



Results of the May 13-15, 2015 MACT Particulate Matter and Sulfur Dioxide Performance Tests at the Empire Iron Mining Partnership Facility Located in Palmer, Michigan

Unit 2 Furnace Waste Gas Stack	EU-UNIT2-FURNACE
Unit 3 Furnace Waste Gas Stack	EU-UNIT3-FURNACE
Unit 4 Furnace Waste Gas Stack	EU-UNIT4-FURNACE

**Renewable Operating Permit: MI-ROP-B1827-2008
Barr Project No. 22/52-1150.00**

Prepared for
Empire Iron Mining Partnership
Palmer, Michigan

July 2015



MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
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RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name Empire Iron Mining Partnership County Marquette

Source Address 101 Empire Mine Road City Palmer

AQD Source ID (SRN) B1827 ROP No. MI-ROP-B1827-2008 ROP Section No. _____

Please check the appropriate box(es):

Annual Compliance Certification (Pursuant to Rule 213(4)(c))

Reporting period (provide inclusive dates): From _____ To _____

1. During the entire reporting period, this source was in compliance with ALL terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, EXCEPT for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))

Reporting period (provide inclusive dates): From _____ To _____

1. During the entire reporting period, ALL monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, EXCEPT for the deviations identified on the enclosed deviation report(s).

Other Report Certification

Reporting period (provide inclusive dates): From _____ To _____

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Test Protocol submittal for stack testing of EU-UNIT 2 Furnace, EU-Unit 3 Furnace and
EU-Unit 4 Furnace

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

<u>James Kochevar</u>	<u>VP & General Manager</u>	<u>(906) 475-3600</u>
Name of Responsible Official (print or type)	Title	Phone Number

<u></u>	<u>7.13.15</u>
Signature of Responsible Official	Date

* Photocopy this form as needed.

Executive Summary

Barr Engineering Company performed tests on Unit 2 furnace waste gas stack (EU-UNIT2-FURNACE), Unit 3 furnace waste gas stack (EU-UNIT3-FURNACE), and Unit 4 furnace waste gas stack (EU-UNIT4-FURNACE) at Empire Iron Mining Partnership facility located in Palmer, Michigan. Tests for particulate matter (PM) and sulfur dioxide (SO₂) emissions were performed on May 13-15, 2015 to demonstrate ongoing compliance with Taconite Maximum Achievable Control Technology (Taconite MACT) requirements found in 40 CFR Part 63 Subpart RRRRR and Renewable Operating Permit No. MI-ROP-B1827-2008.

The Taconite MACT requires measurement of filterable particulate matter (PM) with results expressed in grains per dry standard cubic foot (gr/dscf). The Renewable Operating Permit No. MI-ROP-B1827-2008 requires measurement of PM expressed in pounds per thousand pounds of stack gas (lb/1000 lb gas) and SO₂ emission rate in lb/hr. Test results are provided in the Executive Summary Table.

Table ES-1 Executive Summary Table

Test Parameter EPA Methods 1-6	Unit 2 Furnace Waste Gas Stack	Unit 3 Furnace Waste Gas Stack	Unit 4 Furnace Waste Gas Stack
Source ID	EU-UNIT2-FURNACE	EU-UNIT3-FURNACE	EU-UNIT4-FURNACE
Test Date	May 15, 2015	May 14, 2015	May 13, 2015
Average Filterable Particulate Matter Concentration, gr/dscf	0.0010	0.0024	0.0023
<i>MACT Filterable Particulate Matter Concentration Limit, gr/dscf</i>	<i>0.01</i>	<i>0.01</i>	<i>0.01</i>
Average Filterable Particulate Matter Emission rate, lb/1000 lb gas	0.0019	0.0045	0.0043
<i>Filterable Particulate Matter Permit Emission Limits, lb/1000 lb gas</i>	<i>0.15</i>	<i>0.10</i>	<i>0.10</i>
Average Sulfur Dioxide Emission Rate, lb/hr	14.2	10.3	19.9
<i>Sulfur Dioxide Emission Rate Limits, lb/day¹</i>	<i>19,200</i>	<i>--</i>	<i>--</i>
Ore, tons/hr	240	250	440
Heat Input Rate, MMBTU/hr	123	100	212

¹Sulfur dioxide emissions from Units 2, 3, and 4 including furnaces combined shall not exceed 28,704 lbs/calendar day.

