November 13, 2015

Todd Zynda, P.E.
Environmental Engineer, Air Quality Division
Department of Environmental Quality
3058 West Grand Boulevard, Suite 2-300
Detroit, Michigan 48202-6058

Dear Mr. Zynda:

McLaren Performance Technologies received a violation notice dated October 28, 2015 relative to MI-ROP-A8217-2012. Specifically, EU-TestCell10 was noted as failing to provide notification of operational commencement and to conduct verified CO emissions rates from Test Cell 10. McLaren Performance Technologies acknowledges this oversight and has initiated the following corrective actions to address the error:

1. McLaren has retained GHD Services, Inc. to generate the required test plan and to perform the testing for PTI 67-05B. A copy of the proposed test plan can be found attached to this letter, for your review and comment. McLaren's intent is to conduct this testing immediately upon receiving positive feedback from DEQ.

2. McLaren has initiated an internal 8D / Corrective Action document to determine root cause for the oversight in reporting. A new management structure has been instituted since this violation occurred, and the issue will be tracked during the management review sessions at McLaren.

We thank you for your time and look forward to your feedback relative to our corrective action test plan.

Best Regards,

Andrew Toton
Development Manager

Cc – A. Bosscher, B. Schaumburger, S. Maxwell

Emission Test Plan ECU-TESTCELL 10

McLaren Performance Technologies
Livonia, Michigan

2055 Niagara Falls Boulevard Niagara Falls New York 14304 USA

11110233 | Report No 1 | November 2015

Table of Contents

Figure Index

Table Index

1. Introduction

1.1 Project Overview

GHD Services, Inc. (GHD) was retained by McLaren Performance Technologies (McLaren) to perform a stack emission test program at their test cell facility located in Livonia, Michigan. GHD has prepared this test protocol for submission to McLaren, and the Michigan Department of Environmental Quality (MDEQ). The objective of this test program is to determine the emissions of CO from the exhaust of emission unit ECU-TESTCELL10 as a requirement of the facility's permit to install number 67-05B.

GHD understands that qualified, experienced, and professional consulting services are very important to the successful implementation of any project. All of GHD's senior source test field staff are qualified source test individuals (QSTI). GHD is an accredited Air Emissions Testing Body (AETB) by the Source Testing Accreditation Council (STAC) as documented by AETB Certificate # 3826.01, which is available upon request.

McLaren is proposing a test date of mid-January. McLaren is flexible on the actual test date based on the approval of this test plan.

1.2 Project Organization

The primary contacts for this project are as follows:

McLaren Project Manager:
Mr. Andrew Bosscher
32233 West Eight Mile Road
Livonia, MI 48152
Phone: (248) 473-3227

GHD Project Manager:
Mr. Steven Culmo
GHD Services Inc.
2055 Niagara Falls Boulevard
Niagara Falls, NY 14304
Phone: (716) 297-6150

1.3 Source Description

McLaren conducts research and development tests of internal combustion engines. Engines are mounted on dynamic transient test stands utilizing various types of fuels with the purpose of evaluating performance and durability as well as providing emission certification tests on engines and engine components. Depending on the purpose of the test program and type of engine, a variety of test cycles are used. The engines can be tested with and without after treatment systems.

1.4 Certification

We certify that to the best of our knowledge, the state and federal regulations, operating permits, or plan approvals applicable to each source or control device to be tested have been reviewed and that all testing requirements therein have been incorporated into the test plan.

Steven Culmo, QSTI

GHD Services Inc.

Andrew Bosscher, Project Manager

McLaren Performance Technologies

2. Pollution Control Equipment

Each test cell has two exhaust pipes associated with it. Located inside each exhaust pipe is a catalytic converter. These converters contain a catalyst consisting of a metallic substrate. The optimum substrate bed temperature range is 500 degrees C to 650 degrees C in order for proper emissions control. The two exhaust pipes are manifolded together and exhaust to atmosphere through a single exhaust stack.

3. Permit Number and Emission Limits

McLaren's Permit to Install (PTI) number 67-05B states the emission limits of CO and they are as follows:

- 709.2 lb/day Daily
- 16 tpy 12-month rolling time period as determined at the end of each calendar month

Emissions of carbon monoxide will be expressed in the report as lb/hr, for McLaren's use in emissions calculations.

