-0.10
Relative Accuracy (Compared with RM)						0.10%
Relative Accuracy Criteria <sup>1)</sup> (Compared with RM)						1%

Remark : \* Sample with \* is rejected data  
Source : 1) RA Criteria of O<sub>2</sub> is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 3 (PS-3)  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.



TIPO/WIWI

Unless otherwise stated, the results shown in this report are traceable to the standards listed below.

This document is issued to the Company under the General Conditions of Service (referred to as "General Conditions") which are available on the SGS website and can be downloaded from the SGS website.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of the assessment and does not constitute a warranty of the Company's results. The Company's sole responsibility is to the Client and this document does not constitute a warranty of the Company's results. The Company's sole responsibility is to the Client and this document does not constitute a warranty of the Company's results.

E 242703

SGS (Thailand) Limited Environment, Health and Safety 101 Nangloechai Road, Chongnonsiri, Yomasa, Bangkok 10120  
t +66 (0)2 678 18 13 f +66 (0)2 678 06 22 www.sgs.com

Member of the SGS Group





Report No. : 2022-5003483 / 001-3 (Page 3 of 4)

Issued date: February 24, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

## Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : SO<sub>2</sub>  
MEASUREMENT LOCATION : HRSG 21, MEASURED BY : Phatsakorn Soonthornwiphat  
Ratchaburi Power Co., Ltd., Ratchaburi Province

No.	Date (dd/mm/yy)	Time	Loading condition (MW) <sup>2)</sup>	SO <sub>2</sub>				Diff
				Raw Data (at actual O <sub>2</sub> )		Corrected Value (at 7%O <sub>2</sub> )		
				CEMs	RM	CEMs	RM	
				ppm	ppm	ppm	ppm	
1	09/02/2022	10:16-10:45	162.15	0.70	0.75	1.36	1.46	0.10
2	09/02/2022	10:46-11:15	161.94	0.71	0.65	1.39	1.25	-0.14
3*	09/02/2022	11:16-11:45	163.92	0.90	0.68	1.77	1.33	-0.45
4	09/02/2022	11:46-12:15	160.32	0.63	0.62	1.23	1.20	-0.03
5	09/02/2022	12:16-12:45	163.21	0.75	0.68	1.48	1.32	-0.16
6	09/02/2022	12:46-13:15	163.81	0.62	0.70	1.22	1.34	0.12
7*	09/02/2022	13:16-13:45	162.05	0.71	0.50	1.40	0.96	-0.44
8*	09/02/2022	13:46-14:15	163.11	0.75	0.57	1.47	1.11	-0.37
9	09/02/2022	14:16-14:45	163.24	0.76	0.62	1.48	1.20	-0.28
10	09/02/2022	14:46-15:15	171.29	0.89	0.77	1.74	1.48	-0.26
11	09/02/2022	15:16-15:45	187.95	0.72	0.80	1.39	1.52	0.14
12	09/02/2022	15:46-16:15	187.97	0.75	0.76	1.43	1.44	0.01
Average						1.41	1.36	-0.06
Confidence Coefficient								0.12
Relative Accuracy (Compared with Emission Standard, SO <sub>2</sub> = 20 ppm)								0.91%
Relative Accuracy Criteria <sup>1)</sup> (Compared with Emission Standard, SO <sub>2</sub> = 20 ppm)								10 %

Remarks : \* Sample with \* is rejected data  
Source : 1) Emission standard of SO<sub>2</sub> at 7% O<sub>2</sub> = 20 ppm  
2) RA Criteria of SO<sub>2</sub> is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 2 (PS-2) and compared with the emission standard of the plant.  
3) Loading Condition data was from Ratchaburi Power Co., Ltd.



Thapson Y.  
(Thapson Yommana)  
Technical Manager

TYP/PS/WIW/

This document is issued by the Company under the Company's internal control system. It is not to be used for any other purpose without the written consent of the Company.

Any holder of this document is requested to inform the Company of any change of the data or the result of the test. The Company will be responsible for the data and the result of the test. The Company will be responsible for the data and the result of the test.

E 242704 SGS (Thailand) Limited Environment, Health and Safety 101 Nangloochai Road Chongnong Yomana Bangkok 10110  
t +66 (0)2 678 19 13 f +66 (0)2 678 19 22 www.sgs.com



Report No. : 2022-5003483 / 001-3 (Page 4 of 4)

Issued date: February 24, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

## Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : CO  
MEASUREMENT LOCATION : HRSG 21, MEASURED BY : Phatsakorn Soonthornwiphat  
Ratchaburi Power Co., Ltd., Ratchaburi Province

No.	Date (dd/mm/yy)	Time	Loading condition (MW) <sup>2)</sup>	CO				Diff
				Raw Data (at actual O <sub>2</sub> )		Corrected Value (at 7%O <sub>2</sub> )		
				CEMs	RM	CEMs	RM	
				ppm	ppm	ppm	ppm	
1*	09/02/2022	10:16-10:45	162.15	3.59	5.49	7.05	10.64	-3.60
2*	09/02/2022	10:46-11:15	161.94	3.96	4.86	7.77	9.42	1.65
3	09/02/2022	11:16-11:45	163.92	3.68	4.13	7.24	8.00	0.76
4	09/02/2022	11:46-12:15	160.32	3.88	4.04	7.61	7.80	0.19
5	09/02/2022	12:16-12:45	163.21	3.54	3.48	6.95	6.72	-0.24
6	09/02/2022	12:46-13:15	163.81	3.29	2.95	6.45	5.74	-0.74
7	09/02/2022	13:16-13:45	162.05	3.83	3.52	7.54	6.82	-0.72
8	09/02/2022	13:46-14:15	163.11	3.28	3.04	6.45	5.87	-0.58
9	09/02/2022	14:16-14:45	163.24	3.34	2.96	6.55	5.72	-0.83
10	09/02/2022	14:46-15:15	171.29	3.26	2.84	6.39	5.48	-0.91
11	09/02/2022	15:16-15:45	187.95	1.89	1.22	3.62	2.31	-1.32
12*	09/02/2022	15:46-16:15	187.97	1.61	0.87	3.07	1.64	-1.43
Average						6.53	6.05	-0.49
Confidence Coefficient								0.49
Relative Accuracy (Compared with Emission Standard 690 ppm)								0.14%
Relative Accuracy Criteria <sup>1)</sup> (Compared with Emission Standard 690 ppm)								5%

Remarks : \* Sample with \* is rejected data  
Source : 1) RA Criteria of CO is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 4 (PS-4) and compared with Industrial Emission Standards, Notification of the Ministry of Industry, B.E. 2549 (2006).  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.



Thapson Y.  
(Thapson Yommana)  
Technical Manager

TYP/PS/WIW/

This document is issued by the Company under the Company's internal control system. It is not to be used for any other purpose without the written consent of the Company.

Any holder of this document is requested to inform the Company of any change of the data or the result of the test. The Company will be responsible for the data and the result of the test. The Company will be responsible for the data and the result of the test.

E 242705 SGS (Thailand) Limited Environment, Health and Safety 101 Nangloochai Road Chongnong Yomana Bangkok 10110  
t +66 (0)2 678 19 13 f +66 (0)2 678 19 22 www.sgs.com

## Emission Air Quality

- HRSG 22



Report No. : 2022-5003483 / 002-4 (Page 1 of 1)

Issued date: February 28, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panichakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

## Analysis Report

SAMPLE DESIGNATED AS : Emission Air Quality  
SAMPLING LOCATION : HRSG 22, Ratchaburi Power Plant, Ratchaburi province  
SAMPLING DATE : February 9, 2022  
SAMPLING TIME : 10:20-13:40 hr.  
SAMPLING BY : Weeradech Konrang  
(197-4-8547)

Parameter	Unit	Value	Standard	Analytical Methods
Fuel Type	-	Natural Gas	-	-
Stack Diameter	cm	697	-	-
Stack Temperature	°C	101.8	-	-
Dry Gas Temperature	°C	37.9	-	-
Absolute Stack Pressure	mm.Hg	757.9	-	-
Air Velocity	m/s	15.84	-	U.S.EPA Method 2
Volumetric Flow Rate at actual O <sub>2</sub>	Nm <sup>3</sup> /hr, dry	1,561,477	-	U.S.EPA Method 2
Moisture	%	9.43	-	U.S.EPA Method 4
O <sub>2</sub>	%	13.87	-	-
CO <sub>2</sub>	%	4.20	-	U.S. EPA Method 3A
TSP at 7 % O <sub>2</sub>	mg/Nm <sup>3</sup>	1.74	60 <sup>1)</sup>	U.S.EPA Method 5
NO <sub>x</sub> (as NO <sub>2</sub> ) at 7 % O <sub>2</sub>	ppm	49.62	120 <sup>1)</sup> , 96 <sup>2)</sup>	U.S.EPA Method 7
SO <sub>2</sub> at 7 % O <sub>2</sub>	ppm	N.D.	20 <sup>1)</sup>	U.S.EPA Method 6
CO at 7 % O <sub>2</sub>	ppm	6.9	690 <sup>2)</sup>	U.S.EPA Method 10
Mercury (Hg) at 7%O <sub>2</sub>	mg/Nm <sup>3</sup>	N.D.	2.4 <sup>2)</sup>	U.S. EPA Method 29

Remarks : - N = Normal condition means reference condition at temperature of 25 °C, pressure of 1 atm or 760 mm.Hg, and dry basis.  
- N.D. = Not Detected, detection limit at actual O<sub>2</sub> of SO<sub>2</sub> <1 ppm and Mercury (Hg) <0.00070 mg/Nm<sup>3</sup>  
Sources : 1) Notification of Ministry of Industry, B.E. 2547 (2004), issued under Factory Act B.E. 2535 (1992), dated October 7, B.E. 2547 (2004), New Power Plant.  
2) Notification of the Ministry of Industry, B.E. 2549 (2006)  
3) Emission Standard of Ratchaburi Power Plant.



Thapson Y.  
(Thapson Yommana)  
License ID: 1-174-8538  
Technical Manager

TYP/MI/WIW/

This document is issued by the Company under the Company's internal control system. It is not to be used for any other purpose without the written consent of the Company.

Any holder of this document is requested to inform the Company of any change of the data or the result of the test. The Company will be responsible for the data and the result of the test. The Company will be responsible for the data and the result of the test.

E 242711 SGS (Thailand) Limited Environment, Health and Safety 101 Nangloochai Road Chongnong Yomana Bangkok 10110  
t +66 (0)2 678 19 13 f +66 (0)2 678 19 22 www.sgs.com





Report No. : 2022-5003483 / 001-4 (Page 1 of 4)

Issued date: February 24, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panitchakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

## Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : NO<sub>x</sub> MEASUREMENT DATE : February 9, 2022  
MEASUREMENT LOCATION : HRSG 22, Ratchaburi Power Co., Ltd., Ratchaburi Province MEASURED BY : Phatsakorn Soonthornwiphat

No.	Date (dd/mm/yy)	Time	Loading condition (MW) <sup>#</sup>	NO <sub>x</sub>				Diff
				Raw Data (at actual O <sub>2</sub> )		Corrected Value (at 7%O <sub>2</sub> )		
				CEMs ppm	RM ppm	CEMs ppm	RM ppm	
1*	09/02/2022	10:16-10:45	162.51	24.79	22.95	48.05	44.81	-3.74
2*	09/02/2022	10:46-11:15	162.34	25.25	23.65	49.68	46.44	-3.24
3*	09/02/2022	11:16-11:45	164.39	24.68	22.98	48.55	45.29	-3.27
4	09/02/2022	11:46-12:15	160.81	25.14	23.63	49.54	46.53	-3.02
5	09/02/2022	12:16-12:45	163.39	25.14	23.58	49.40	46.40	-3.00
6	09/02/2022	12:46-13:15	164.17	25.05	23.46	49.27	46.26	-3.01
7	09/02/2022	13:16-13:45	162.29	25.30	24.03	49.83	47.35	-2.47
8	09/02/2022	13:46-14:15	163.51	25.18	23.70	49.54	46.84	-2.70
9	09/02/2022	14:16-14:45	163.46	24.63	23.28	48.43	46.04	-2.38
10	09/02/2022	14:46-15:15	171.59	24.62	23.42	48.27	46.25	-2.03
11	09/02/2022	15:16-15:45	188.16	26.09	24.63	50.30	48.09	-2.22
12	09/02/2022	15:46-16:15	188.19	26.26	24.79	50.26	48.05	-2.22
Average						49.43	46.87	-2.56
Confidence Coefficient								0.30
Relative Accuracy (Compared with Emission standard NO <sub>x</sub> = 96 ppm)								2.98%
Relative Accuracy Criteria <sup>1)</sup> (Compared with Emission standard NO <sub>x</sub> = 96 ppm)								10%

Remarks : \* Sample with \* is rejected data  
Emission standard of NO<sub>x</sub> at 7% O<sub>2</sub> = 96 ppm  
Source : 1) RA Criteria of NO<sub>x</sub> is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 2 (PS-2) and compared with emission standard of the plant.  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.



Thapson Y.  
(Thapson Yommana)  
Technical Manager

TYP/PS/WIWI

(Unless otherwise stated the results shown in this test report refer only to the samples tested.)

This document is issued by the Company under the General Conditions of Service printed hereon. Attention is drawn to the limitation of liability, indemnification and jurisdiction clauses herein.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its examination and is not intended to be a statement of fact. The Company's sole responsibility is to the Client and the document shall not be used for any other purpose without the prior written consent of the Company. The Company's liability is limited to the amount of the fee received by the Company and shall not be used for any other purpose without the prior written consent of the Company.

