IMPACT COMPLIANCE & TESTING

AIR EMISSION TEST REPORT

Report Title:	Test Report for the Verification of Air Pollutant Emissions from Hot Mix Asphalt Manufacturing Processes
Test Date(s):	September 9-10, 2020
Report Date:	October 14, 2020

Facility Information	
Name:	Michigan Paving & Materials
Street Address:	1100 Market Avenue
City, County:	Grand Rapids, Kent
SRN:	N6309

Facility Permit Information	
Permit No.:	66-84F
Emission Unit:	EUHMAPLANT
EGLE District Office	Grand Rapids

Testing Contractor	
Company:	Impact Compliance & Testing, Inc.
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Project No.:	2000136

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

IMPACT COMPLIANCE & TESTING

TEST REPORT FOR THE VERIFICATION OF
AIR POLLUTANT EMISSIONS FROM HOT MIX ASPHALT MANUFACTURING PROCESSES

MICHIGAN PAVING & MATERIALS
GRAND RAPIDS, MICHIGAN

Test Date(s): September 9-10, 2020

1.0 INTRODUCTION

Michigan Paving & Materials (MI Paving) has been issued Permit to Install (PTI) No. 66-84F by the State of Michigan Department of Environment, Great Lakes, and Energy-Air Quality Division (EGLE-AQD), for the operation of its hot mix asphalt (HMA) manufacturing processes located in Grand Rapids, Kent County, Michigan (State Registration No. (SRN) N6309).

The testing and sampling conditions of PTI No. 66-84F specify that:

- *AQD Verification and quantification of emission rates of PM, NOx, CO, and SO2 from EUHMAPLANT, by testing at owner's expense, in accordance with Department requirements, will be required for continued operation. Within 60 days after the notification required in SC V.4 of this PTI, a complete test plan shall be submitted to the AQD. The final plan must be approved by the AQD prior to testing. Verification of emission rates includes the submittal of a complete report of the test results within one calendar year after the notification required in SC's I.2, I.3, I.4 and I.7 of this PTI.*

- *Within 60 days after achieving the maximum production rate, but not later than 180 days after commencement of trial (initial) operation, the permittee shall verify particulate emission rates from EUHMAPLANT, as required by federal Standards of Performance for New Stationary Sources, by testing at owner's expense, in accordance with 40 CFR Part 60 Subparts A and I.... No less than 60 days prior to testing, the permittee shall submit a complete test plan to the AQD Technical Programs Unit and District Office. The AQD must approve the final plan prior to testing. The permittee must submit a complete report of the test results to the AQD Technical Programs Unit and District Office within 90 days following the last date of the test.*

Air emission testing was performed September 9-10, 2020 by Impact Compliance & Testing, Inc. (ICT) personnel Clay Gaffey, Andrew Eisenberg, Jake Spry, and Blake Beddow. EGLE-AQD representatives, Ms. Lindsey Wells and Mr. Adam Schaffer, were on-site to observe portions of the compliance test event.

A Stack Test Protocol was submitted to EGLE-AQD prior to the testing project, and a Test Plan Approval Letter was issued by EGLE-AQD. The following items provide information required in EGLE-AQD *Format for Submittal of Source Emission Test Plans and Reports*, dated November 2019.

Appendix A provides a copy of the EGLE-AQD Test Plan Approval Letter.

Questions concerning this emission report should be directed to:

Testing Procedures	Andrew Eisenberg Environmental Consultant Impact Compliance & Testing, Inc. 37660 Hills Tech Drive Farmington Hills, MI 48331 Andrew.Eisenberg@ImpactCandT.com (734) 464-3880
Site Operations	Ms. Susanne Hanf, P.E. Environmental Engineer Michigan Paving & Materials 7555 Whiteford Road Ottawa Lake, MI 49267 (734) 854-2265 SHanf@mipmc.com

This Test Report was prepared by ICT based on the field sampling data collected by ICT. Certain analyses were contracted to and performed by third parties and the results are presented in this Test Report and its appendices. Facility process data was collected and provided by MI Paving employees or representatives.