4. Pollutants to be Measured

The pollutant of interest for this test program will be Carbon Monoxide. Number 10 engine test cell with a 350-400 horsepower engine running on 93 octane gasoline will be utilized for this test program.

5. Sampling and Analysis Procedures

This test program will be conducted in accordance with the reference methods (RMs) described in the United States Code of Federal Regulations, Title 40 Part 60 (40 CFR 60) Appendix A. These versions of the reference methods are obtained from the United States Environmental Protection Agency (USEPA) Emission Measurement Center (EMC) website (www.epa.gov/ttn/emc).

5.1 Stack Gas Velocity and Volumetric Flow Rate (RM 2)

According to RM 2, the gas velocity in a stack is determined from the average velocity head with an "S" type pitot tube, gas density, stack temperature, and stack pressure. The average velocity head is determined using an inclined manometer and a standard type pitot tube with a known coefficient of 0.84 that is determined geometrically by standards set forth in RM 2. Stack temperature is taken at each traverse point using a type-K thermocouple. Static pressure is determined using a straight tap and an inclined manometer. For this test program a flow will be performed before and after each run for a total of 4 determinations.

5.2 Gas Analysis for CO_2 and O_2 (RM 3)

Gas samples will be collected according to RM 3 to determine the CO_2 fraction, O_2 fraction and dry molecular weight of the gas stream. Single-point grab samples will be drawn with a squeeze bulb once for each test. Samples will be analyzed for CO_2 and O_2 with a Fyrite gas analyzer. The results will entered directly onto the field data sheets and included in in the final report.

5.3 Moisture Determination (RM 4)

The moisture of the gas stream at the outlet will be measured using a RM 4 type train. The sample probe will be placed at the centroid of the stack and left at one sample point for the duration of the test. Three, 35-minute sample runs will be performed.

5.4 Carbon Monoxide (RM 10)

CO concentrations will be measured utilizing RM 10. Analysis will be performed on a TECO Model 48 series Gas Filter Correlation, Non-dispersive Infrared Analyzer (GFC-NDIR) or equivalent. The GFC eliminates the interferences from moisture or CO_2. The operational range will be determined on set-up day. CO analysis will be continuous with one-minute average concentrations recorded on a DAS. Three, 60-minute test runs will be performed.

6. Sampling Parameters

Table 6.1 Parameter Summary

Parameter	Reference Method	Number of Runs	Duration Minutes	Comments
Flow	RM 1 & 2	4	N/A	Pre/post for each run
Molecular Weight	M 3	3	N/A	Fyrite Analysis once per Run
Moisture	RM 4	3	35 min	Modified[1]
Carbon Monoxide	RM 10	3	1 hour	

[1]Will be sampled utilizing a single point at the centroid of the stack.

6.1 Anticipated Schedule

At this time it is expected to perform the testing Mid-January, 2016 anticipating the following schedule:

- Day 1 arrive on site, set up all equipment, and perform all QA including leak checks
- Day 2 perform all testing and demobilize from site

6.2 Services Provided by the Facility

McLaren will be responsible for:

- Operation of the equipment under test
- Recording of pertinent operating information and subsequent data reduction if necessary
- Sample ports as per 40 CFR 60.8
- Safe and adequate access to the ports
- Utilities, as required
- Providing production data
- Four, 115 VAC, 20 amp circuits within 50 feet of the sampling sites

7. Test Site Description and Sampling Port Location

7.1 ECU-TEST CELL 10 Outlet

ECU-TESTCELL 10 outlet stack is a round stack, with an internal diameter of 12 inches. The sampling ports will be located at 90 degrees relative to each other. Sample ports are not currently installed. GHD will work with McLaren on the proper location and installation of the sampling ports. The number of traverse points based on the upstream and downstream disturbance measurements will be determined on setup day.

8. Flue Gas Conditions

The estimated flue gas conditions for this test program will wary depending on the engine selected. All conditions such as temperature, moisture, and velocity will be recorded and included in the final report.

9. Operating Conditions

For this test program McLaren will run the engine in ECU-TESTCELL 10 following a modified over-the-road test protocol. This program represents an aggressive engine test that makes up a large portion of their testing activities.