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3.0 Process Description

The Units 2, Unit 3 and Unit 4 pelletizing processes pass green ball pellets through a rotary kiln where they are heated to approximately 2400 degrees Fahrenheit. The heated gases from the kiln are mixed with recouped hot air from the pellet cooler. This air is used to dry the green ball pellets prior to the kiln in the preheat zones. Green ball pellet production rate is measured by scales and recorded. Particulate Matter emissions from each induration process are controlled by a dry electrostatic precipitator prior to venting to atmosphere through the corresponding stack.

During the Unit 2 furnace tests the ore throughput averaged 240 tons/hr and the heat input rate averaged 123 million British thermal units per hour (MMBTU/hr). During the Unit 3 furnace tests the ore throughput averaged 250 tons/hr and the heat input rate averaged 100 MMBTU/hr. During the Unit 4 furnace tests the ore throughput averaged 440 tons/hr and the heat input rate averaged 212 MMBTU/hr. The fuel type for each of the furnaces was 100% natural gas.

All process data is located are Appendix E.

1.0 Introduction

Barr Engineering Co. performed emissions testing at Empire Iron Mining Partnership (Empire) facility located in Palmer, Michigan on May 13-15, 2015. Empire operates under Renewable Operating Permit No. MI-ROP-B1827-2008. Particulate matter (PM) tests were performed on the Unit 2 furnace stack (EU-UNIT2-FURNACE), Unit 3 furnace stack (EU-UNIT3-FURNACE), and Unit 4 furnace stack (EU-UNIT4-FURNACE) to demonstrate ongoing compliance with the Taconite MACT and facility operating permit limits. Sulfur dioxide test were performed at each of the sources to demonstrate compliance with the facility permit limits.

A test protocol was submitted to the Michigan Department of Environmental Quality (MDEQ). A test protocol approval letter from the MDEQ was provided on April 24, 2015. Copies of the test protocol, approval letter and relevant email correspondence are located in Appendix F.

Tim Russell and Gabe Zika of Barr Engineering Co. performed the tests. Tom O'Brien of Empire provided test coordination with facility operations. Portions of the testing on May 13 and 14 were witnessed by a Jeremy Howe of the MDEQ. A list of project participants is provided in Appendix G.

Each test consisted of three two-hour test runs at each source by EPA Method 5. The sample train incorporated EPA Method 6 for the determination of SO₂ emissions.

Process samples corresponding to each test run were collected and analyzed as requested in the approval letter.

Results of the testing are discussed in the following section. Supporting documentation is located in the appendices of the report.

2.0 Results

Results of the particulate matter emissions (PM) and sulfur dioxide performance tests are summarized in the Executive Summary Table.. Sulfur dioxide emission rates are reported in terms of the pollutant permit limit in lb/hr.

The results of the May 15, 2015 Unit 2 furnace waste gas stack are summarized in Table 1. The average PM concentration for the Unit 2 furnace waste gas stack test is 0.0010 gr/dscf. The average PM emission rate is 0.0019 lb/1000 lb gas. The SO₂ emission rate averaged 14.2 lb/hr.

The Unit 3 furnace waste gas stack test results collected on May 14, 2015 are summarized in Table 2. The average PM concentration for the Unit 3 furnace waste gas stack test is 0.0024 gr/dscf. The average PM emission rate is 0.0045 lb/1000 lb gas. The SO₂ emission rate averaged 10.3 lb/hr.

The Unit 4 furnace waste gas stack results collected on May 13, 2015 are presented in Table 3. The average PM concentration for the Unit 4 furnace waste gas stack test is 0.0023 gr/dscf. The average PM emission rate is 0.0043 lb/1000 lb gas. The SO₂ emission rate averaged 19.9 lb/hr. The Unit 4 furnace stack does not meet EPA Method 1 criteria for upstream distance to disturbance from test ports.

There were no other test method exceptions or deviations from the test plan except that stack diameters for Unit 3 and Unit 4 listed in the test protocol were found to be incorrect and diameters measured on site were used for the tests.

Production data collected during the test periods and results of process samples analyzed for sulfur content are provided in Appendix E.