E 242706

SGS (Thailand) Limited Environment, Health and Safety 180 Nangloelue Road Chongnonsi, Yommaraj Bangkok 10120  
T +66 (0) 676 18 12 F +66 (0) 676 67 02 22 www.sgs.com

Member of the SGS Group



Report No. : 2022-5003483 / 001-4 (Page 2 of 4)

Issued date: February 24, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panitchakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

## Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : O<sub>2</sub> MEASUREMENT DATE : February 9, 2022  
MEASUREMENT LOCATION : HRSG 22, Ratchaburi Power Co., Ltd., Ratchaburi Province MEASURED BY : Phatsakorn Soonthornwiphat

No.	Date (dd/mm/yy)	Time	Loading condition (MW) #	O <sub>2</sub>		Diff
				CEMs %	RM %	
				%	%	
1	09/02/2022	10:16-10:45	162.51	13.82	13.80	-0.02
2	09/02/2022	10:46-11:15	162.34	13.84	13.82	-0.02
3	09/02/2022	11:16-11:45	164.39	13.84	13.85	0.01
4	09/02/2022	11:46-12:15	160.81	13.85	13.84	0.00
5	09/02/2022	12:16-12:45	163.39	13.83	13.84	0.01
6	09/02/2022	12:46-13:15	164.17	13.83	13.85	0.02
7	09/02/2022	13:16-13:45	162.29	13.84	13.85	0.01
8	09/02/2022	13:46-14:15	163.51	13.84	13.87	0.03
9	09/02/2022	14:16-14:45	163.46	13.83	13.87	0.04
10*	09/02/2022	14:46-15:15	171.59	13.81	13.86	0.05
11*	09/02/2022	15:16-15:45	188.16	13.69	13.78	0.09
12*	09/02/2022	15:46-16:15	188.19	13.64	13.73	0.09
Average				13.83	13.84	0.01
Relative Accuracy (Compared with RM)						0.01%
Relative Accuracy Criteria <sup>1)</sup> (Compared with RM)						1%

Remark : \* Sample with \* is rejected data  
Source : 1) RA Criteria of O<sub>2</sub> is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 3 (PS-3)  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.



Thapson Y.  
(Thapson Yommana)  
Technical Manager

TYP/PS/WIWI

(Unless otherwise stated the results shown in this test report refer only to the samples tested.)

This document is issued by the Company under the General Conditions of Service printed hereon. Attention is drawn to the limitation of liability, indemnification and jurisdiction clauses herein.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its examination and is not intended to be a statement of fact. The Company's sole responsibility is to the Client and the document shall not be used for any other purpose without the prior written consent of the Company. The Company's liability is limited to the amount of the fee received by the Company and shall not be used for any other purpose without the prior written consent of the Company.

E 242707

SGS (Thailand) Limited Environment, Health and Safety 180 Nangloelue Road Chongnonsi, Yommaraj Bangkok 10120  
T +66 (0) 676 18 12 F +66 (0) 676 67 02 22 www.sgs.com

Member of the SGS Group



Report No. : 2022-5003483 / 001-4 (Page 3 of 4)

Issued date: February 24, 2022

CLIENT : RATCHABURI POWER CO., LTD.  
CONTACT : Khun Patchanee Panitchakuljarus  
ADDRESS : 1828 Sukhumvit Road, Phra Khanong Tai, Phra Khanong, Bangkok 10260  
Tel. 032-719300 Ext. 1054 Fax. 032-719300 Ext. 1090

## Analysis Report

SAMPLE DESCRIPTION : Emission Air  
SAMPLE DESIGNATED AS : Relative Accuracy Test Audit : SO<sub>2</sub> MEASUREMENT DATE : February 9, 2022  
MEASUREMENT LOCATION : HRSG 22, Ratchaburi Power Co., Ltd., Ratchaburi Province MEASURED BY : Phatsakorn Soonthornwiphat

No.	Date (dd/mm/yy)	Time	Loading condition (MW) <sup>#</sup>	SO <sub>2</sub>				Diff
				Raw Data (at actual O <sub>2</sub> )		Corrected Value (at 7%O <sub>2</sub> )		
				CEMs	RM	CEMs	RM	
				ppm	ppm	ppm	ppm	
1	09/02/2022	10:16-10:45	162.51	0.85	0.73	1.68	1.43	-0.25
2	09/02/2022	10:46-11:15	162.34	0.82	0.77	1.62	1.51	-0.11
3	09/02/2022	11:16-11:45	164.39	0.88	0.80	1.73	1.57	-0.16
4	09/02/2022	11:46-12:15	160.81	0.92	0.91	1.81	1.80	-0.01
5	09/02/2022	12:16-12:45	163.39	0.91	1.11	1.79	2.19	0.40
6*	09/02/2022	12:46-13:15	164.17	0.87	0.83	1.71	1.64	-0.07
7	09/02/2022	13:16-13:45	162.29	0.89	0.69	1.75	1.37	-0.38
8	09/02/2022	13:46-14:15	163.51	0.83	0.73	1.63	1.44	-0.19
9	09/02/2022	14:16-14:45	163.46	0.85	0.85	1.67	1.28	-0.39
10*	09/02/2022	14:46-15:15	171.59	0.77	0.52	1.51	1.03	-0.48
11	09/02/2022	15:16-15:45	188.16	0.76	0.57	1.47	1.12	-0.35
12*	09/02/2022	15:46-16:15	188.19	0.81	0.58	1.55	1.13	-0.42
Average						1.68	1.46	-0.21
Confidence Coefficient								0.11
Relative Accuracy (Compared with Emission Standard, SO <sub>2</sub> = 20 ppm)								1.60%
Relative Accuracy Criteria <sup>1)</sup> (Compared with Emission Standard, SO <sub>2</sub> = 20 ppm)								10%

Remarks : \* Sample with \* is rejected data  
Emission standard of SO<sub>2</sub> at 7% O<sub>2</sub> = 20 ppm  
Source : 1) RA Criteria of SO<sub>2</sub> is referred to 40 CFR 60 Appendix B, U.S. EPA : Performance Specification 2 (PS-2) and compared with the emission standard of the plant.  
2) Loading Condition data was from Ratchaburi Power Co., Ltd.



Thapson Y.  
(Thapson Yommana)  
Technical Manager

TYP/PS/WIWI

(Unless otherwise stated the results shown in this test report refer only to the samples tested.)

This document is issued by the Company under the General Conditions of Service printed hereon. Attention is drawn to the limitation of liability, indemnification and jurisdiction clauses herein.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its examination and is not intended to be a statement of fact. The Company's sole responsibility is to the Client and the document shall not be used for any other purpose without the prior written consent of the Company. The Company's liability is limited to the amount of the fee received by the Company and shall not be used for any other purpose without the prior written consent of the Company.

E 242708

SGS (Thailand) Limited Environment, Health and Safety 180 Nangloelue Road Chongnonsi, Yommaraj Bangkok 10120  
T +66 (0) 676 18 12 F +66 (0) 676 67 02 22 www.sgs.com

Member of the SGS Group





ลำดับที่	สารเคมี	วิธีวิเคราะห์
8	Nickel	Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(2,8)</sup>
9	Opacity	Ringelmann's Method <sup>(2,1)</sup>
10	Oxide of Nitrogen	Instrumental Analyzer Method <sup>(2,4)</sup>
11	Selenium	Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(2,8)</sup>
12	Sulfur Dioxide	Instrumental Analyzer Method <sup>(2,4)</sup>
13	Tellurium	Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(2,8)</sup>
14	Tin	Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(2,8)</sup>
15	Vanadium	Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(2,8)</sup>
16	Xylene	Adsorption Sampling, Gas Chromatographic Method <sup>(2,1)</sup>

สิ่งปลูกสร้างหรือวัตถุที่ไม่ใช่แล้ว จำนวน 35 รายการ

ลำดับที่	สารเคมี	วิธีวิเคราะห์
1	Aldrin	1) Waste Extraction, Gas Chromatographic Method <sup>(2,3)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
2	Antimony	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
3	Arsenic	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
4	Barium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>



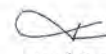
(นายทรี อ้าพ้านี่)

ผู้อำนวยการ

ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก

5 Beryllium...

ลำดับที่	สารเคมี	วิธีวิเคราะห์
5	Beryllium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
6	Cadmium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
7	Chlordane	1) Waste Extraction, Gas Chromatographic Method <sup>(2,4)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
8	Chromium (VI)	1) Waste Extraction, Digestion, Colorimetric Method <sup>(2,12)</sup> 2) Alkaline Digestion, Colorimetric Method <sup>(2,12)</sup>
9	Cobalt	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
10	Copper	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
11	Dieldrin	1) Waste Extraction, Gas Chromatographic Method <sup>(2,3)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
12	DDD	1) Waste Extraction, Gas Chromatographic Method <sup>(2,3)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
13	DDE	1) Waste Extraction, Gas Chromatographic Method <sup>(2,3)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
14	DDT	1) Waste Extraction, Gas Chromatographic Method <sup>(2,3)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
15	2,4-D (2,4-Dichlorophenoxyacetic acid)	1) Waste Extraction, Gas Chromatographic Method <sup>(2,4)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>



(นายทรี อ้าพ้านี่)

ผู้อำนวยการ

ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก

16 Endrin...

ลำดับที่	สารเคมี	วิธีวิเคราะห์
16	Endrin	1) Waste Extraction, Gas Chromatographic Method <sup>(2,3)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
17	Heptachlor	1) Waste Extraction, Gas Chromatographic Method <sup>(2,3)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
18	Kepon	1) Waste Extraction, Gas Chromatographic Method <sup>(2,3)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
19	Lead	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
20	Lindane	1) Waste Extraction, Gas Chromatographic Method <sup>(2,3)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
21	Mercury	1) Waste Extraction, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>(2,13)</sup> 2) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>(2,13)</sup>
22	Methoxychlor	1) Waste Extraction, Gas Chromatographic Method <sup>(2,3)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
23	Mirex	1) Waste Extraction, Gas Chromatographic Method <sup>(2,3)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
24	Molybdenum	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
25	Polychlorinated Biphenyls (PCBs)	1) Waste Extraction, Gas Chromatographic Method <sup>(2,4)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
26	Pentachlorophenol	1) Waste Extraction, Gas Chromatographic Method <sup>(2,4)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>



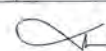
(นายทรี อ้าพ้านี่)

ผู้อำนวยการ

ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก

27 Nickel...

ลำดับที่	สารเคมี	วิธีวิเคราะห์
27	Nickel	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
28	Selenium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
29	Silver	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
30	Silver; 2,4,5-Trichlorophenoxypropionic acid	1) Waste Extraction, Gas Chromatographic Method <sup>(2,4)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
31	Thallium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
32	Toxaphene	1) Waste Extraction, Gas Chromatographic Method <sup>(2,4)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(2,10)</sup>
33	Trichloroethylene	Waste Extraction, Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(2,14)</sup> Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(2,14)</sup>
34	Vanadium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>
35	Zinc	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(2,11)</sup>



(นายทรี อ้าพ้านี่)

ผู้อำนวยการ

ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก

End...



สืบ จำนวน 5 รายการ

ลำดับที่	สารเคมี	วิธีการวิเคราะห์
1	Mercury	Digestion, Cold vapor Atomic Absorption Spectrometric Method <sup>[94]</sup>
2	Polychlorinated Biphenyls (PCBs)	Ultrasonic Extraction, Gas Chromatographic Method <sup>[84,87]</sup>
3	TPH (C <sub>8</sub> -C <sub>6</sub> )	Purge and Trap, Gas Chromatographic Mass Spectrometric Method <sup>[10,18]</sup>
4	TPH (C <sub>9</sub> -C <sub>16</sub> )	Ultrasonic Extraction, Gas Chromatographic Mass Spectrometric Method <sup>[84,86]</sup>
5	TPH (C <sub>17</sub> -C <sub>30</sub> )	Ultrasonic Extraction, Gas Chromatographic Mass Spectrometric Method <sup>[10,18]</sup>

เอกสารอ้างอิง

- กระทรวงอุตสาหกรรม, ประกาศกระทรวงอุตสาหกรรม พ.ศ.2549 เรื่อง กำหนดค่าปริมาณเขตกากวันให้เจือปนในอากาศที่ระบายออกจากระบบของโรงงานที่ใช้น้ำมันเป็นเชื้อเพลิง, ราชกิจจานุเบกษา, 4 ธันวาคม 2549, เล่มที่ 123 ตอนพิเศษ 125 ง.
- กระทรวงอุตสาหกรรม, ประกาศกระทรวงอุตสาหกรรม พ.ศ.2548 เรื่อง การกำจัดกากของเสียที่ไม่ใช่กาก, ราชกิจจานุเบกษา, 25 มกราคม 2549, เล่มที่ 123 ตอนพิเศษ 11 ง.
- APHA, AWWA, WEF, Standard Methods for the Examination of Water and Wastewater, 23<sup>rd</sup> ed. Washington, DC: APHA, 2017
- United States Environmental Protection Agency, Standard of Performance for New Stationary Sources, 40 CFR Part 60, Appendix A, 2017.
- United States Environmental Protection Agency, Standard of Performance for New Stationary Sources, 40 CFR Part 60, Appendix A, 2019.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Acid Digestion of Sediments Sludges, and Soils, SW-846 Method 3050B, 1996.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Alkaline Digestion for Hexavalent Chromium, SW-846 Method 3060A, 1996.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, SW-846, 1997.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Ultrasonic Extraction, SW-846 Method 3550C, 2007.

(นายทวี อ้าพาทันย์)  
ผู้อำนวยการ

ศูนย์วิจัยและเฝ้าระวังมลพิษโรงงานภาคตะวันออก

10 United

- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Closed-System Purge-and-Trap for Aqueous Samples, SW-846 Method 5035C, 2003.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Inductively Coupled Plasma Atomic Emission spectrometry, SW-846 Method 6010D, 2014.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Antimony and Arsenic (Atomic Absorption, Borohydride Reduction), SW-846 Method 7062A, 1994.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Chromium, Hexavalent (Colorimetric), Method 7196A, 1992.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique), SW-846 Method 7471B, 2007.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Nonhalogenated Organics Using GC/FID, SW-846 Method 8015D, 2003.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Organochlorine Pesticide by Gas Chromatography, SW-846 Method 8081B, 2007.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Polychlorinated Biphenyls (PCBs) By Gas Chromatography, SW-846 Method 8082A, 2007.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry, SW-846 Method 8260D, 2018.
- United States Environmental Protection Agency, Test Methods for Evaluation Solid Waste Physical/Chemical Methods, Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry, SW-846 Method 8270E, 2018.