Report Prepared By:

Andrew Eisenberg
Environmental Consultant

Reviewed By:

Tyler J. Wilson
Senior Project Manager

Responsible Official Certification

This Test Report has been reviewed by MI Paving representatives and is approved for submittal to EGLE-AQD.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this Test Report are true, accurate and complete.

Susanne Hanf, P.E.
Environmental Engineer
Michigan Paving & Materials

2.0 SUMMARY OF TEST RESULTS

The exhaust gases from the HMA baghouse stack (emission unit EUHMAPLANT) were sampled and analyzed to determine the concentration of carbon monoxide (CO), nitrogen oxides (NO_X), sulfur dioxide (SO_2), and filterable particulate matter (PM) content and emission rates using USEPA Methods 10, 7E, 8, and 5, respectively. Exhaust gas opacity observations were performed on the emission unit exhaust (EUHMAPLANT) using USEPA Method 9.

The air pollutant emission test data were converted to units necessary for comparison to the allowable emission limits specified in PTI No. 66-84F.

Table 2.1 presents a summary of measured air pollutant emission rates and visual emission opacity readings for the process.

Test results for each one-hour sampling period are presented at the end of this Test Report in Section 6.0 and Tables 6.1 and 6.2.

Table 2.1 Summary of measured air pollutant emission rates and exhaust plume opacity for EUHMAPLANT

Emission Unit	CO (lb/ton)	NOx (lb/ton)	PM (gr/dscf)	PM (lb/ton)	SO_2 (lb/ton)	6-Min. Avg. Opacity (%)
EUHMAPLANT	0.148	0.03	1.19	0.76	0.00001	0
Permit Limit	*0.201*	*0.12*	*0.04*	*0.04*	*0.14*	*20*

3.0 SOURCE DESCRIPTION

3.1 General Process Description and Type of Raw and Finished Materials

The process produces HMA material by combining aggregate and liquid asphalt cement in a horizontal, rotating counter-flow drum. Aggregate is introduced into the drum at the burner end and moves towards the opposite end of the drum in parallel with the hot gases of combustion. Liquid asphalt cement is introduced into the mixing zone of the drum (located behind the burner flame zone) and the finished HMA material is discharged from the drum and conveyed to storage/loadout silos. The exhaust gases exit the drum and are directed to the baghouse particulate control system.

The HMA process combines aggregate with a liquid asphalt cement mixture using a counter-flow, direct-fired rotary drum. The drum is permitted to be fired by various fuels including natural gas, propane, distillate oil, residual oil, blended fuel oil, and recycled used oil. During compliance testing, the drum was fired by natural gas for three (3) one-hour tests.

The counter-flow dryer/mixer has a maximum design production rating of 650 tons per hour (tph). The typical operation of the plant ranges from 300-600 tph, with an average day running approximately 450 tph.

3.2 Emission Control System Description

Exhaust gas from the dryer/mixer is directed to a particulate matter emission control system consisting of a primary collector and baghouse. The baghouse filter media is periodically cleaned using reverse air pulses.

The filtered process air from the baghouse is exhausted through a vertical stack to the atmosphere (SVHMAPLANT).

3.3 Operating Variables

A Test Plan Approval Letter dated August 26, 2020 requested that MI Paving monitor and record the following process operational data during each test period:

- Natural gas firing rate;
- Liquid asphalt (asphalt cement) usage rate;
- Virgin aggregate feed rate;
- Recycled asphalt product (RAP) feed rate;
- Hot mix asphalt (HMA) production rate (tph);
- Average percent of RAP per ton of HMA produced;
- Baghouse pressure drop;
- Drum mix temperature; and
- Drum exhaust temperature.

Appendix B provides process and control device operating records for the test periods.