TABLE 1

PARTICULATE MATTER AND SULFUR DIOXIDE EMISSIONS TEST RESULTS

Unit 2 Furnace (EU-Unit2-Furnace)

Parameter	Run 1	Run 2	Run 3	Average
Test Date	5/15/2015	5/15/2015	5/15/2015	---
Test Period	1000 - 1208	1229 - 1434	1450 - 1656	---
Test Duration, min	120	120	120	120
Average Stack Temperature, °F	223	225	225	224
Average Moisture Content, %V/V	9.6	9.7	9.7	9.7
Particulate Loading, g				
PM - Filterable	0.00537	0.00417	0.00457	0.00470
Sulfur Dioxide Lab Results				
SO ₂ , mg	25.90	26.50	26.80	26.40
Air Flow Rate				
acfm	429,000	428,200	428,700	428,600
scfm	318,800	317,200	317,600	317,900
dscfm	288,200	286,500	286,800	287,200
Sample Volume				
acf	73.70	73.97	74.37	74.01
dscf	71.26	70.70	70.63	70.86
Isokinetic Variation, %				
	100.6	100.4	100.2	100.4
Particulate Concentration, gr/dscf				
PM - Filterable	0.0012	0.0009	0.0010	0.0010
Particulate Emission Rates				
PM - Filterable, lb/hr	2.87	2.24	2.46	2.52
PM - Filterable, lb/1000 lb gas	0.0022	0.0017	0.0019	0.0019
Sulfur Dioxide Emission Rate, lb/hr				
	13.9	14.2	14.4	14.2

TABLE 2

PARTICULATE MATTER AND SULFUR DIOXIDE EMISSIONS TEST RESULTS

Unit 3 Furnace (EU-Unit3-Furnace)

Parameter	Run 1	Run 2	Run 3	Average
Test Date	5/14/2015	5/14/2015	5/14/2015	---
Test Period	1115 - 1324	1353 - 1559	1618 - 1823	---
Test Duration, min	120	120	120	120
Average Stack Temperature, °F	240	238	236	238
Average Moisture Content, %V/V	8.8	8.8	8.7	8.8
Particulate Loading, g				
PM - Filterable	0.01009	0.01081	0.01130	0.01073
Sulfur Dioxide Lab Results				
SO ₂ , mg	18.0	18.2	18.4	18.2
Air Flow Rate				
acfm	444,900	442,400	442,500	443,300
scfm	324,800	323,800	324,800	324,500
dscfm	296,300	295,200	296,400	296,000
Sample Volume				
acf	73.20	73.30	73.83	73.44
dscf	70.13	68.93	69.31	69.46
Isokinetic Variation, %				
	102.3	100.9	101.1	101.4
Particulate Concentration, gr/dscf				
PM - Filterable	0.0022	0.0024	0.0025	0.0024
Particulate Emission Rates				
PM - Filterable, lb/hr	5.64	6.12	6.39	6.05
PM - Filterable, lb/1000 lb gas	0.0042	0.0046	0.0048	0.0045
Sulfur Dioxide Emission Rate, lb/hr				
	10.1	10.3	10.4	10.3

TABLE 3

PARTICULATE MATTER AND SULFUR DIOXIDE EMISSIONS TEST RESULTS

Unit 4 Furnace (EU-Unit4-Furnace)

Parameter	Run 1	Run 2	Run 3	Average
Test Date	5/13/2015	5/13/2015	5/13/2015	---
Test Period	1030 - 1240	1315 - 1526	1601 - 1812	---
Test Duration, min	120	120	120	120
Average Stack Temperature, °F	277	275	269	274
Average Moisture Content, %V/V	8.6	8.6	8.9	8.7
Particulate Loading, g				
PM - Filterable	0.01061	0.01052	0.01137	0.01084
Sulfur Dioxide Lab Results				
SO ₂ , mg	20.4	18.5	17.7	18.9
Air Flow Rate				
acfm	931,400	899,600	909,800	913,600
scfm	648,400	628,300	640,300	639,000
dscfm	592,900	574,500	583,100	583,500
Sample Volume				
acf	75.58	75.89	75.10	75.52
dscf	73.89	72.41	73.01	73.10
Isokinetic Variation, %				
	100.9	102.0	101.4	101.4
Particulate Concentration, gr/dscf				
PM - Filterable	0.0022	0.0022	0.0024	0.0023
Particulate Emission Rates				
PM - Filterable, lb/hr	11.3	11.0	12.0	11.4
PM - Filterable, lb/1000 lb gas	0.0042	0.0043	0.0046	0.0043
Sulfur Dioxide Emission Rate, lb/hr				
	21.7	19.4	18.7	19.9

4.0 Stack Testing Procedures and Methods

Testing at Unit 2 and Unit 3 was performed from ports meeting EPA Method 1 criteria. Unit 4 stack does not meet EPA Method 1 criteria for minimum upstream diameters from ports. A 24-point traverse was used at each sample location and sampling was performed from four test ports. Sample port location and traverse point detail are provided in Figures 1-6. Cyclonic flow measurements were taken at each source and are located in Appendix B on the EPA Method 2 Field Data Sheet. The average yaw angle is below the maximum allowable of 20 degrees at each source.