(นายทวี อ้าพาทันย์)  
ผู้อำนวยการ

ศูนย์วิจัยและเฝ้าระวังมลพิษโรงงานภาคตะวันออก

ศูนย์วิจัยและเฝ้าระวังมลพิษโรงงานภาคตะวันออก, กระทรวงอุตสาหกรรม, กระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม, กระทรวงสาธารณสุข, โทร. 0-2042-7420-24

ลำดับที่	สารเคมี	วิธีการวิเคราะห์
1	Mercury	Digestion, Cold vapor Atomic Absorption Spectrometric Method <sup>[94]</sup>
2	Polychlorinated Biphenyls (PCBs)	Ultrasonic Extraction, Gas Chromatographic Method <sup>[84,87]</sup>
3	TPH (C <sub>8</sub> -C <sub>6</sub> )	Purge and Trap, Gas Chromatographic Mass Spectrometric Method <sup>[10,18]</sup>
4	TPH (C <sub>9</sub> -C <sub>16</sub> )	Ultrasonic Extraction, Gas Chromatographic Mass Spectrometric Method <sup>[84,86]</sup>
5	TPH (C <sub>17</sub> -C <sub>30</sub> )	Ultrasonic Extraction, Gas Chromatographic Mass Spectrometric Method <sup>[10,18]</sup>

ลำดับที่	สารเคมี	วิธีการวิเคราะห์
1	Mercury	Digestion, Cold vapor Atomic Absorption Spectrometric Method <sup>[94]</sup>
2	Polychlorinated Biphenyls (PCBs)	Ultrasonic Extraction, Gas Chromatographic Method <sup>[84,87]</sup>
3	TPH (C <sub>8</sub> -C <sub>6</sub> )	Purge and Trap, Gas Chromatographic Mass Spectrometric Method <sup>[10,18]</sup>
4	TPH (C <sub>9</sub> -C <sub>16</sub> )	Ultrasonic Extraction, Gas Chromatographic Mass Spectrometric Method <sup>[84,86]</sup>
5	TPH (C <sub>17</sub> -C <sub>30</sub> )	Ultrasonic Extraction, Gas Chromatographic Mass Spectrometric Method <sup>[10,18]</sup>

ลำดับที่	สารเคมี	วิธีการวิเคราะห์
1	Mercury	Digestion, Cold vapor Atomic Absorption Spectrometric Method <sup>[94]</sup>
2	Polychlorinated Biphenyls (PCBs)	Ultrasonic Extraction, Gas Chromatographic Method <sup>[84,87]</sup>
3	TPH (C <sub>8</sub> -C <sub>6</sub> )	Purge and Trap, Gas Chromatographic Mass Spectrometric Method <sup>[10,18]</sup>
4	TPH (C <sub>9</sub> -C <sub>16</sub> )	Ultrasonic Extraction, Gas Chromatographic Mass Spectrometric Method <sup>[84,86]</sup>
5	TPH (C <sub>17</sub> -C <sub>30</sub> )	Ultrasonic Extraction, Gas Chromatographic Mass Spectrometric Method <sup>[10,18]</sup>

ลำดับที่	สารเคมี	วิธีการวิเคราะห์
1	Mercury	Digestion, Cold vapor Atomic Absorption Spectrometric Method <sup>[94]</sup>
2	Polychlorinated Biphenyls (PCBs)	Ultrasonic Extraction, Gas Chromatographic Method <sup>[84,87]</sup>
3	TPH (C <sub>8</sub> -C <sub>6</sub> )	Purge and Trap, Gas Chromatographic Mass Spectrometric Method <sup>[10,18]</sup>
4	TPH (C <sub>9</sub> -C <sub>16</sub> )	Ultrasonic Extraction, Gas Chromatographic Mass Spectrometric Method <sup>[84,86]</sup>
5	TPH (C <sub>17</sub> -C <sub>30</sub> )	Ultrasonic Extraction, Gas Chromatographic Mass Spectrometric Method <sup>[10,18]</sup>











Certificate of Approval  
This is to certify that

**SGS (Thailand) Limited**

Address of premises : Eastern Sealand Industrial Estate,  
Premises 1 : 380/100 Moo 1,  
Ta Si, Phrakasong District,  
Rayong 21140, Thailand

Premises 2 : 1209, 1211 Moo 1, Soi Sukumvit 2, Sukhumvit Road,  
Ban Chang, Ban Chang District,  
Rayong 21130, Thailand

Has been assessed and found to be conforming to the requirements of  
ISO 14001:2015 (ISO 14001:2015)

On the scope :  
Premises 1 : Automotive Laboratory  
Premises 2 : Environmental Laboratory

**SGS (Thailand) Limited**  
14001:2015 (ISO 14001:2015)

SGS (Thailand) Limited  
14001:2015 (ISO 14001:2015)



Certificate of Approval  
This is to certify that

**SGS (Thailand) Limited**

Address of premises : Eastern Sealand Industrial Estate,  
Premises 1 : 380/100 Moo 1,  
Ta Si, Phrakasong District,  
Rayong 21140, Thailand

Premises 2 : 1209, 1211 Moo 1, Soi Sukumvit 2, Sukhumvit Road,  
Ban Chang, Ban Chang District,  
Rayong 21130, Thailand

Has been assessed and found to be conforming to the requirements of  
ISO 14001:2015 (ISO 14001:2015)

On the scope :  
Premises 1 : Automotive Laboratory  
Premises 2 : Environmental Laboratory

**SGS (Thailand) Limited**  
14001:2015 (ISO 14001:2015)

SGS (Thailand) Limited  
14001:2015 (ISO 14001:2015)



ใบรับรองข้อปฏิบัติตาม

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)



ใบรับรองข้อปฏิบัติตาม

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)

บริษัท ไทยเซอีเอส จำกัด (มหาชน) สาขาโรงงานอุตสาหกรรม

มาตรฐาน ISO 14001:2015 (ISO 14001:2015)







HRSG 91 - 14 Jan 22  
HRSG 22 - 9 Feb 22

# **HORIBA** Process & Environmental

Horiba (Thailand) Limited (Head Office) 363, 365, 367, 369, 401, 403 Laya Road, Sornomchongpraya, Klongkum, Bangkok 10600  
Telephone (66) 02 861-5985, Facsimile (66) 02 861-5200, http://www.horiba.com  
Tax ID: 010-554-7010-7-49

Horiba (Thailand) Limited (Lai Krabang Office) 8507 Lai Krabang Road, Lai Krabang, Lai Krabang, Bangkok 10520  
Telephone (66) 02 734-4434, Facsimile (66) 02 734-4438

## **MULTI-POINT GAS TEST REPORT OF OXYGEN**

### **Equipment Information**

Manufacturer: Horiba  
Model: HORIBA PG-350  
Serial Number: 8SPNRVX4  
Calibration Date: 26-Dec-21  
Background: -  
Coefficient: 1.0592  
Room Temperature: 24.7 °C

### **Standard Gas Information**

Zero Gas: 14W004104  
Cylinder Number: N2  
Component: 89.999 %  
Concentration: -  
Expiration Date: -  
Span Gas: ND27125  
Cylinder Number: O2  
Component: 21.15 %  
Concentration: 7-Dec-29  
Expiration Date: -

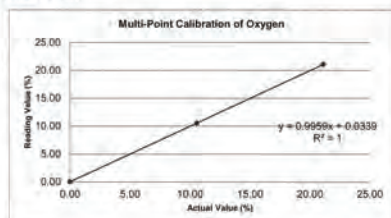
Measurement Range: 26  
% Measurement Range: 84.6

### **Multi-Point Gas Test Data**

Level	Actual Value	Reading Value (%)				Difference	
		1	2	3	Average	%	%
0%	0.00	0.03	0.05	0.04	0.04	0.04	
50%	10.58	10.56	10.54	10.56	-0.02	0.20	
100%	21.15	21.11	21.09	21.11	-0.05	0.22	
					Average	0.21	
					Result	PASS	

Slope	0.9959	Interception	0.0339	Correlation Coefficient	1.0000
% Slope	-0.4079%	% Interception	0.1352%	% Correlation Coefficient	-0.0001%
Result	PASS	Result	PASS	Result	PASS

### **Multi-Point Gas Test Chart**



Test By: [Signature] Approve By: [Signature]  
Date: 7-Jan-22 Date: 7-Jan-22

# **HORIBA** Process & Environmental

Horiba (Thailand) Limited (Head Office) 363, 365, 367, 369, 401, 403 Laya Road, Sornomchongpraya, Klongkum, Bangkok 10600  
Telephone (66) 02 861-5985, Facsimile (66) 02 861-5200, http://www.horiba.com  
Tax ID: 010-554-7010-7-49

Horiba (Thailand) Limited (Lai Krabang Office) 8507 Lai Krabang Road, Lai Krabang, Lai Krabang, Bangkok 10520  
Telephone (66) 02 734-4434, Facsimile (66) 02 734-4438

## **MULTI-POINT GAS TEST REPORT OF NITRIC OXIDE**

### **Equipment Information**

Manufacturer: Horiba  
Model: HORIBA PG-350  
Serial Number: 8SPNRVX4  
Calibration Date: 26-Dec-21  
Background: -  
Coefficient: 1.0432  
Room Temperature: 24.7 °C

### **Standard Gas Information**

Zero Gas: 14W004104  
Cylinder Number: N2  
Component: 99.999 %  
Concentration: -  
Expiration Date: -  
Span Gas: GN0019208  
Cylinder Number: NO  
Component: 90.33 ppm  
Concentration: 28-Feb-27  
Expiration Date: -

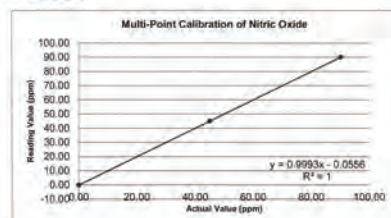
Measurement Range: 100  
% Measurement Range: 90.33

### **Multi-Point Gas Test Data**

Level	Actual Value	Reading Value (ppm)				Difference	
		1	2	3	Average	ppm	%
0%	0.00	0.00	-0.10	0.00	-0.03	-0.03	
50%	45.17	45.00	45.00	45.10	45.03	-0.13	0.29
100%	90.33	90.30	90.20	90.20	90.23	-0.10	0.11
					Average	0.20	
					Result	PASS	

Slope	0.9993	Interception	-0.0356	Correlation Coefficient	1.0000
% Slope	-0.0101%	% Interception	-0.0396%	% Correlation Coefficient	0.0000%
Result	PASS	Result	PASS	Result	PASS

### **Multi-Point Gas Test Chart**



Test By: [Signature] Approve By: [Signature]  
Date: 7-Jan-22 Date: 7-Jan-22

# **HORIBA** Process & Environmental

Horiba (Thailand) Limited (Head Office) 363, 365, 367, 369, 401, 403 Laya Road, Sornomchongpraya, Klongkum, Bangkok 10600  
Telephone (66) 02 861-5985, Facsimile (66) 02 861-5200, http://www.horiba.com  
Tax ID: 010-554-7010-7-49

Horiba (Thailand) Limited (Lai Krabang Office) 8507 Lai Krabang Road, Lai Krabang, Lai Krabang, Bangkok 10520  
Telephone (66) 02 734-4434, Facsimile (66) 02 734-4438

## **MULTI-POINT GAS TEST REPORT OF SULFUR DIOXIDE**

### **Equipment Information**

Manufacturer: Horiba  
Model: HORIBA PG-350  
Serial Number: 8SPNRVX4  
Calibration Date: 26-Dec-21  
Background: -  
Coefficient: 1.0457  
Room Temperature: 24.7 °C

### **Standard Gas Information**

Zero Gas: 14W004104  
Cylinder Number: N2  
Component: 99.999 %  
Concentration: -  
Expiration Date: -  
Span Gas: GN0019208  
Cylinder Number: SO2  
Component: 90.61 ppm  
Concentration: 7-Jun-24  
Expiration Date: -

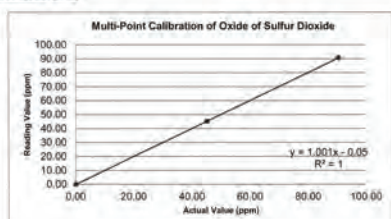
Measurement Range: 200  
% Measurement Range: 45.305

### **Multi-Point Gas Test Data**

Level	Actual Value	Reading Value (ppm)				Difference	
		1	2	3	Average	ppm	%
0%	0.00	0.00	0.00	0.10	0.03	0.03	
50%	45.31	45.20	45.10	45.10	45.13	-0.17	0.38
100%	90.61	90.70	90.80	90.70	90.73	0.12	0.14
					Average	0.26	
					Result	PASS	

Slope	1.0010	Interception	-0.0500	Correlation Coefficient	1.0000
% Slope	0.0993%	% Interception	-0.0250%	% Correlation Coefficient	-0.0005%
Result	PASS	Result	PASS	Result	PASS

### **Multi-Point Gas Test Chart**



Test By: [Signature] Approve By: [Signature]  
Date: 7-Jan-22 Date: 7-Jan-22

# **HORIBA** Process & Environmental

Horiba (Thailand) Limited (Head Office) 363, 365, 367, 369, 401, 403 Laya Road, Sornomchongpraya, Klongkum, Bangkok 10600  
Telephone (66) 02 861-5985, Facsimile (66) 02 861-5200, http://www.horiba.com  
Tax ID: 010-554-7010-7-49

Horiba (Thailand) Limited (Lai Krabang Office) 8507 Lai Krabang Road, Lai Krabang, Lai Krabang, Bangkok 10520  
Telephone (66) 02 734-4434, Facsimile (66) 02 734-4438