3.4 Sampling Location

Filtered exhaust gas is discharged to the ambient air through a rectangular 47-inch by 96-inch exhaust stack (EUHMAPLANT). Four (4) sample ports were installed that were >40 ft. (480 in.) downstream and >37 ft. (444 in.) upstream from the nearest flow disturbance. Exhaust gas was sampled from three (3) points across each port for a total of 12 sampling points.

Appendix C provides a drawing of the exhaust stack sampling location.

4.0 SUMMARY OF USEPA TEST METHODS

The following USEPA reference test methods and sampling trains were used to perform the emission compliance testing.

4.1 Exhaust Gas Flowrate and Air Pollutant Emissions Sampling Methods

USEPA Method 1	Velocity and sampling locations were selected based on physical stack measurements in accordance with USEPA Method 1.
USEPA Method 2	Exhaust gas velocity pressure and temperature using a Type-S Pitot tube connected to a red oil incline manometer and K-type thermocouple.
USEPA Method 3A	Exhaust gas O_2 and CO_2 content was determined using paramagnetic and infrared instrumental analyzers, respectively.
USEPA Method 4	Exhaust gas moisture determined using the chilled impinger method (as part of the particulate sampling train).
USEPA Method 5	Filterable PM was determined using isokinetic sampling procedures and analysis of the front half of the particulate matter sampling train (filter and acetone rinse).
USEPA Method 7E	Exhaust gas NOx concentration was determined using a chemiluminescence instrumental analyzer.
USEPA Method 8	SO_2 was determined using isokinetic sampling procedures and analysis of sampling train catch.
USEPA Method 9	Exhaust gas opacity during each sampling period was determined by a certified observer of visible emissions.
USEPA Method 10	Exhaust gas CO concentration was measured using a NDIR instrumental analyzer.

In addition to the sampling and analytical methods presented in the preceding text, USEPA Method 205; *Verification of Dilution Systems for Field Instrument Calibrations,* was used to verify linearity of the calibration gas dilution system.

5.0 DETAILED SAMPLING AND ANALYTICAL PROCEDURES

Testing was performed to verify CO, NOx, SO_2, and filterable PM emission rates and opacity from the hot mix asphalt mix/dryer drum. The exhaust gas existing the baghouse was sampled for three (3) one-hour test periods using the USEPA sampling methods

specified in section 4.1 of this Test Report. CO, NOx, SO_2, and filterable PM emissions were determined analytically (CO and NOx) or based on the amount of catch in the sample train (SO_2 and filterable PM) and the measured exhaust gas volumetric flowrate.

5.1 Velocity traverse locations & stack gas velocity measurements (USEPA Methods 1&2)

The representative sample locations were determined in accordance with USEPA Method 1 based on the measured distance to upstream and downstream disturbances. The absence of significant cyclonic flow was determined at the sampling location.

Exhaust gas velocity was measured using USEPA Method 2 throughout each test period as part of the isokinetic sampling procedures. Velocity pressure measurements were performed at each stack traverse point using an S-type Pitot tube and red-oil manometer. Temperature measurements were performed at each traverse point using a K-type thermocouple and a calibrated digital thermometer.

Prior to performing the initial velocity traverse, the S-type Pitot tube and manometer lines were leak-checked at the test site. These checks were made by blowing into the impact opening of the Pitot tube until 3 or more inches of water were recorded on the manometer, then capping the impact opening and holding it closed for 15 seconds to ensure that it was leak free. The static pressure side of the Pitot tube was leak-checked using the same procedure.

5.2 Measurement of carbon dioxide and oxygen content (USEPA Method 3A)

CO_2 and O_2 content in the exhaust gas stream was measured continuously throughout each test period in accordance with USEPA Method 3A. The exhaust gas CO_2 content was monitored using a Servomex 4900 infrared gas analyzer. The exhaust gas O_2 content was monitored using a paramagnetic sensor within the Servomex 4900 gas analyzer.