Volumetric airflow determinations were performed in accordance with EPA Method 2 using an S-type pitot tube. Airflows were determined in conjunction with the EPA Method 5/6 tests.

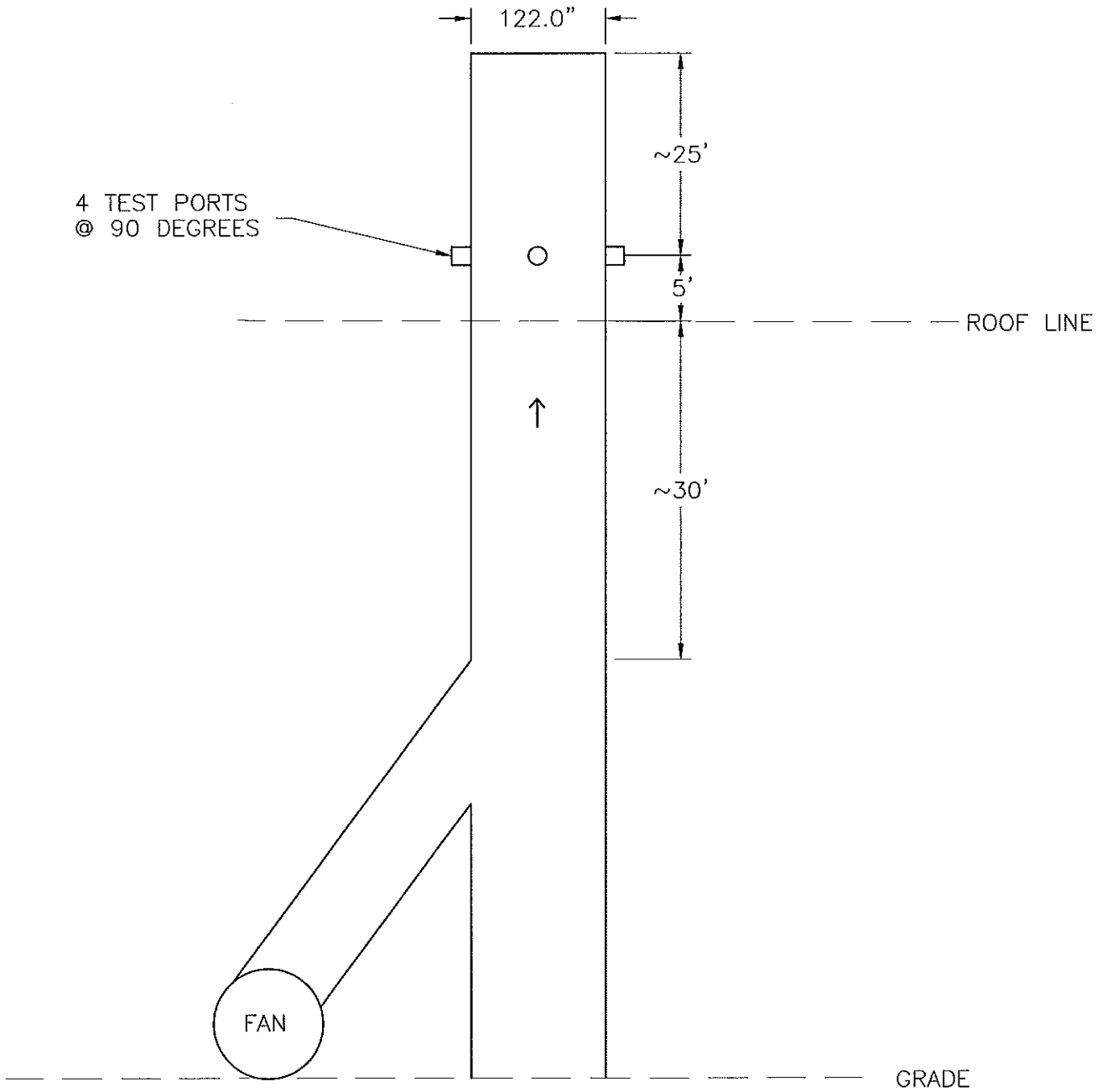
Stack gas compositions of the furnace stacks were determined from integrated gas samples collected in conjunction with the EPA Method 5 test runs. The samples were analyzed using a Fyrite gas analyzer for determination of oxygen and carbon dioxide concentrations. The gas analysis data are located in Appendix B.