## **MULTI-POINT GAS TEST REPORT OF CARBON MONOXIDE**

### **Equipment Information**

Manufacturer: Horiba  
Model: HORIBA PG-350  
Serial Number: 8SPNRVX4  
Calibration Date: 26-Dec-21  
Background: -  
Coefficient: 1.0195  
Room Temperature: 24.7 °C

### **Standard Gas Information**

Zero Gas: 14W004104  
Cylinder Number: N2  
Component: 99.999 %  
Concentration: -  
Expiration Date: -  
Span Gas: ND27117  
Cylinder Number: CO  
Component: 905.9 ppm  
Concentration: 20-Jul-29  
Expiration Date: -

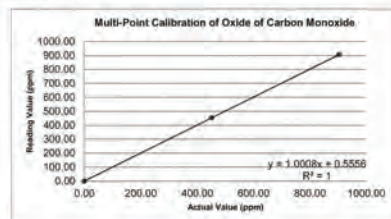
Measurement Range: 1000  
% Measurement Range: 90.59

### **Multi-Point Gas Test Data**

Level	Actual Value	Reading Value (ppm)				Difference	
		1	2	3	Average	ppm	%
0%	0.00	1.00	1.00	0.00	0.67	0.67	
50%	452.95	454.00	454.00	453.00	453.67	0.72	0.16
100%	905.90	907.00	908.00	907.00	907.33	1.43	0.16
					Average	0.16	
					Result	PASS	

Slope	1.0008	Interception	0.5556	Correlation Coefficient	1.0000
% Slope	0.0848%	% Interception	0.0556%	% Correlation Coefficient	0.0000%
Result	PASS	Result	PASS	Result	PASS

### **Multi-Point Gas Test Chart**



Test By: [Signature] Approve By: [Signature]  
Date: 7-Jan-22 Date: 7-Jan-22



## MULTI-POINT GAS TEST REPORT OF CARBON DIOXIDE

### Equipment Information

Manufacturer	Horiba	Calibration Date	26-Dec-21
Model	HORIBA PG-350	Background	-
Serial Number	8SPNRVX4	Coefficient	1.0053
		Room Temperature	24.7 °C

### Standard Gas Information

Zero Gas		Span Gas	
Cylinder Number	14W004104	Cylinder Number	GN0018529
Component	N2	Component	CO2
Concentration	99.999 %	Concentration	20.95 %
Expiration Date	-	Expiration Date	14-Feb-27

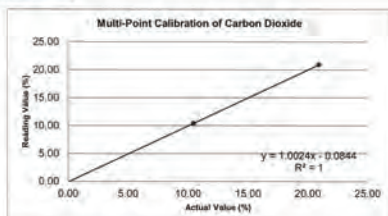
Measurement Range	30
% Measurement Range	69.633333

### Multi-Point Gas Test Data

Level	Actual Value	Reading Value (%)				Difference	
		1	2	3	Average	%	%
0%	0.00	-0.05	-0.10	-0.07	-0.07	-0.07	
50%	10.48	10.40	10.39	10.39	10.39	-0.08	0.78
100%	20.95	20.92	20.96	20.90	20.93	-0.02	0.11
						Average	0.45
						Result	PASS

Slope	1.0024	Interception	-0.0844	Correlation Coefficient	1.0000
% Slope	0.2387%	% Interception	-0.2815%	% Correlation Coefficient	-0.0002%
Result	PASS	Result	PASS	Result	PASS

### Multi-Point Gas Test Chart



Test By: [Signature] Approve By: [Signature]  
Date: 7-Jan-22 Date: 7-Jan-22

## MULTI-POINT GAS TEST REPORT OF OXYGEN

### Equipment Information

Manufacturer	Horiba	Calibration Date	27-Dec-21
Model	HORIBA PG-350	Background	-
Serial Number	J402YU7S	Coefficient	1.0411
		Room Temperature	24.7 °C

### Standard Gas Information

Zero Gas		Span Gas	
Cylinder Number	14W004104	Cylinder Number	N027125
Component	N2	Component	O2
Concentration	99.999 %	Concentration	21.15 %
Expiration Date	-	Expiration Date	7-Dec-29

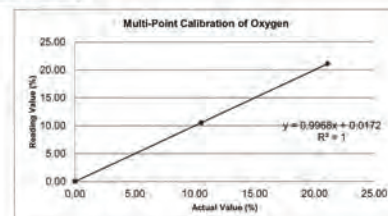
Measurement Range	25
% Measurement Range	84.6

### Multi-Point Gas Test Data

Level	Actual Value	Reading Value (%)				Difference	
		1	2	3	Average	%	%
0%	0.00	0.05	0.01	0.04	0.03	0.03	
50%	10.58	10.49	10.54	10.55	10.53	-0.05	0.46
100%	21.15	21.12	21.11	21.12	21.12	-0.03	0.16
						Average	0.31
						Result	PASS

Slope	0.9968	Interception	0.0172	Correlation Coefficient	1.0000
% Slope	-0.3152%	% Interception	0.0689%	% Correlation Coefficient	-0.0004%
Result	PASS	Result	PASS	Result	PASS

### Multi-Point Gas Test Chart



Test By: [Signature] Approve By: [Signature]  
Date: 7-Jan-22 Date: 7-Jan-22

## MULTI-POINT GAS TEST REPORT OF NITRIC OXIDE

### Equipment Information

Manufacturer	Horiba	Calibration Date	27-Dec-21
Model	HORIBA PG-350	Background	-
Serial Number	J402YU7S	Coefficient	1.0053
		Room Temperature	24.7 °C

### Standard Gas Information

Zero Gas		Span Gas	
Cylinder Number	14W004104	Cylinder Number	GN0019208
Component	N2	Component	NO
Concentration	99.999 %	Concentration	90.33 ppm
Expiration Date	-	Expiration Date	28-Feb-27

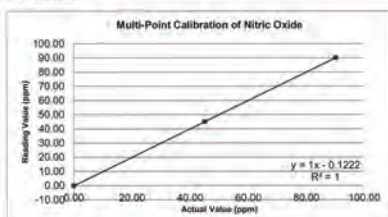
Measurement Range	100
% Measurement Range	90.33

### Multi-Point Gas Test Data

Level	Actual Value	Reading Value (ppm)				Difference	
		1	2	3	Average	ppm	%
0%	0.00	-0.30	-0.10	0.00	-0.13	-0.13	
50%	45.17	45.00	45.00	45.20	45.07	-0.10	0.22
100%	90.33	90.20	90.20	90.20	90.20	-0.13	0.14
						Average	0.18
						Result	PASS

Slope	1.0000	Interception	-0.1222	Correlation Coefficient	1.0000
% Slope	0.0037%	% Interception	-0.1222%	% Correlation Coefficient	0.0000%
Result	PASS	Result	PASS	Result	PASS

### Multi-Point Gas Test Chart



Test By: [Signature] Approve By: [Signature]  
Date: 7-Jan-22 Date: 7-Jan-22

## MULTI-POINT GAS TEST REPORT OF SULFUR DIOXIDE

### Equipment Information

Manufacturer	Horiba	Calibration Date	27-Dec-21
Model	HORIBA PG-350	Background	-
Serial Number	J402YU7S	Coefficient	1.0333
		Room Temperature	24.7 °C

### Standard Gas Information

Zero Gas		Span Gas	
Cylinder Number	14W004104	Cylinder Number	GN0019208
Component	N2	Component	SO2
Concentration	99.999 %	Concentration	90.61 ppm
Expiration Date	-	Expiration Date	7-Jun-24

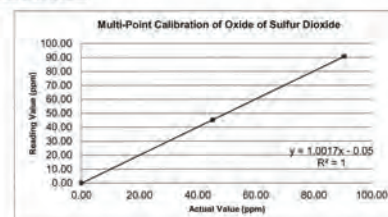
Measurement Range	200
% Measurement Range	45.305

### Multi-Point Gas Test Data

Level	Actual Value	Reading Value (ppm)				Difference	
		1	2	3	Average	ppm	%
0%	0.00	-0.10	0.00	0.10	0.00	-0.05	
50%	45.31	45.30	45.20	45.20	45.23	-0.07	0.16
100%	90.61	90.80	90.80	90.70	90.77	-0.16	0.17
						Average	0.17
						Result	PASS

Slope	1.0017	Interception	-0.0500	Correlation Coefficient	1.0000
% Slope	0.1729%	% Interception	-0.0250%	% Correlation Coefficient	-0.0002%
Result	PASS	Result	PASS	Result	PASS

### Multi-Point Gas Test Chart



Test By: [Signature] Approve By: [Signature]  
Date: 7-Jan-22 Date: 7-Jan-22

## MULTI-POINT GAS TEST REPORT OF CARBON MONOXIDE

### Equipment Information

Manufacturer	Horiba	Calibration Date	27-Dec-21
Model	HORIBA PG-350	Background	-
Serial Number	J4D2YU7S	Coefficient	1.0095
		Room Temperature	24.7 °C

### Standard Gas Information

Zero Gas		Span Gas	
Cylinder Number	14W004104	Cylinder Number	ND27117
Component	N2	Component	CO
Concentration	99.999 %	Concentration	905.9 ppm
Expiration Date	-	Expiration Date	26-Jul-29

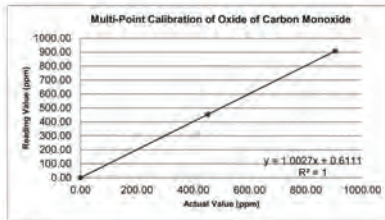
Measurement Range	1000
% Measurement Range	90.59

### Multi-Point Gas Test Data

Level	Actual Value	Reading Value (ppm)			Difference	
		1	2	3	Average	%
0%	0.00	0.00	1.00	0.00	0.33	-
50%	455.00	455.00	456.00	455.33	2.38	0.53
100%	905.90	909.00	908.00	909.00	3.10	0.31
				Average	0.42	
				Result	PASS	

Slope	1.0027	Interception	0.6111	Correlation Coefficient	1.0000
% Slope	0.2686%	% Interception	0.0611%	% Correlation Coefficient	-0.0001%
Result	PASS	Result	PASS	Result	PASS

### Multi-Point Gas Test Chart



Test By [Signature] Approve By [Signature]  
Date 7-Jan-22 Date 7-Jan-22

## MULTI-POINT GAS TEST REPORT OF CARBON DIOXIDE

### Equipment Information

Manufacturer	Horiba	Calibration Date	27-Dec-21
Model	HORIBA PG-350	Background	-
Serial Number	J4D2YU7S	Coefficient	0.9854
		Room Temperature	24.7 °C

### Standard Gas Information

Zero Gas		Span Gas	
Cylinder Number	14W004104	Cylinder Number	GN0016529
Component	N2	Component	CO2
Concentration	99.999 %	Concentration	20.95 %
Expiration Date	-	Expiration Date	14-Feb-27

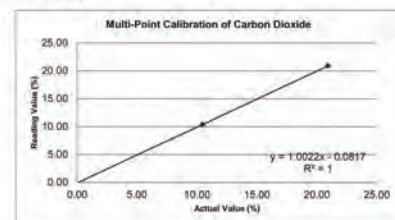
Measurement Range	30
% Measurement Range	69.83333

### Multi-Point Gas Test Data

Level	Actual Value	Reading Value (%)			Difference	
		1	2	3	Average	%
0%	0.00	-0.04	-0.10	-0.07	-0.07	-
50%	10.48	10.40	10.39	10.39	-0.08	0.78
100%	20.95	20.92	20.96	20.94	-0.01	0.11
				Average	0.45	
				Result	PASS	

Slope	1.0022	Interception	-0.0817	Correlation Coefficient	1.0000
% Slope	0.2228%	% Interception	-0.2722%	% Correlation Coefficient	-0.0002%
Result	PASS	Result	PASS	Result	PASS

### Multi-Point Gas Test Chart



Test By [Signature] Approve By [Signature]  
Date 7-Jan-22 Date 7-Jan-22

## MULTI-POINT GAS TEST REPORT OF OXYGEN

### Equipment Information

Manufacturer	Horiba	Calibration Date	27-Dec-21
Model	HORIBA PG-350	Background	-
Serial Number	V40KVOLD	Coefficient	0.9874
		Room Temperature	24.7 °C

### Standard Gas Information

Zero Gas		Span Gas	
Cylinder Number	14W004104	Cylinder Number	ND27125
Component	N2	Component	O2
Concentration	99.999 %	Concentration	21.15 %
Expiration Date	-	Expiration Date	7-Dec-29

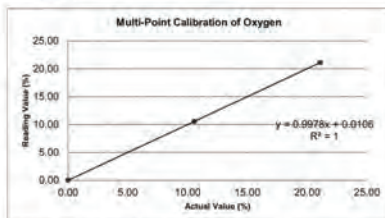
Measurement Range	25
% Measurement Range	84.6

### Multi-Point Gas Test Data

Level	Actual Value	Reading Value (%)			Difference	
		1	2	3	Average	%
0%	0.00	-0.01	0.02	0.03	0.01	-
50%	10.58	10.55	10.56	10.56	-0.02	0.17
100%	21.15	21.12	21.11	21.12	-0.03	0.16
				Average	0.17	
				Result	PASS	

Slope	0.9978	Interception	0.0106	Correlation Coefficient	1.0000
% Slope	-0.2206%	% Interception	0.0422%	% Correlation Coefficient	0.0000%
Result	PASS	Result	PASS	Result	PASS

### Multi-Point Gas Test Chart



Test By [Signature] Approve By [Signature]  
Date 7-Jan-22 Date 7-Jan-22

## MULTI-POINT GAS TEST REPORT OF NITRIC OXIDE

### Equipment Information

Manufacturer	Horiba	Calibration Date	27-Dec-21
Model	HORIBA PG-350	Background	-
Serial Number	V40KVOLD	Coefficient	0.9762
		Room Temperature	24.7 °C