During each sampling period, a continuous sample of the exhaust gas stream was extracted from the stack using a stainless-steel probe connected to a Teflon® heated sample line. The sampled gas was conditioned by removing moisture prior to being introduced to the analyzers; therefore, measurement of O_2 and CO_2 concentrations correspond to standard dry gas conditions. Instrument response data were recorded using an ESC Model 8816 data acquisition system that monitored the analog output of the instrumental analyzers continuously and logged data as one-minute averages.

Prior to, and at the conclusion of each test, the instruments were calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.9 of this document). Sampling times were recorded on field data sheets.

5.3 Determination of moisture content via isokinetic sampling (USEPA Method 4)

Moisture content was measured concurrently with the particulate matter sampling trains and determined in accordance with USEPA Method 4. Moisture from the gas sample was removed by the chilled impingers of the isokinetic sampling train. The net moisture gain from the gas sample was determined by either volumetric or gravimetric analytical techniques in the field. Percent moisture was calculated based on the measured net gain from the impingers and the metered gas sample volume of dry air.

5.4 Determination of PM emissions via isokinetic sampling (USEPA Method 5)

A USEPA Method 5 sample train was used to measure filterable PM. Exhaust gas from the baghouse was drawn at an isokinetic rate through a properly sized borosilicate glass sampling nozzle, heated probe with borosilicate glass liner connected to the nozzle via Silonite-coated union, and heated glass fiber particulate filter. Following the particulate filter, moisture was removed from the sample gas using chilled impingers and sample gas rate was measured using a calibrated dry gas meter.

At the end of each test period the PM collected in the front half of the sampling train (from the sampling nozzle to the heated filter) was recovered in accordance with the triple rinse and brush procedures specified in USEPA Method 5. The impinger solutions were weighed gravimetrically for moisture content determination.

The laboratory particulate matter analyses were conducted by a qualified third-party laboratory according to the appropriate QA/QC procedures specified in USEPA Method 5 and are included in the final laboratory report provided by Enthalpy Analytical (Durham, North Carolina).

Diluent gas content (Method 3A O_2 and CO_2) measurements was performed with each of the PM sampling periods.

Appendix D provides a Method 5/8 sampling train diagram.

Appendix G provides a copy of the final laboratory analytical report.

5.5 Measurement of NOx and CO by instrumental analyzers (USEPA Methods 7E&10)

NOx and CO pollutant concentrations in the HMA exhaust gas stream was determined using a Thermo Environmental Instruments, Inc. (TEI) Model 42c High Level chemiluminescence NO-NO_2-NOx analyzer and a California Analytics / Fuji Model ZRF CO analyzer that utilizes non-dispersive infrared (NDIR) technology, respectively.

Throughout each test period, a continuous sample of the HMA exhaust gas was extracted from the stack using the Teflon® heated sample line and gas conditioning system and delivered to the instrumental analyzers. Instrument response for each analyzer was recorded on an ESC

Model 8816 data acquisition system that logged data as one-minute averages. Prior to, and at the conclusion of each test, the instruments were calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias.

Appendix E provides NOx and CO calculation sheets. Raw instrument response data are provided in Appendix I. Appendix D provides a Method 7E/10 sampling train diagram.

5.6 Determination of sulfur dioxide content via isokinetic sampling (USEPA Method 8)

USEPA Method 8 procedures were used to determine the sulfur dioxide content of the exhaust gas stream. The Method 8 sampling train consisted of:

1. Standard Greenburg-Smith (GS) impinger containing 100 ml 80% isopropanol;
2. Modified GS impinger containing 100 ml 3% H_2O_2;
3. Standard GS impinger containing 100 ml 3% H_2O_2; and
4. Modified GS impinger containing silica gel.

The Method 8 sampling train was connected to the Method 5 sampling train and was also used to determine moisture content of the exhaust gas. A borosilicate glass sampling nozzle and probe liner with a silonite-coated union were used to perform the isokinetic sampling.