Stack gas moisture content was determined by the performance of EPA Method 4, in conjunction with the EPA Method 5/6 performance test.

Filterable particulate matter concentrations and emission rates were determined in accordance with EPA Method 5. The laboratory results for the EPA Method 5 samples were obtained by Barr Engineering Co. The PM sample analytical results and sample chain of custody are located in Appendix C.

Sulfur dioxide emission rates were by incorporating 3% hydrogen peroxide reagent into the back half of the EPA method 5 sample train determined as allowed by EPA Method 6. The 3% hydrogen peroxide reagent was prepared daily in the field prior to use. Samples collected were analyzed by Enthalpy Analytical of Durham, North Carolina. As requested by MDEQ, audit samples were obtained from ERA for each source and provided with the samples to the laboratory. The analytical laboratory report and results of the audit sample analyses are located in Appendix C.

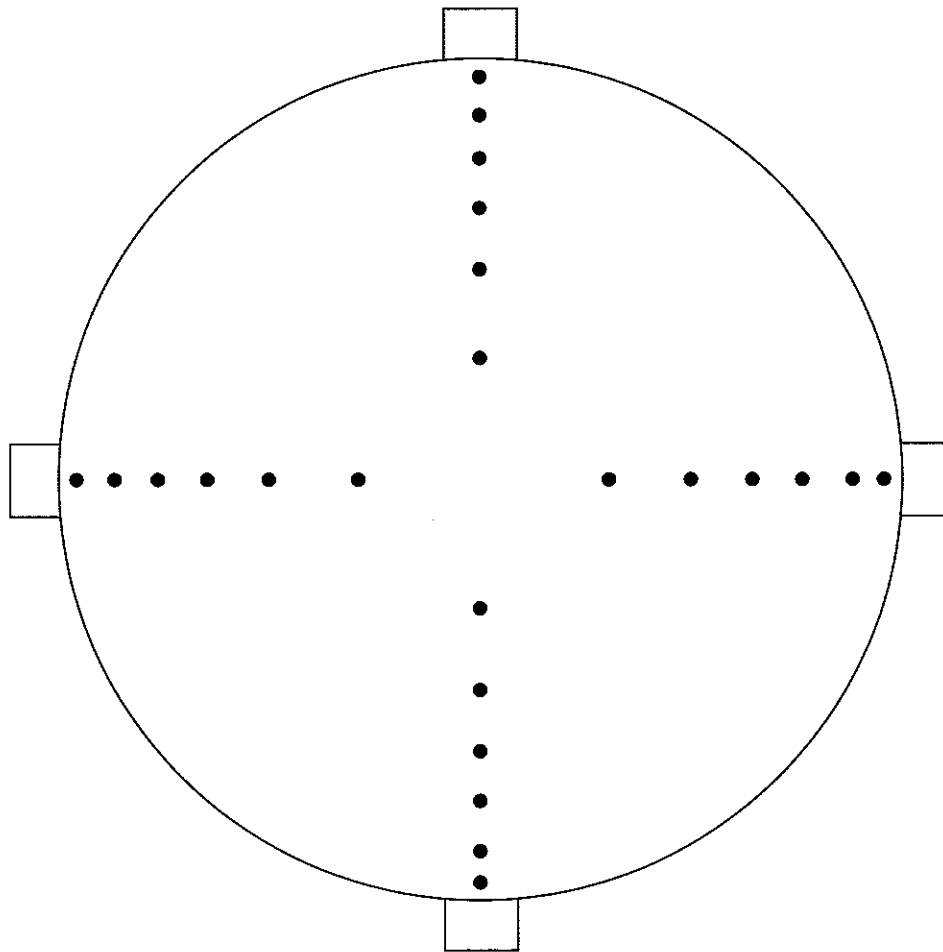
The test methods referenced above are found in 40 CFR Part 60, Appendix A.