### Standard Gas Information

Zero Gas		Span Gas	
Cylinder Number	14W004104	Cylinder Number	GN0019208
Component	N2	Component	NO
Concentration	99.999 %	Concentration	90.33 ppm
Expiration Date	-	Expiration Date	28-Feb-27

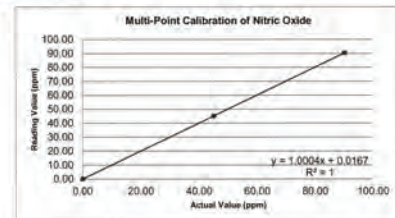
Measurement Range	100
% Measurement Range	90.33

### Multi-Point Gas Test Data

Level	Actual Value	Reading Value (ppm)			Difference	
		1	2	3	Average	%
0%	0.00	0.20	-0.10	0.00	0.03	-
50%	45.17	45.00	45.30	45.20	-0.00	0.00
100%	90.33	90.40	90.40	90.40	0.07	0.08
				Average	0.04	
				Result	PASS	

Slope	1.0004	Interception	0.0187	Correlation Coefficient	1.0000
% Slope	0.0406%	% Interception	0.0167%	% Correlation Coefficient	0.0000%
Result	PASS	Result	PASS	Result	PASS

### Multi-Point Gas Test Chart



Test By [Signature] Approve By [Signature]  
Date 7-Jan-22 Date 7-Jan-22



**MULTI-POINT GAS TEST REPORT OF SULFUR DIOXIDE**

**Equipment Information**

Manufacturer	Horiba	Calibration Date	27-Dec-21
Model	HORIBA PG-350	Background	-
Serial Number	V40KVOLD	Coefficient	0.9877
		Room Temperature	24.7 °C

**Standard Gas Information**

Zero Gas		Span Gas	
Cylinder Number	14W004104	Cylinder Number	GN0019208
Component	N2	Component	SO2
Concentration	99.999 %	Concentration	90.61 ppm
Expiration Date	-	Expiration Date	7-Jun-24

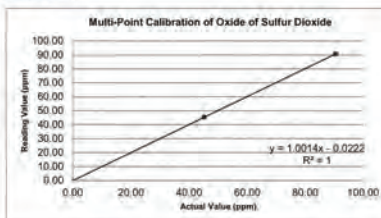
Measurement Range	200
% Measurement Range	45.305

**Multi-Point Gas Test Data**

Level	Actual Value	Reading Value (ppm)			Average	Difference	
		1	2	3		ppm	%
0%	0.00	0.00	0.00	-0.20	-0.07	-0.07	
50%	45.31	45.50	45.40	45.40	45.43	0.13	0.28
100%	90.61	90.70	90.60	90.70	90.67	0.06	0.06
						Average	0.17
						Result	PASS

Slope	1.0014	Interception	-0.0222	Correlation Coefficient	1.0000
% Slope	0.1361%	% Interception	-0.0111%	% Correlation Coefficient	-0.0001%
Result	PASS	Result	PASS	Result	PASS

**Multi-Point Gas Test Chart**



Test By: [Signature] Date: 7-Jan-22  
Approve By: [Signature] Date: 7-Jan-22

**MULTI-POINT GAS TEST REPORT OF CARBON MONOXIDE**

**Equipment Information**

Manufacturer	Horiba	Calibration Date	27-Dec-21
Model	HORIBA PG-350	Background	-
Serial Number	V40KVOLD	Coefficient	1.0456
		Room Temperature	24.7 °C

**Standard Gas Information**

Zero Gas		Span Gas	
Cylinder Number	14W004104	Cylinder Number	ND27117
Component	N2	Component	CO
Concentration	99.999 %	Concentration	905.9 ppm
Expiration Date	-	Expiration Date	20-Jul-29

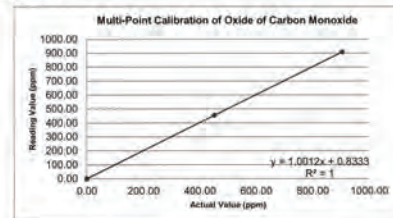
Measurement Range	1000
% Measurement Range	90.59

**Multi-Point Gas Test Data**

Level	Actual Value	Reading Value (ppm)				Difference	
		1	2	3	Average	ppm	%
0%	0.00	1.00	1.00	0.00	0.67	0.67	
50%	452.95	455.00	456.00	453.00	454.67	1.72	0.38
100%	905.90	907.00	907.00	909.00	907.67	1.77	0.20
					Average		0.29
					Result		PASS

Slope	1.0012	Interception	0.8333	Correlation Coefficient	1.0000
% Slope	0.1214%	% Interception	0.0933%	% Correlation Coefficient	0.0000%
Result	PASS	Result	PASS	Result	PASS

**Multi-Point Gas Test Chart**



Test By: [Signature] Date: 7-Jan-22  
Approve By: [Signature] Date: 7-Jan-22

**MULTI-POINT GAS TEST REPORT OF CARBON DIOXIDE**

**Equipment Information**

Manufacturer	Horiba	Calibration Date	27-Dec-21
Model	HORIBA PG-350	Background	-
Serial Number	V40KVOLD	Coefficient	1.0095
		Room Temperature	24.7 °C

**Standard Gas Information**

Zero Gas		Span Gas	
Cylinder Number	14W004104	Cylinder Number	GN0018529
Component	N2	Component	CO2
Concentration	99.999 %	Concentration	20.95 %
Expiration Date	-	Expiration Date	14-Feb-27

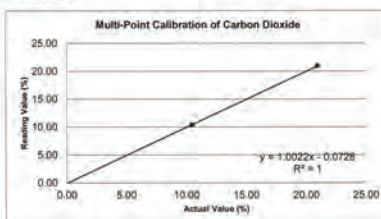
Measurement Range	30
% Measurement Range	69.83333

**Multi-Point Gas Test Data**

Level	Actual Value	Reading Value (%)				Difference	
		1	2	3	Average	%	%
0%	0.00	-0.02	-0.10	-0.05	-0.08	-0.08	
50%	10.48	10.40	10.39	10.39	10.39	-0.08	0.78
100%	20.95	20.92	21.00	20.90	20.94	-0.01	0.05
						Average	0.41
						Result	PASS

Slope	1.0022	Interception	-0.0728	Correlation Coefficient	1.0000
% Slope	0.2228%	% Interception	-0.2426%	% Correlation Coefficient	-0.0004%
Result	PASS	Result	PASS	Result	PASS

**Multi-Point Gas Test Chart**



Test By: [Signature] Date: 7-Jan-22  
Approve By: [Signature] Date: 7-Jan-22

**CERTIFICATE OF ANALYSIS**  
Grade of Product: EPA Protocol

Part Number:	ED4N98E3HAD032	Reference Number:	82-401420322-1
Cylinder Number:	GN0018505	Cylinder Volume:	247.1 CF
Laboratory:	124 - Riverton (SAF) - NJ	Cylinder Pressure:	2215 PSIG
PGVP Number:	652019	Valve Outlet:	860
		Certification Date:	Feb 20, 2019

Expiration Date: Feb 20, 2022

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 8200-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration cylinder. All concentrations are in a volumetric basis unless otherwise noted.  
Do not use this cylinder below 132 psig, 1.6 gpm flow rate.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	43.90 PPM	GI	±1.4% NIST Traceable	02/15/2019, 02/20/2019
CARBON MONOXIDE	45.00 PPM	45.15 PPM	GI	±1.0% NIST Traceable	02/15/2019
NITROGEN DIOXIDE	45.00 PPM	43.25 PPM	GI	±1.4% NIST Traceable	02/15/2019, 02/20/2019
SULFUR DIOXIDE	45.00 PPM	44.02 PPM	GI	±1.0% NIST Traceable	02/15/2019, 02/20/2019
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	14000728	CO434334	49.85 PPM CARBON MONOXIDE/NITROGEN	±1.0%	Feb 22, 2020
PRM	12368	8604119	25.85 PPM NITROGEN DIOXIDE/AMR	±1.5%	Jun 02, 2017
NTRM	10101224	KAL034487	30.03 PPM NITROGEN DIOXIDE/NITROGEN	±1.0%	Mar 18, 2024
QMS	704010104	CO003841	5.100 PPM NITROGEN DIOXIDE/NITROGEN	±1.0%	Jun 01, 2020
NTRM	14010327	KAL034378	49.08 PPM SULFUR DIOXIDE/NITROGEN	±1.0%	Apr 17, 2024

Instrument/Make/Model	Analytical Principle	Last Multi-Point Calibration
Nicola 8700 APV1100381 CO	FTIR	Feb 07, 2019
Nicola 8700 APV1100381 H2O	FTIR	Feb 06, 2019
Nicola 8700 APV1100381 NO2	FTIR	Feb 05, 2019
Nicola 8700 APV1100381 SO2	FTIR	Feb 07, 2019

**Test Data Available Upon Request**

NOTES:  
Gross Weight: 105.5 lbs.  
Net Weight: 17.9 lbs.  
PO# 521500555

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 8200-12/031, using the assay procedures listed. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. This certificate is not to be reproduced in full without written approval of the issuer.



**ACCREDITED**  
TESTING CERT No. 3982.05

Approved for Release



# **CERTIFICATE OF ANALYSIS** Grade of Product: EPA Protocol

Part Number: E02N1809E3HAC001 Reference Number: 82-40142030-1  
Cylinder Number: GND019008 Cylinder Volume: 247.3 CF  
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2215 PSIG  
PGVP Number: B52019 Valve Outlet: 600  
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Feb 28, 2019  
Expiration Date: Feb 28, 2027

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 600/R-12/531, using the assay procedures listed. Analytical Metrology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volumetric basis unless otherwise noted.  
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	90.00 PPM	90.42 PPM	G1	+/- 1.1% NIST Traceable	02/21/2019, 02/28/2019
CARBON MONOXIDE	90.00 PPM	90.44 PPM	G1	+/- 0.7% NIST Traceable	02/28/2019
NITRIC OXIDE	90.00 PPM	90.33 PPM	G1	+/- 1.1% NIST Traceable	02/21/2019, 02/28/2019
SULFUR DIOXIDE	90.00 PPM	90.61 PPM	G1	+/- 1.0% NIST Traceable	02/21/2019, 02/28/2019
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No.	Concentration	Uncertainty	Expiration Date
NTRM	09019254	KAL004675	38.48 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Oct 16, 2024
PRM	12352	S504119	25.86 PPM NITROGEN DIOXIDE/AIR	+/- 0.5%	Jun 02, 2017
NTRM	1706241	E00076687	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	May 11, 2019
QMS	704230104	CC039841	5.101 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Jan 01, 2020
NTRM	11010416	KAL004692	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicole 8750 APW1100381 CO	FTIR	Feb 07, 2019
Nicole 8750 APW1100381 NO	FTIR	Feb 06, 2019
Nicole 8750 APW1100381 NOX	FTIR	Feb 06, 2019
Nicole 8750 APW1100381 SO2	FTIR	Feb 07, 2019

Triad Data Available Upon Request

NOTES:  
Gross Weight: 136.3 lbs.  
Net Weight: 17.8 lbs.  
PO# 5219000565  
This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



**ACCREDITED**  
TESTING CERT No. 3082.05

Approved for Release

Page 1 of 82-40142030-1

# **CERTIFICATE OF ANALYSIS** Grade of Product: EPA Protocol

Part Number: E02N179E3HAC02A9 Reference Number: 82-40142033-1  
Cylinder Number: GND018534 Cylinder Volume: 250.6 CF  
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2214 PSIG  
PGVP Number: B52019 Valve Outlet: 590  
Gas Code: O2,BALN Certification Date: Feb 14, 2019  
Expiration Date: Feb 14, 2027

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 600/R-12/531, using the assay procedures listed. Analytical Metrology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volumetric basis unless otherwise noted.  
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	21.00 %	20.99 %	G1	+/- 0.6% NIST Traceable	02/14/2019
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No.	Concentration	Uncertainty	Expiration Date
NTRM	09061452	CC279671	22.03 % OXYGEN/NITROGEN	+/- 0.4%	Mar 08, 2019

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba MPA 510-CO2-TTWA041	Paramagnetic	Feb 04, 2019

Triad Data Available Upon Request

NOTES:  
Gross Weight: 48523.9 grams  
Net Weight: 6463.6 grams  
PO# 5219000565  
This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



**ACCREDITED**  
TESTING CERT No. 3082.05

Approved for Release

Page 1 of 82-40142033-1

# **CERTIFICATE OF ANALYSIS** Grade of Product: EPA Protocol

Part Number: E02N188E3HAC04C Reference Number: 82-124527650-1  
Cylinder Number: ND43982 Cylinder Volume: 258.7 CF  
Laboratory: ASG - Riverton - NJ Cylinder Pressure: 2214 PSIG  
PGVP Number: B52015 Valve Outlet: 580  
Gas Code: CO2,BALN Certification Date: Dec 22, 2015  
Expiration Date: Dec 22, 2023

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 600/R-12/531, using the assay procedures listed. Analytical Metrology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volumetric basis unless otherwise noted.  
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	11.50 %	11.55 %	G1	+/- 0.7% NIST Traceable	12/22/2015
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No.	Concentration	Uncertainty	Expiration Date
NTRM	12061339	CC360796	11.002 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 11, 2018

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA 510-CO2-LDHILRNS	NDIR	Dec 09, 2015

Triad Data Available Upon Request

NOTES:  
This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



**ACCREDITED**  
TESTING CERT No. 2000.02

Approved for Release

Page 1 of 82-124527650-1



# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Airgas, Inc.  
801 Union Landing Road  
Chenoweth, NJ 08077  
609-625-7878 Fax: 609-625-8576

Part Number: E02N179E3HAC01C  
Cylinder Number: ND43535  
Laboratory: ASG - Riverton - NJ  
PGVP Number: B52016  
Gas Code: CO2,6ALN

Customer PO Number: 5215004252  
Reference Number: 82-124527551-1  
Cylinder Volume: 270.4 CF  
Cylinder Pressure: 2214 PSIG  
Valve Outlet: 580  
Certification Date: Dec 23, 2016

Expiration Date: Dec 23, 2023

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 600/R-12/021, using the assay procedures listed. Analytical Metrology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volumetric basis unless otherwise noted.