Appendix D provides a Method 5/8 sampling train diagram.

Appendix G provides a copy of the final laboratory analytical report.

5.7 Visual determination of opacity (USEPA Method 9)

USEPA Method 9 procedures were used to evaluate the opacity of the exhaust gas during each 60-minute test period. In accordance with USEPA Method 9, the qualified observer stood at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to his back. As much as possible, the line of vision was approximately perpendicular to the plume direction.

Opacity observations were made at the point of greatest opacity in the portion of the plume where condensed water vapor was not present. Observations were made at 15-second intervals for the duration of the 60-minute testing period.

All visible emissions determinations were performed by a qualified observer in accordance with USEPA Method 9, Section 3.

5.8 Number and length of sampling runs

The emission performance tests consisted of three (3), one-hour sampling periods for CO, NOx, SO_2, PM, and VE concentration measurements. Exhaust gas flowrate measurements were performed at each point during isokinetic sampling.

5.9 Quality assurance/quality control procedures

Appendix E provides sampling equipment quality assurance and calibration data. A summary of these procedures is provided in this section.

5.9.1 Flow measurement equipment

Prior to arriving onsite, the instruments used during the source test to measure exhaust gas properties and velocity (barometer, pyrometer, scale, and Pitot tube) were calibrated to specifications outlined in the sampling methods.

5.9.2 Isokinetic sampling for PM & SO_2

The dry gas meter sampling console was calibrated prior to and after the testing program using the critical orifice calibration technique presented in USEPA Method 5. The metering console calibration exhibited no data outside the acceptable ranges required by USEPA Method 5. The digital pyrometer in the metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

The sampling nozzle diameter was determined using the three-point calibration technique.

5.9.3 PM & SO_2 analyses

All recovered PM and SO_2 samples were stored and shipped in glass sample bottles with Teflon® lined caps. The liquid level on each bottle was marked with permanent marker and the caps were secured closed with tape. Samples of the reagents used in the test project (approximately 200 milliliters of acetone) were sent to the laboratory for analysis to verify that the reagents used to recover the samples have low particulate matter residue values.

5.9.4 Sampling system response time determination

The response time of the sampling system was determined prior to the commencement of the performance tests by introducing upscale gas and zero gas, in series, into the sampling system using a tee connection at the base of the sample probe. The elapsed time for the analyzer to display a reading of 95% of the expected concentration was determined using a stopwatch. Each test period began once the instrument sampling probe has been in place for at least twice the greatest system response time.

5.9.5 Gas divider certification (USEPA Method 205)

A STEC Model SGD-710C 10-step gas divider was used to obtain appropriate calibration span gases. The ten-step STEC gas divider was NIST certified (within the last 12 months) with a primary flow standard in accordance with Method 205. When cut with an appropriate zero gas, the ten-step STEC gas divider delivers calibration gas values ranging from 0% to 100% (in 10% step increments) of the USEPA Protocol 1 calibration gas introduced into the system. The field evaluation procedures presented in Section 3.2 of Method 205 were followed prior to use of gas divider. The field evaluation yielded no errors greater than 2% of the triplicate measured average and no errors greater than 2% from the expected values.

5.9.6 Instrumental analyzer interference check

The instrumental analyzers used to measure NO_X, CO, O_2, and CO_2 have had an interference response test preformed prior to their use in the field, pursuant to the interference response test procedures specified in USEPA Method 7E. The appropriate interference test gases (i.e., gases that would be encountered in the exhaust gas stream) were introduced into each analyzer, separately and as a mixture with the analyte that each analyzer is designed to measure. All of analyzers exhibited a composite deviation of less than 2.5% of the span for all measured interferent gases. No major analytical components of the analyzers have been replaced since performing the original interference tests.