TEST PORT LOCATIONS
 EMPIRE IRON MINING PARTNERSHIP
 PALMER, MICHIGAN
 UNIT 2 FURNACE STACK (SV-UNIT2-FURNACE)

NOT TO SCALE

FIGURE 1



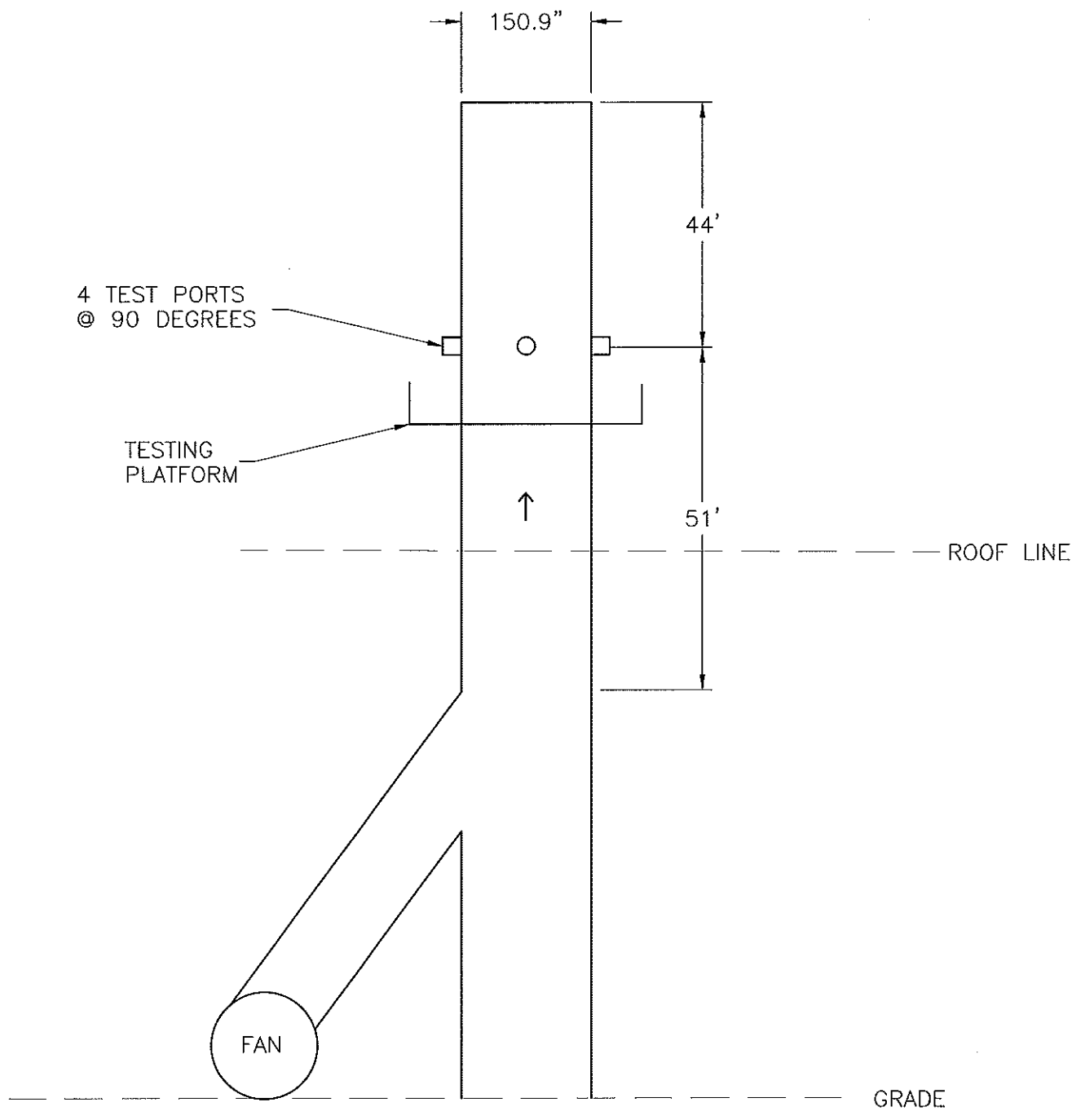
NO. OF TEST PORTS	4
PORT LENGTH	6.25"
PORT DIAMETER	6.0"
NO. OF TRAVERSE POINTS	24
DUCT DIAMETER	122.00"