Do Not Use This Cylinder Below 100 psig, i.e. 0.7% impurities.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
CARBON DIOXIDE	20.80 %	20.80 %	G1	±0.7% NIST Traceable
NITROGEN	Balance			
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	12080519	CD417106	24.04 % CARBON DIOXIDE/NITROGEN	±0.8%
ANALYTICAL EQUIPMENT				
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration	
Honke VA 510-CO2-LDHLRNS	NDIR		Dec 09, 2016	

Triad Data Available Upon Request

PERMANENT NOTES: Bangkok Industrial Gas Co.

NOTES: 300A, 580 VALVE  
PO# 5215004252



Approved for Release

Page 1 of 02-124527551-1

# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Part Number: E04N189E3HA0032  
Cylinder Number: GND019200  
Laboratory: 124 - Riverton (SAF) - NJ  
PGVP Number: B52019

Reference Number: 82-401420322-1  
Cylinder Volume: 247.1 CF  
Cylinder Pressure: 2215 PSIG  
Valve Outlet: 580  
Certification Date: Feb 20, 2019

Expiration Date: Feb 20, 2022

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 600/R-12/021, using the assay procedures listed. Analytical Metrology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volumetric basis unless otherwise noted.

Do Not Use This Cylinder Below 100 psig, i.e. 0.7% impurities.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
NOX	45.00 PPM	43.77 PPM	G1	±1.0% NIST Traceable
CARBON MONOXIDE	45.00 PPM	43.09 PPM	G1	±0.7% NIST Traceable
NITRIC OXIDE	45.00 PPM	43.71 PPM	G1	±1.1% NIST Traceable
SULFUR DIOXIDE	45.00 PPM	44.12 PPM	G1	±1.0% NIST Traceable
NITROGEN	Balance			
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	1400726	CC343334	49.88 PPM CARBON MONOXIDE/NITROGEN	±0.8%
PRM	12382	3804110	79.89 PPM NITROGEN DIOXIDE/AIR	±1.5%
NTRM	12010724	KAL004497	59.00 PPM NITRIC OXIDE/NITROGEN	±0.8%
GMS	704210104	CC303941	5.161 PPM NITROGEN DIOXIDE/NITROGEN	±2.0%
NTRM	14010327	KAL004376	49.08 PPM SULFUR DIOXIDE/NITROGEN	±1.0%
ANALYTICAL EQUIPMENT				
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration	
Nicrol 8700 APW1100091 CO	FTIR		Feb 07, 2019	
Nicrol 8700 APW1100091 NO	FTIR		Feb 07, 2019	
Nicrol 8700 APW1100091 NO2	FTIR		Feb 08, 2019	
Nicrol 8700 APW1100091 SO2	FTIR		Feb 07, 2019	

The NTRM, PRM or GMS noted above is only in reference to the GMS used in the assay and not part of the product.

Triad Data Available Upon Request

NOTES:  
Gross Weight: 106.5 lb.  
Net Weight: 17.9 lb.  
PO# 5219000555

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/021. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2000 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

Approved for Release

Page 1 of 02-401420322-1

# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Part Number: E04N189E3HAC8TC  
Cylinder Number: ND57143  
Laboratory: 124 - Plumsteadville - PA  
PGVP Number: A12021  
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 160-402161778-1  
Cylinder Volume: 224.8 CF  
Cylinder Pressure: 2001 PSIG  
Valve Outlet: 580  
Certification Date: Jul 30, 2021

Expiration Date: Jul 20, 2029

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 600/R-12/021, using the assay procedures listed. Analytical Metrology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volumetric basis unless otherwise noted.

Do Not Use This Cylinder Below 100 psig, i.e. 0.7% impurities.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
NOX	90.00 PPM	89.33 PPM	G1	±1.3% NIST Traceable
CARBON MONOXIDE	90.00 PPM	90.11 PPM	G1	±0.8% NIST Traceable
NITRIC OXIDE	90.00 PPM	89.33 PPM	G1	±1.0% NIST Traceable
SULFUR DIOXIDE	90.00 PPM	89.72 PPM	G1	±1.0% NIST Traceable
NITROGEN	Balance			
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	11010130	KAL004535	97.31 PPM CARBON MONOXIDE/NITROGEN	±0.8%
PRM	12382	D980505	9.81 PPM ARSENIC TRIOXIDE	±2.0%
NTRM	30001047	CC733418	88.81 PPM NITRIC OXIDE/NITROGEN	±0.8%
GMS	194208868	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	±2.1%
NTRM	18016224	KAL003836	87.58 PPM SULFUR DIOXIDE/NITROGEN	±0.8%
ANALYTICAL EQUIPMENT				
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration	
Nicrol 8300 FTIR AUP2010245 CO	FTIR		Jun 24, 2021	
Nicrol 8300 FTIR AUP2010245 NO	FTIR		Jul 01, 2021	
Nicrol 8300 FTIR AUP2010245 NO2	FTIR		Jun 30, 2021	
Nicrol 8300 FTIR AUP2010245 SO2	FTIR		Jul 09, 2021	

The NTRM, PRM or GMS noted above is only in reference to the GMS used in the assay and not part of the product.

Triad Data Available Upon Request

NOTES:  
Gross Weight: 50.2 Kg  
Net Weight: 8.4 Kg  
PO# 5221003102



Approved for Release



Page 1 of 160-402161778-1

# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Customer: PO# 5215004252  
Part Number: E02N189E3HAC14C  
Cylinder Number: ND43897  
Laboratory: ASG - Riverton - NJ  
PGVP Number: B52016  
Gas Code: CO2,BALN2

Reference Number: 82-124527854-1A  
Cylinder Volume: 249.0 CF  
Cylinder Pressure: 2214 PSIG  
Valve Outlet: 590  
Certification Date: Jan 18, 2016

Expiration Date: Jan 18, 2024

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 600/R-12/021, using the assay procedures listed. Analytical Metrology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volumetric basis unless otherwise noted.

Do Not Use This Cylinder Below 100 psig, i.e. 0.7% impurities.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
OXYGEN	11.50 %	11.52 %	G1	±0.4% NIST Traceable
NITROGEN	Balance			
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRMplus	09060203	CG762337	9.951 % OXYGEN/NITROGEN	±0.3%
ANALYTICAL EQUIPMENT				
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration	
Honke MPA 510-CO2-7TWAJ041	Paramagnetic		Jan 04, 2016	

Triad Data Available Upon Request

NOTES:  
This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/021. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2000 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3080.62

Approved for Release

Page 1 of 82-124527854-1A



# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Airgas, Inc.  
400 Union Landing Blvd  
Clarks Summit, NJ 07077  
800-425-7478 Fax: 800-425-4376

Part Number: E02N179E3HAC15C  
Cylinder Number: NC25793  
Laboratory: ASG - Riverton - NJ  
PGVP Number: B52015  
Gas Code: CQ, BALN2

Customer PO Number: 5216004262  
Reference Number: 86-12427653-1  
Cylinder Volume: 350.8 CF  
Cylinder Pressure: 2214 PSIG  
Valve Outlet: 590  
Certification Date: Dec 22, 2015

Expiration Date: Dec 22, 2023

Certification performed in accordance with EPA Traceability Protocol for Analytical and Certification of Gaseous Calibration Standards May 2012 (Document EPA 600/R-12/531), using the assay procedures from Analytical Metrology data not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration cylinder. All concentrations are on a volumetric basis unless otherwise noted.  
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
OXYGEN	20.50 %	20.50 %	G1	±0.5% NIST Traceable
NITROGEN	Balance			
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No.	Concentration	Uncertainty
NITRMeas	20081404	CC267783	22.63 % OXYGEN/NITROGEN	±0.4%
ANALYTICAL EQUIPMENT				
Instrument/Make/Model			Last Multipoint Calibration	
Horiba MPA 810-CG-7TMM-D41			Paramagnetic	

Triad Data Available Upon Request

NOTES: This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA 600/R-12/531. All testing procedures and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 2000.02

Approved for Release

Page 1 of 52-12427653-1

# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Airgas Specialty Gases  
Airgas USA, LLC  
600 Union Landing Road  
Clarks Summit, NJ 07077-1001  
Airgas.com

Part Number: E02N179E3HAC000  
Cylinder Number: GN0018529  
Laboratory: 124 - Riverton (SAP) - NJ  
PGVP Number: B52018  
Gas Code: CQ2, BALN

Reference Number: 82-401420321-1  
Cylinder Volume: 271.2 CF  
Cylinder Pressure: 2214 PSIG  
Valve Outlet: 580  
Certification Date: Feb 14, 2019

Expiration Date: Feb 14, 2027

Certification performed in accordance with EPA Traceability Protocol for Analytical and Certification of Gaseous Calibration Standards May 2012 (Document EPA 600/R-12/531), using the assay procedures from Analytical Metrology data not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration cylinder. All concentrations are on a volumetric basis unless otherwise noted.  
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
CARBON DIOXIDE	21.00 %	20.98 %	G1	±0.8% NIST Traceable
NITROGEN	Balance			
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No.	Concentration	Uncertainty
NITR	12081945	CC354843	19.82 % CARBON DIOXIDE/NITROGEN	±0.8%
ANALYTICAL EQUIPMENT				
Instrument/Make/Model			Last Multipoint Calibration	
Horiba VA 510-CO2-100VCHSG			NDIR	

Triad Data Available Upon Request

NOTES: This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA 600/R-12/531. All testing procedures and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 2002.05

Approved for Release

Page 1 of 52-401420321-1

BANGKOK INDUSTRIAL GAS CO., LTD.  
11<sup>th</sup> Floor, Rajanakarn Building  
3 South Sathorn Rd., Yanawa, Sathorn  
Bangkok 10120, Thailand  
Tel : (662) 685-6789 Fax : (662) 685-6790-1

# CERTIFICATE OF CONFORMITY

## (For Package Gases)

Customer Name : SGS (Thailand) Limited  
Product Name : Nitrogen  
Date of Issue : 8/8/2020  
Lot No. : 050820N261 / DO. 3300114888  
Page no. : 1/1

Certificate No. : QC20B3-4051  
Gas Content : 7 M<sup>3</sup>  
Cylinder Valve Type : CGA 580

Components	Specification
Oxygen	<3 ppm
Moisture	<3 ppm
Carbon Dioxide	<1 ppm
Carbon Monoxide	<1 ppm
Total Hydrocarbon	<1 ppm
Nitrogen	>99.999 %

Cylinders Barcode

14W004104 D9124155 15W009055 D9126073

Signed: (Wiroonwut Supervisor)

# Meter Console Verification

Dry Gas Meter ID : ENSS 045  
Instrument Brand : Apex / Model S72  
Date of Calibration : 23/10/2021  
Calibrated By : OC

## Wet gas meter Information

Wet gas Brand : Shinagawa  
Wet gas Model : W-HK-2.5A  
Wet gas S/N : 544122  
Expire Date : 27 July 2022

Orifice Setting AHG (mm H <sub>2</sub> O)	Wet gas		Metering System		Time (min)	Y1	AHG
	V <sub>m</sub> (L)	T <sub>m</sub> (°C)	V <sub>s</sub> (L)	T <sub>s</sub> (°C)			
13	137.20	25.2	140.0	22.5	12:23	0.9700	50.518
13	137.08	25.0	140.0	23.0	12:28	0.9713	51.288
26	136.44	25.0	140.0	23.0	8:34	0.9658	48.823
28	135.78	24.9	140.0	23.0	8:34	0.9614	48.250
40	270.39	24.6	280.0	23.5	13:44	0.9584	49.001
40	270.21	24.5	280.0	24.0	13:43	0.9598	48.816
50	268.39	24.2	280.0	24.0	12:08	0.9533	48.382
50	267.15	24.1	280.0	24.0	12:08	0.9492	48.913
70	266.29	24.1	280.0	24.0	10:06	0.9444	47.703
70	265.77	24.0	280.0	24.0	10:06	0.9428	47.857
90	264.06	23.9	280.0	24.0	8:54	0.9354	48.457
90	264.26	23.8	280.0	24.0	8:57	0.9364	48.806
Average							0.9540 48.990

Remark : Y1 ± 0.02 from average  
Y1 = 1.00 ± 0.05  
AHG ± 5.08 mm H<sub>2</sub>O from average  
AHG = 46.7 ± 6.4 mm H<sub>2</sub>O

Checked By: (Wasagorn Praveschotumit)  
Position : Operation Manager  
Date : 25/10/2021

Approved By: (Theeran Yommana)  
Position : Technical Manager  
Date : 25/10/2021

SGS

## Manometer Verification

Dry Gas Meter ID. : EN55 045 Date of Calibration : 23/10/2021  
Instrument Brand : Apex / Model 572 Calibrated By : OC/MW

## Magnehelic gauge Information

Magnehelic Brand : Dwyer Industries, Inc. Magnehelic S/N : R060822A1109  
Magnehelic Model : 2000-100MM Expire Date : 14/10/2022

Test No.	Manometer data			Reference/Monitoring A/B
	Manometer Reference $\Delta P$ (mm.H <sub>2</sub> O):A	Manometer monitoring $\Delta P$ (mm.H <sub>2</sub> O):B	Difference	
1	2.0	2.0	0.00	1.00
2	6.0	6.0	0.00	1.00
3	10.0	10.5	0.50	0.95
4	16.0	16.0	0.00	1.00
5	20.0	20.0	0.00	1.00
Average			0.10	0.99

Remark : [ Reference(Avg) / Monitoring(Avg) ] must be = 0.95 to 1.05

Checked By : Wasajorn P.  
(Wasajorn Praveschotinunt)  
Position : Operation Manager  
Date : 25 / 10 / 2021

Approved By : Thaporn Y.  
(Thaporn Yommana)  
Position : Technical Manager  
Date : 25 / 10 / 2021