10. Process and Control Equipment Data

10.1 Process Data

Each test cell has a data acquisition system associated with it. This data acquisition records various operation conditions and based on customer request, parameters can be added or reduced. The following is an example of the various conditions recorded:

Inlet air temperature	B.M.E.P.	Battery Voltage	Coolant Pressure
Corrected Power	Corrected Torque	Correction Factor	Engine hours
Engine Speed	Fuel Pressure	Fuel Flow	Ignition Voltage
LH Air / Fuel Ratio	LH Exhaust Back Pressure	LH Exhaust Temperature	Manifold Vacuum
Observed B.S.F.C.	Observed Power	Observed Torque	Oil Pressure
Oil Sump Temperature	RH Air / Fuel Ratio	RH Exhaust Back Pressure	RH Exhaust Temperature
Time of day	Water Temperature In	Water Temperature Out	Blow-By
Coolant Flow	Crankcase Pressure	Oil Temperature In	Oil Temperature Out
Cylinder 1 Exhaust Temperature	Cylinder 2 Exhaust Temperature	Cylinder 3 Exhaust Temperature	Cylinder 4 Exhaust Temperature
Cylinder 5 Exhaust Temperature	Cylinder 6 Exhaust Temperature	Cylinder 7 Exhaust Temperature	Cylinder 8 Exhaust Temperature

10.2 Control Equipment Data

Each test cell has a catalytic converter associated with it. Data such as back pressure, air/fuel ratio, bed temperature, and inlet temperature for each exhaust is recorded every 6 minutes and stored on a network drive. This data will be included in the final report.

11. QA/QC Procedures

The QA/QC procedures for sampling operations include performing leak checks before and after each sample run. These are performed on all train components including vacuum sample trains, pitot lines, and gas bag systems. If pre-test leak checks do not meet the criteria, the trains are adjusted to do so. Post-test leak checks are mandatory, performed, and recorded on field data sheets.

11.1 Leak Checks

11.1.1 Sampling Trains

Both pre-and post-run leak checks will be conducted. A pre-test leak check is performed to verify integrity of the vacuum system. A leak check is mandatory at the conclusion of each sampling run. The leak check is conducted in accordance with the procedures outlined in RM 5, Section 8.4, except that it is conducted at a vacuum equal to or greater than the maximum value reached during the sampling run. If the leakage rate is found to be no greater than 0.02 cubic feet per minute (cfm) or four percent of the sample rate, the results are acceptable and no correction is applied to the total volume of dry gas metered.

11.1.2 Pitot Tubes

The pitot tubes used during the test program will be leak checked prior to the test series and following each traverse set. The leak check is performed according to RM 2, Section 8.1 by placing flexible tubing over one side of the pitot tube tip. The tubing is pinched off when the pitot is pressurized to greater than 3 inches of water. No loss of pressure for 15 seconds indicates a successful leak check. This procedure is repeated for the other side of the pitot tube as well.

11.2 Calibrations

11.2.1 Meterbox Calibrations

Following the procedures outlined in RM 5, Section 10.3.1, a standard dry gas meter is substituted for a wet test meter per RM 5, Section 16.1. Primarily, the meter calibration factors (Y and ΔH@) are determined at multi-point calibration runs at a variety of flow rates. Factors calculated at the individual runs must agree within 2 percent of each other. The factors are then averaged and that average is posted on the meter box. Calibration data will be included in the final report.

After each sampling run, calculations from Alternative Method 5 Post-Test Calibration (ALT-009) are performed. If the average Yqa is within 5 percent of the posted Y, the post-test calibration is acceptable. This calculation will be included with the field data sheets in the final report.

11.2.2 Pitot Calibrations

Pitot tubes are calibrated following the procedures outlined in EPA Method 2, Section 10.1. Pitot tubes are given a baseline coefficient when they meet certain geometrically measured angles and dimensions as set forth in the method.

11.2.3 Thermocouple Calibration

Thermocouples are calibrated according to the Approved Alternative Method (ALT-011), Alternative Method 2 Thermocouple Calibration Procedure. This alternative method utilizes single-point calibration procedure at room temperature of the thermocouple being calibrated were made. If the thermocouple being calibrated and the CAL-PAL are within +/- 2.0 degrees F of each other, the calibration is acceptable.