5.9.7 Instrument calibration and system bias checks

At the beginning of each day of the testing program, initial three-point instrument calibrations were performed for the NO_X, CO, CO_2, and O_2 analyzers by injecting calibration gas directly into the inlet sample port for each instrument. System bias checks were performed prior to and at the conclusion of each sampling period by introducing an appropriate upscale calibration gas and zero gas into the sampling system (at the base of the stainless steel sampling probe prior to the particulate filter and Teflon® heated sample line) and verifying the instrument response against the initial instrument calibration readings.

The instruments were calibrated with USEPA Protocol 1 certified concentrations of CO_2, O_2, NO_X, and CO in nitrogen and zeroed using nitrogen. A STEC Model SGD-710C 10-step gas divider were used to obtain intermediate calibration gas concentrations as needed.

5.9.8 Determination of exhaust gas stratification

A stratification test was performed for the HMA process exhaust stack. The stainless-steel sample probe was positioned at sample points correlating to 16.7, 50.0 (centroid), and 83.3% of the stack diameter. Pollutant concentration data were recorded at each sample point for a minimum of twice the maximum system response time.

The recorded concentration data for the exhaust stack indicates that the measured NO_X concentrations did not vary by more than 5% of the mean across the stack diameter. Therefore, the exhaust gas was considered to be unstratified.

Although the exhaust gas was considered to be unstratified, the test crew still positioned the stainless-steel analyzer sample probe at three (3) sample points, correlating to 16.7, 50.0 (centroid), and 83.3% of the stack diameter, throughout each test period.

6.0 TEST RESULTS AND DISCUSSION

6.1 Air pollutant emission test results and allowable emission limits

HMA operating data and NOx, CO, SO_2, and PM emission measurement results for each one-hour test period are presented in Tables 6.1.

Table 6.2 presents the opacity (VE) reading test results for the three (3) sampling periods.

The measured NOx, CO, and SO_2 concentrations and emission rates, and VE readings are less than the allowable limits specified in PTI No. 66-84F.

The measured PM concentrations and emission rates are greater than the allowable limits specified in PTI No. 66-84F.

6.2 Operating conditions during compliance tests

Testing was performed while the process operated at maximum routine operating conditions. MI Paving representatives provided production data at 15-minute intervals for each test period. The average recorded Asphalt production rate was 349 tons per hour (TPH) for the three (3) test periods.

Additionally, MI Paving operators recorded aggregate processed (TPH), RAP processed (TPH), asphalt cement processed (TPH), total HMA produced (TPH), fuel type and usage rate (MCF), HMA discharge temperature (°F), baghouse inlet temperature (°F) and pressure drop (in. H_2O), frequency of filter fabric cleaning cycle, damper position (% open), and burner position (% open).

Appendix B provides operating data collected during the compliance tests.

6.3 Variations from normal sampling procedures or operating conditions

The testing was performed as described in the approved Stack Test Protocol and reference test methods. During the test periods, the process was operated at normal routine operating conditions, at or near maximum achievable capacity, and satisfied the parameters specified in the Test Plan Approval Letter. The test event was witnessed by Ms. Lindsey Wells and Mr. Adam Schaffer of the EGLE-AQD.

Each one-hour test was paused for a few minutes to move the probe/sampling train from one sampling port to the next.

As with most HMA production facilities, a significant steam plume was present at the exhaust point. The certified VE reader performed the opacity observations downwind of the steam plume at the point where there was no longer visible water vapor.

Due to adverse weather conditions for accurate VE opacity observations, a VE test was not performed during analyzer and isokinetic Test No. 1. VE Test No. 1 was performed during analyzer and isokinetic Test No. 2, VE test No. 2 was performed during analyzer and isokinetic Test No. 3, and VE Test No. 3 was performed directly following analyzer and isokinetic Test No. 3 / VE Test No. 2. This procedure was discussed with and approved by EGLE-AQD personnel onsite. MI Paving operated the HMA process the same (and verified that the HMA production rate was the same) for VE Test No. 2 and VE Test No. 3.