SGS (Thailand) Limited | 100 Nongkhai Road, Chongnonsi, Nongkhai 19120 | +66 (0) 428 18 13 | +66 (0) 428 18 41 | www.sgs.com  
Member of the SGS Group

SGS

## Temperature Display Verification

Dry Gas Meter ID. : EN55 045 Date of Calibration : 23/10/2021  
Instrument Brand : Apex / Model 572 Calibrated By : MW

## Temperature Simulator Information

Simulator Brand : Handy Cal Simulator S/N : TIL1015  
Simulator Model : CA11E Expire Date : 15/06/2022

Standard Value	Instrument Display				
	Stack	Probe	Filter	Aux	Exit
300	299	299	300	300	-
200	199	199	199	200	-
150	150	151	150	151	-
100	100	101	100	101	-101
50	50	50	-48	51	50
0	0	0	0	0	0
Difference	0.2%	1.0	1.0	1.0	1.0

Remark : Stack  $\leq \pm 1.5\%$  Absolute Aux  $\leq \pm 3.0\%$  °C  
Probe  $\leq \pm 3.0\%$  °C Exit  $\leq \pm 3.0\%$  °C  
Filter  $\leq \pm 3.0\%$

Checked By : Wasajorn P.  
(Wasajorn Praveschotinunt)  
Position : Operation Manager  
Date : 25 / 10 / 2021

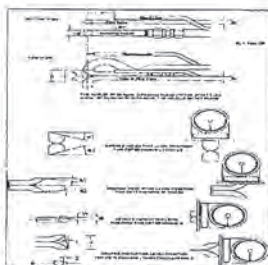
Approved By : Thaporn Y.  
(Thaporn Yommana)  
Position : Technical Manager  
Date : 25 / 10 / 2021

SGS (Thailand) Limited | 100 Nongkhai Road, Chongnonsi, Nongkhai 19120 | +66 (0) 428 18 13 | +66 (0) 428 18 41 | www.sgs.com  
Member of the SGS Group

SGS

## Certificate of Calibration

3-Port Gasometer Pilot Tube Calibration  
See the body of EN45-2 regulations, Title 40, Part 60, Appendix A,  
Method 2, item 6



Pilot tube/Probe No. No. 20			
Parameter	Value	Allowable Range	Check
Assembly Level?	Y	Yes or y	PASS
Ports Damaged?	N	No or n	PASS
Q1	2.8	$-10^\circ < \alpha < +10^\circ$	PASS
Q2	2.7	$-10^\circ < \alpha < +10^\circ$	PASS
Q1	-0.3	$-5^\circ < \alpha < +5^\circ$	PASS
Q2	-0.6	$-5^\circ < \alpha < +5^\circ$	PASS
r	2.2	N/A	-
Q	0.6	N/A	-
D1	0.375	0.188" to 0.375"	PASS
A	0.929	2.10" $\leq$ A $\leq$ 3.00"	PASS
A/2D1	1.238	1.05 $\leq$ A/2D1 $\leq$ 1.5	PASS
Z + A tan y	0.019	Z $\leq$ 0.125"	PASS
W = A tan B	0.009	W $\leq$ 0.021"	PASS

I certify that pilot tube/probe No. 20 meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned to pilot tube specifications Section of D.64. See 40 CFR Pt. 401, App. A, EPA Method 4

Standard Device  
Device Name : Digital inclinometer  
Manufacturer : B&S Inc.  
Model : 22-2057  
ID No. : QC-1824

Expiration date : 07-Dec-22  
EN55 No. : EN55 22159

Certified by : Necvach A.  
Date : 6 / 01 / 2022

Approved by : Wasajorn P.  
Date : 06 / 01 / 2022

SGS

## Prob Nozzle Diameter Calibration Data Sheet

Date : 19/11/2021 Personal : MW  
Vernier (Digital) : Dial Caliper Reference : GS 584607  
Nozzle ID : EN55 088 Nozzle Set (Borosilicate Glass)

Nozzle No.	Nozzle Diameter (mm)			Hi-Lo	D <sub>avg</sub>
	D1	D2	D3		
1	4.16	4.12	4.14	0.04	4.14
2	4.78	4.76	4.76	0.02	4.77
3	4.88	4.88	4.90	0.02	4.89
4	5.64	5.60	5.68	0.08	5.64
5	6.88	6.82	6.82	0.06	6.84
6	8.92	8.88	8.88	0.04	8.89
7	10.92	10.92	10.90	0.02	10.91

Remark :  $\Delta D$  = Maximum distance between any two diameters, must be  $\leq$  0.100 mm.  
 $D_{avg} = (D1 + D2 + D3) / 3$

Checked By : Wasajorn P.  
(Wasajorn Praveschotinunt)  
Position : Operations Manager  
Date : 23 / 11 / 2021

Approved By : Naris P.  
(Naris Phongvithai)  
Position : Technical Manager  
Date : 23 / 11 / 2021



Dry Gas Meter ID. : ENSS 071 Date of Calibration : 23/10/2021  
Instrument Brand : Apex / Model 572 Calibrated By : OC

## Wet gas meter information

Wet gas Brand : Shinagawa Wet gas S/N : 544122  
Wet gas Model : W-NK-2.5A Expire Date : 27 July 2022

Orifice Setting ΔH <sub>0</sub> (mm H <sub>2</sub> O)	Wet gas		Metering System		Time (min)	Y1	ΔH <sub>0</sub>
	V <sub>0</sub> (L)	T <sub>0</sub> (°C)	V <sub>1</sub> (L)	T <sub>1</sub> (°C)			
13	142.64	25.1	140.0	22.5	12:12	1.0089	45.367
13	142.54	24.8	140.0	22.0	12:19	1.0073	46.325
26	142.46	24.8	140.0	22.0	8:32	1.0058	44.551
26	141.78	24.8	140.0	23.0	8:32	1.0047	44.796
40	283.70	24.0	280.0	21.0	14:07	0.9991	47.298
40	282.00	23.8	280.0	21.5	14:10	0.9956	46.047
50	279.78	23.7	280.0	22.5	12:32	0.9905	47.610
50	279.92	23.5	280.0	23.5	12:36	0.9950	47.843
70	277.32	23.2	280.0	24.0	10:31	0.9866	47.456
70	278.22	22.8	280.0	24.0	10:31	0.9836	47.740
90	274.51	22.7	280.0	24.0	9:21	0.9763	49.149
90	273.97	21.9	280.0	24.0	9:22	0.9769	49.268
Average						0.9942	47.123

Remark : Y1 ≤ ± 0.02 from average  
Y1 = 1.00 ± 0.05  
ΔH<sub>0</sub> ≤ ± 5.08 mm.H<sub>2</sub>O from average  
ΔH<sub>0</sub> = 46.7 ± 6.4 mm.H<sub>2</sub>O

Checked By : Wasagorn P.  
(Wasagorn Praveschotinnunt)  
Position : Operation Manager  
Date : 25/10/2021

Approved By : Thepsan Y.  
(Thepsan Yommana)  
Position : Technical Manager  
Date : 25/10/2021

Dry Gas Meter ID. : ENSS 071 Date of Calibration : 23/10/2021  
Instrument Brand : Apex / Model 572 Calibrated By : OC/MW

## Magnehelic gauge information

Magnehelic Brand : Dwyer Industries, Inc. Magnehelic S/N : R050822A1109  
Magnehelic Model : 2000-100MM Expire Date : 14/10/2022

Test No.	Manometer data		Reference/Monitoring A/B
	Reference ΔP (mm.H <sub>2</sub> O):A	Manometer monitoring ΔP (mm.H <sub>2</sub> O):B	
1	2.0	2.0	0.00
2	5.0	5.5	0.50
3	10.0	10.0	0.00
4	15.0	16.5	0.50
5	20.0	20.0	0.00
Average			0.20
			0.98

Remark : [Reference(Avg) / Monitoring(Avg)] must be = 0.95 to 1.05

Checked By : Wasagorn P.  
(Wasagorn Praveschotinnunt)  
Position : Operation Manager  
Date : 25/10/2021

Approved By : Thepsan Y.  
(Thepsan Yommana)  
Position : Technical Manager  
Date : 25/10/2021

Dry Gas Meter ID. : ENSS 071 Date of Calibration : 23/10/2021  
Instrument Brand : Apex / Model 572 Calibrated By : MW

## Temperature Simulator Information

Simulator Brand : Handy Cal Simulator S/N : T1L1015  
Simulator Model : CA11E Expire Date : 15/06/2022

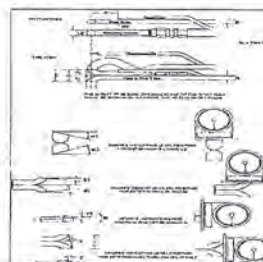
Standard Value	Instrument Display				
	Stack	Probe	Filter	Aux	Exit
300	300	301	301	300	-
200	200	201	201	200	-
150	151	152	152	151	-
100	102	102	102	101	102
50	51	52	51	50	51
0	0	0	0	0	0
Difference 0.9%					

Remark : Stack ≤ ± 1.5 % Absolute Aux ≤ ± 3.0 °C  
Probe ≤ ± 3.0 °C Exit ≤ ± 3.0 °C  
Filter ≤ ± 3.0 °C

Checked By : Wasagorn P.  
(Wasagorn Praveschotinnunt)  
Position : Operation Manager  
Date : 25/10/2021

Approved By : Thepsan Y.  
(Thepsan Yommana)  
Position : Technical Manager  
Date : 25/10/2021

S-Type (Stainless Steel) Tube Calibration  
See the Code of Federal Regulations, Title 49, Part 83, Appendix A,  
Method 3, Item 4



Piston tube/Probe No. : No. 50/A3599

Parameter	Value	Allowable Range	Check
Assembly level?	Y	Y or N	PASS
Parts Damaged?	N	Y or N	PASS
B1	-0.9	-10°C ≤ ΔT ≤ +10°C	PASS
B2	-1.5	-10°C ≤ ΔT ≤ +10°C	PASS
B3	-0.8	-5°C ≤ ΔT ≤ +5°C	PASS
B4	0.5	-5°C ≤ ΔT ≤ +5°C	PASS
T	-3.4	N/A	-
U	1.5	N/A	-
D1	0.375	0.188" to 0.375"	PASS
A	0.893	2.10 ≤ S.A.S ≤ 3.60	PASS
A/2D1	1.11	1.05 ≤ S.A.S ≤ 1.5	PASS
Z = A tan γ	0.02	2 ≤ 0.135"	PASS
W = A sin θ	0.022	W ≤ 0.031"	PASS

I certify that piston tube/parts No. 50/A3599 meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a piston tube calibration factor of 0.00. See 49 CFR 83. App A, (7) Manual 2

Standard Device : Digital thermometer  
Device Name : BASELINE  
Manufacturer : 12-1057  
Model : OC 1824  
ID No. :

Expiration date : 27-06-22  
ENSS No. : ENSS 21159

Certified by : Heemach K.  
Date : 6/10/2022

Approved by : Wasagorn P.  
Date : 24/10/2021



## Meter Console Verification

Dry Gas Meter ID: : ENSS 046 Date of Calibration : 23/10/2021  
Instrument Brand : Apex / Model 572 Calibrated By : OC

### Wet gas meter Information

Wet gas Brand : Shingawa Wet gas S/N : 544122  
Wet gas Model : W NK-2.5A Expire Date : 27 July 2022

Orifice Setting $\Delta H_0$ (mm H <sub>2</sub> O)	Wet gas		Metering System		Time (min)	Yi	$\Delta H_0$
	$V_1$ (L)	$T_1$ (°C)	$V_2$ (L)	$T_2$ (°C)			
13	136.08	25.1	140.0	24.0	12:22	0.9673	50.958
13	136.26	25.0	140.0	24.0	12:22	0.9689	50.787
26	134.55	24.7	140.0	24.0	8:31	0.9564	48.380
26	134.27	24.5	140.0	24.0	8:32	0.9552	49.697
40	270.27	24.3	280.0	24.5	13:53	0.9623	49.688
40	267.81	24.1	280.0	25.0	13:53	0.9656	50.654
50	266.89	24.1	280.0	25.0	12:15	0.9518	49.647
50	266.45	24.0	280.0	24.0	12:15	0.9470	49.983
70	264.74	24.0	280.0	24.5	10:08	0.9409	48.496
70	265.83	23.8	280.0	25.0	10:07	0.9468	47.816
90	263.32	23.8	280.0	24.0	8:55	0.9029	48.928
90	263.34	23.8	280.0	24.0	8:54	0.9030	48.738
Average						0.9515	49.578

Remark :  $Y_i \leq \pm 0.02$  from average  
 $Y_i = 1.00 \pm 0.05$   
 $\Delta H_0 \leq \pm 5.08$  mm H<sub>2</sub>O from average  
 $\Delta H_0 = 48.7 \pm 5.4$  mm H<sub>2</sub>O

Checked By: Wasagorn P.  
(Wasagorn Praveschotnunt)  
Position : Operation Manager  
Date : 25/10/2021

Approved By: Thapson Y.  
(Thapson Yommana)  
Position : Technical Manager  
Date : 25/10/2021



## Manometer Verification

Dry Gas Meter ID: : ENSS 046 Date of Calibration : 23/10/2021  
Instrument Brand : Apex / Model 572 Calibrated By : OC, MW

### Magnehelic gauge Information

Magnehelic Brand : Dwyer Industries, Inc. Magnehelic S/N : R080822A1109  
Magnehelic Model : 2000-100MM Expire Date : 14/10/2022

Test No.	Manometer data			Reference/Monitoring A/B
	Manometer Reference $\Delta P$ (mm.H <sub>2</sub> O):A	Manometer monitoring $\Delta P$ (mm.H <sub>2</sub> O):B	Difference	
1	2.0	2.0	0.00	1.00
2	6.0	6.0	0.00	1.00
3	10.0	10.5	0.50	0.95
4	15.0	16.5	0.50	0.97
5	20.0	20.5	0.50	0.98
Average			0.30	0.98