POINT	INSERTION DEPTH IN "
1	2.60
2	8.17
3	14.41
4	21.62
5	30.50
6	43.39

TRAVERSE POINT LOCATIONS
 EMPIRE IRON MINING PARTNERSHIP
 PALMER, MICHIGAN
 UNIT 2 FURNACE STACK (SV-UNIT2-FURNACE)

NOT TO SCALE

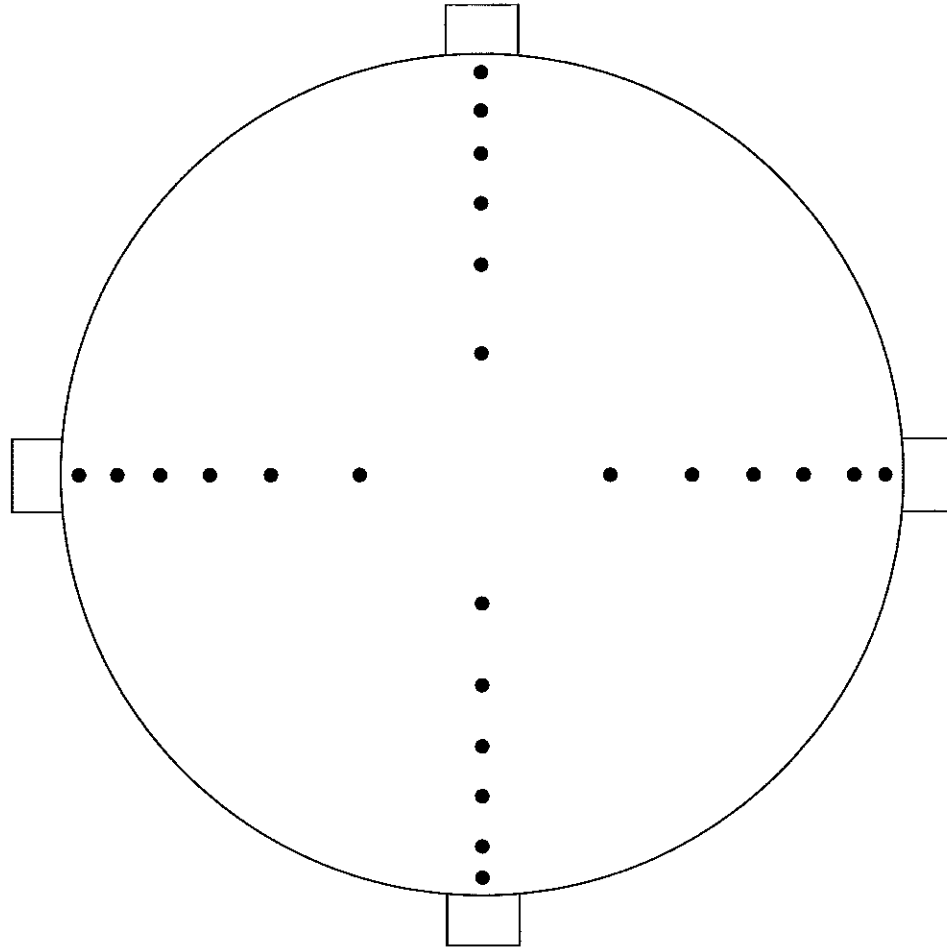
FIGURE 2



TEST PORT LOCATIONS
 EMPIRE IRON MINING PARTNERSHIP
 PALMER, MICHIGAN
 UNIT 3 FURNACE STACK (SV-UNIT3-FURNACE)

NOT TO SCALE

FIGURE 3



NO. OF TEST PORTS	4
PORT LENGTH	9.0"
PORT DIAMETER	6.0"
NO. OF TRAVERSE POINTS	24
DUCT DIAMETER	150.9"

POINT	INSERTION DEPTH IN "
1	3.21
2	10.11
3	17.82
4	26.75
5	37.73
6	53.67

TRAVERSE POINT LOCATIONS
 EMPIRE IRON MINING PARTNERSHIP
 PALMER, MICHIGAN
 UNIT 3 FURNACE STACK (SV-UNIT3-FURNACE)

NOT TO SCALE

FIGURE 4