Remark : [ Reference(Avg) / Monitoring(Avg) ] must be  $\approx 0.95$  to 1.05

Checked By: Wasagorn P.  
(Wasagorn Praveschotnunt)  
Position : Operation Manager  
Date : 25/10/2021

Approved By: Thapson Y.  
(Thapson Yommana)  
Position : Technical Manager  
Date : 25/10/2021



## Temperature Display Verification

Dry Gas Meter ID: : ENSS 046 Date of Calibration : 23/10/2021  
Instrument Brand : Apex / Model 572 Calibrated By : MW

### Temperature Simulator Information

Simulator Brand : Handy Cal Simulator S/N : T1L1015  
Simulator Model : CA11E Expire Date : 15/06/2022

Standard Value	Instrument Display				
	Stack	Probe	Filter	Aux	Exit
300	300	300	300	300	-
200	200	200	200	200	-
150	150	150	150	150	-
100	100	100	100	100	101
50	50	50	49	50	50
0	0	0	0	0	0
Difference	0.0%	0.0	1.0	0.0	1.0

Remark : Stack  $\leq \pm 1.5\%$  Absolute Aux  $\leq \pm 3.0$  °C  
Probe  $\leq \pm 3.0$  °C Exit  $\leq \pm 3.0$  °C  
Filter  $\leq \pm 3.0$  °C

Checked By: Wasagorn P.  
(Wasagorn Praveschotnunt)  
Position : Operation Manager  
Date : 25/10/2021

Approved By: Thapson Y.  
(Thapson Yommana)  
Position : Technical Manager  
Date : 25/10/2021



## Prob Nozzle Diameter Calibration Data Sheet

Date : 19/11/2021 Personal : MW  
Vernier (Digital) : Dial Caliper Reference : GS 584607  
Nozzle ID : ENSS 074 Nozzle Set (Borosilicate Glass)

Nozzle No.	Nozzle Diameter (mm)			Hi-Lo AD	$D_{avg}$
	D1	D2	D3		
1	3.22	3.20	3.20	0.02	3.21
2	3.38	3.38	3.36	0.02	3.37
3	4.02	4.00	4.02	0.02	4.01
4	4.68	4.64	4.66	0.04	4.66
5	4.68	4.64	4.68	0.04	4.67
6	4.72	4.70	4.70	0.02	4.71
7	5.68	5.62	5.68	0.06	5.66

Remark : AD = Maximum distance between any two diameters, must be  $\leq 0.100$  mm  
 $D_{avg} = (D1+D2+D3)/3$

Checked By: Wasagorn P.  
(Wasagorn Praveschotnunt)  
Position : Operations Manager  
Date : 25/10/2021

Approved By: Naris P.  
(Naris Phongviratjai)  
Position : Technical Manager  
Date : 25/11/2021



- HRSG 11

# SGS

## System Calibration Data Sheet

Job No. 10045 Contact WMS Date 14/10/2012  
 Client Name WMS Job Calibration WMS Time 13:30  
 Plant Name WMS Plant Calibration WMS Date 14/10/2012  
 Location WMS Plant Name WMS

Parameter LO Description PERMIA H2S-100 Serial No. ADP0010

Plant Name WMS  
 Examination Level LO  
 Mfr or High Level Data WMS

Station	Initial Value				Final Value				Diff		Offset	
	Analyzer Calibration Response (%)	System Calibration Response (%)	System Bias (%)	Value (%)	Result (%)	System Verification Response (%)	System Bias (%)	Value (%)	Result (%)	(% of Span)	Value (%)	Offset (%)
Zero gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spanning gas	44.50	44.50	0.00	44.50	44.50	44.50	0.00	44.50	44.50	0.00	44.50	0.00

Plant Name WMS  
 Examination Level LO  
 Mfr or High Level Data WMS

Station	Initial Value				Final Value				Diff		Offset	
	Analyzer Calibration Response (%)	System Calibration Response (%)	System Bias (%)	Value (%)	Result (%)	System Verification Response (%)	System Bias (%)	Value (%)	Result (%)	(% of Span)	Value (%)	Offset (%)
Zero gas	0.15	0.15	0.00	0.15	0.15	0.15	0.00	0.15	0.15	0.00	0.15	0.00
Spanning gas	44.50	44.50	0.00	44.50	44.50	44.50	0.00	44.50	44.50	0.00	44.50	0.00

Plant Name WMS  
 Examination Level LO  
 Mfr or High Level Data WMS

Station	Initial Value				Final Value				Diff		Offset	
	Analyzer Calibration Response (%)	System Calibration Response (%)	System Bias (%)	Value (%)	Result (%)	System Verification Response (%)	System Bias (%)	Value (%)	Result (%)	(% of Span)	Value (%)	Offset (%)
Zero gas	0.15	0.15	0.00	0.15	0.15	0.15	0.00	0.15	0.15	0.00	0.15	0.00
Spanning gas	44.50	44.50	0.00	44.50	44.50	44.50	0.00	44.50	44.50	0.00	44.50	0.00

Plant Name WMS  
 Examination Level LO  
 Mfr or High Level Data WMS

Station	Initial Value				Final Value				Diff		Offset	
	Analyzer Calibration Response (%)	System Calibration Response (%)	System Bias (%)	Value (%)	Result (%)	System Verification Response (%)	System Bias (%)	Value (%)	Result (%)	(% of Span)	Value (%)	Offset (%)
Zero gas	0.15	0.15	0.00	0.15	0.15	0.15	0.00	0.15	0.15	0.00	0.15	0.00
Spanning gas	44.50	44.50	0.00	44.50	44.50	44.50	0.00	44.50	44.50	0.00	44.50	0.00

Plant Name WMS  
 Examination Level LO  
 Mfr or High Level Data WMS

Station	Initial Value				Final Value				Diff		Offset	
	Analyzer Calibration Response (%)	System Calibration Response (%)	System Bias (%)	Value (%)	Result (%)	System Verification Response (%)	System Bias (%)	Value (%)	Result (%)	(% of Span)	Value (%)	Offset (%)
Zero gas	0.15	0.15	0.00	0.15	0.15	0.15	0.00	0.15	0.15	0.00	0.15	0.00
Spanning gas	44.50	44.50	0.00	44.50	44.50	44.50	0.00	44.50	44.50	0.00	44.50	0.00

Page 1

Signature WMS  
 Date 14/10/2012

Page 1

Signature WMS  
 Date 14/10/2012

MS-THESIS-2012-0146 2012-05-21 Page 2 of 2

[illegible]

10.1186/1745-6215-10-109

## Analyzer Calibration Data Sheet

- HRSG 12

Analyzer Calibration Data Sheet

[illegible]

## System Calibration Data Sheet

[illegible]

## Analyzer Calibration Data Sheet

- HRSG 21

## Analyzer Calibration Data Sheet

[illegible]



## System Calibration Data Sheet

Job No.	ECN/REV	Date	INSTRUMENT
Client Name	QC/PC	No. of Columns	INSTRUMENT
Warehouse	QC/PC/REVISION	Port Configuration	INSTRUMENT
Location	QC/PC/REVISION	Notes/Issues	INSTRUMENT
Parameter:	AS	Sample/Injection	INSTRUMENT
Blank Value:	100	Blank	INSTRUMENT
Calibration Span:	10.23	Span	INSTRUMENT
Min or High Level Dev:	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	Control
Response	Response	Response	Response
Value	Value	Value	Value
Unit	Unit	Unit	Unit
Blank	Blank	Blank	Blank
Span	Span	Span	Span
Min or High Level Dev	Min		
Station	Analyzer	System	Control
Calibration	Calibration	System	

www.mindgarden.com Nov 21/22 05:21 Page 2 of 2

## Analyzer Calibration Data Sheet

- HRSG 22



### Analyzer Calibration Data Sheet

[illegible]

1950-1954-1958-1962-1966-1970-1974-1978-1982-1986-1990-1994-1998-2002-2006-2010-2014-2018-2022-2026-2030-2034-2038-2042-2046-2050-2054-2058-2062-2066-2070-2074-2078-2082-2086-2090-2094-2098-2102-2106-2110-2114-2118-2122-2126-2130-2134-2138-2142-2146-2150-2154-2158-2162-2166-2170-2174-2178-2182-2186-2190-2194-2198-2202-2206-2210-2214-2218-2222-2226-2230-2234-2238-2242-2246-2250-2254-2258-2262-2266-2270-2274-2278-2282-2286-2290-2294-2298-2302-2306-2310-2314-2318-2322-2326-2330-2334-2338-2342-2346-2350-2354-2358-2362-2366-2370-2374-2378-2382-2386-2390-2394-2398-2402-2406-2410-2414-2418-2422-2426-2430-2434-2438-2442-2446-2450-2454-2458-2462-2466-2470-2474-2478-2482-2486-2490-2494-2498-2502-2506-2510-2514-2518-2522-2526-2530-2534-2538-2542-2546-2550-2554-2558-2562-2566-2570-2574-2578-2582-2586-2590-2594-2598-2602-2606-2610-2614-2618-2622-2626-2630-2634-2638-2642-2646-2650-2654-2658-2662-2666-2670-2674-2678-2682-2686-2690-2694-2698-2702-2706-2710-2714-2718-2722-2726-2730-2734-2738-2742-2746-2750-2754-2758-2762-2766-2770-2774-2778-2782-2786-2790-2794-2798-2802-2806-2810-2814-2818-2822-2826-2830-2834-2838-2842-2846-2850-2854-2858-2862-2866-2870-2874-2878-2882-2886-2890-2894-2898-2902-2906-2910-2914-2918-2922-2926-2930-2934-2938-2942-2946-2950-2954-2958-2962-2966-2970-2974-2978-2982-2986-2990-2994-2998-3002-3006-3010-3014-3018-3022-3026-3030-3034-3038-3042-3046-3050-3054-3058-3062-3066-3070-3074-3078-3082-3086-3090-3094-3098-3102-3106-3110-3114-3118-3122-3126-3130-3134-3138-3142-3146-3150-3154-3158-3162-3166-3170-3174-3178-3182-3186-3190-3194-3198-3202-3206-3210-3214-3218-3222-3226-3230-3234-3238-3242-3246-3250-3254-3258-3262-3266-3270-3274-3278-3282-3286-3290-3294-3298-3302-3306-3310-3314-3318-3322-3326-3330-3334-3338-3342-3346-3350-3354-3358-3362-3366-3370-3374-3378-3382-3386-3390-3394-3398-3402-3406-3410-3414-3418-3422-3426-3430-3434-3438-3442-3446-3450-3454-3458-3462-3466-3470-3474-3478-3482-3486-3490-3494-3498-3502-3506-3510-3514-3518-3522-3526-3530-3534-3538-3542-3546-3550-3554-3558-3562-3566-3570-3574-3578-3582-3586-3590-3594-3598-3602-3606-3610-3614-3618-3622-3626-3630-3634-3638-3642-3646-3650-3654-3658-3662-3666-3670-3674-3678-3682-3686-3690-3694-3698-3702-3706-3710-3714-3718-3722-3726-3730-3734-3738-3742-3746-3750-3754-3758-3762-3766-3770-3774-3778-3782-3786-3790-3794-3798-3802-3806-3810-3814-3818-3822-3826-3830-3834-3838-3842-3846-3850-3854-3858-3862-3866-3870-3874-3878-3882-3886-3890-3894-3898-3902-3906-3910-3914-3918-3922-3926-3930-3934-3938-3942-3946-3950-3954-3958-3962-3966-3970-3974-3978-3982-3986-3990-3994-3998-4002-4006-4010-4014-4018-4022-4026-4030-4034-4038-4042-4046-4050-4054-4058-4062-4066-4070-4074-4078-4082-4086-4090-4094-4098-4102-4106-4110-4114-4118-4122-4126-4130-4134-4138-4142-4146-4150-4154-4158-4162-4166-4170-4174-4178-4182-4186-4190-4194-4198-4202-4206-4210-4214-4218-4222-4226-4230-4234-4238-4242-4246-4250-4254-4258-4262-4266-4270-4274-4278-4282-4286-4290-4294-4298-4302-4306-4310-4314-4318-4322-4326-4330-4334-4338-4342-4346-4350-4354-4358-4362-4366-4370-4374-4378-4382-4386-4390-4394-4398-4402-4406-4410-4414-4418-4422-4426-4430-4434-4438-4442-4446-4450-4454-4458-4462-4466-4470-4474-4478-4482-4486-4490-4494-4498-4502-4506-4510-4514-4518-4522-4526-4530-4534-4538-4542-4546-4550-4554-4558-4562-4566-4570-4574-4578-4582-4586-4590-4594-4598-4602-4606-4610-4614-4618-4622-4626-4630-4634-4638-4642-4646-4650-4654-4658-4662-4666-4670-4674-4678-4682-4686-4690-4694-4698-4702-4706-4710-4714-4718-4722-4726-4730-4734-4738-4742-4746-4750-4754-4758-4762-4766-4770-4774-4778-4782-4786-4790-4794-4798-4802-4806-4810-4814-4818-4822-4826-4830-4834-4838-4842-4846-4850-4854-4858-4862-4866-4870-4874-4878-4882-4886-4890-4894-4898-4902-4906-4910-4914-4918-4922-4926-4930-4934-4938-4942-4946-4950-4954-4958-4962-4966-4970-4974-4978-4982-4986-4990-4994-4998-5002-5006-5010-5014-5018-5022-5026-5030-5034-5038-5042-5046-5050-5054-5058-5062-5066-5070-5074-5078-5082-5086-5090-5094-5098-5102-5106-5110-5114-5118-5122-5126-5130-5134-5138-5142-5146-5150-5154-5158-5162-5166-5170-5174-5178-5182-5186-5190-5194-5198-5202-5206-5210-5214-5218-5222



## System Calibration Data Sheet

[illegible]

POLYMER LETTERS EDITION 18, 241 (1980)