11.2.4 Barometer Calibrations

Prior to being sent in the field, GHD's barometer is compared to the barometer from the National Weather Service (NWS) located at the Niagara Falls Airport. If the GHD barometer disagrees by more than ±2.3 mm (0.1 in.) of Hg from the barometer located at the airport, the GHD barometer is adjusted until it agrees with the NWS barometer.

GHD's office and the NWS station elevations are within ten feet of each other, thus eliminating the need for any elevation correction.

When in the field, barometer readings are taken from the GHD barometer. At the conclusion of field work, the barometer is brought back, checked against the NWS barometer, and corrected if necessary. Readings taken in the field are corrected based on the degree of error between the GHD barometer and the NWS barometer.

11.3 System Response Time

The system response time will be measured during set up activities at each location in accordance with RM 7E. The high level gas for each analyzer will be introduced to the probe. The time it takes to achieve 95 percent of the certified value will be measured and recorded as the upscale response time for each analyzer. Upon achieving a stable high level response, zero gas will be introduced. The time it takes to achieve 5 percent or 0.5 ppmv of the span value will be recorded as the downscale response time. The longest of all upscale and downscale response times will be used as the system response time.

11.4 RM 10 Analyzer Calibration Error (CE) Test

The CE tests will be performed following the procedures outlined in RM 7E, Section 8.2.3 by first introducing the zero calibration gas and adjusting the instrument to read zero. Next, the high level span gas will be introduced with the analyzer's response adjusted to match this calibration gas concentration. Finally, the low, mid, and high level gases are introduced without any adjustments to the analyzer. The analyzer's response must be within ± 2 percent of calibration span at each point.

Analyzer calibrations will be performed using USEPA Protocol 1 standards and CEMS-zero grade nitrogen. An Environics Model 4040 Series Gas Dilution System will be used to generate appropriate calibration gases.

11.5 RM 10 Analyzer System Bias Check

A system bias check will be conducted immediately following the CE test in accordance with RM 7E, Section 8.2.5. The system bias will be determined by introducing both the zero gas and both upscale gases at the probe and recording the analyzers response. The system bias is acceptable if the analyzer response does not differ from the target value by more than ±5 percent of the calibration span, or the difference is less than or equal to 0.5 ppmv, whichever is less restrictive.

11.6 RM 10 Post-Run Drift Checks

A drift check will be conducted at the conclusion of each run following the procedures outlined in RM 7E, Section 8.5. The zero and the appropriate upscale gas for each method will be sequentially introduced into the system and responses recorded. The zero and upscale responses must agree with the target by ±3 percent of span.

11.7 Stratification Test

Prior to the start of the test program, a three-point stratification test will be performed in accordance with RM 7E, Section 8.1.2. The points will be spaced at 16.7, 50.0, and 83.3 percent of a measurement line passing through the centroidal area of each duct. Sampling will be performed for a minimum of twice the system response time at each traverse point. Upon completing the test, the mean concentrations for each individual point and the overall average concentration will be determined. Consistent with Method 7E, if the concentration at each traverse point differs from the mean concentration for all traverse points by no more than ±5.0 percent of the mean concentration; or ± 0.5 parts per million (ppm) (whichever is less restrictive), the gas stream is not considered stratified. In this event, sampling will be performed from a single point that most closely matches the mean.

If the above criteria are not met, but the concentration at each traverse point differs from the mean concentration for all traverse points by no more than ± 10.0 percent of the mean; or (b) ± 1.0 ppmv (whichever is less restrictive), the gas stream is considered to be minimally stratified. In this event, sampling will be performed at the three points used in the stratification test. If none of the above criteria can be met, sampling will be performed at 12 points as determined using Table 1-2 of Method 1.

11.8 Verification of Gas Dilution System (USEPA Method 205)

RM 205 will be used to evaluate the calibration gas dilution system. The field verification will be conducted according to procedures given in RM 205 Section 3 of the method.

11.9 Data Reduction

The QA/QC procedure for data reduction includes using computer spreadsheet programs to generate tables of results. Data input files and equations are double-checked by a second person, and tables are checked for transposition errors with spot calculations being performed by hand.

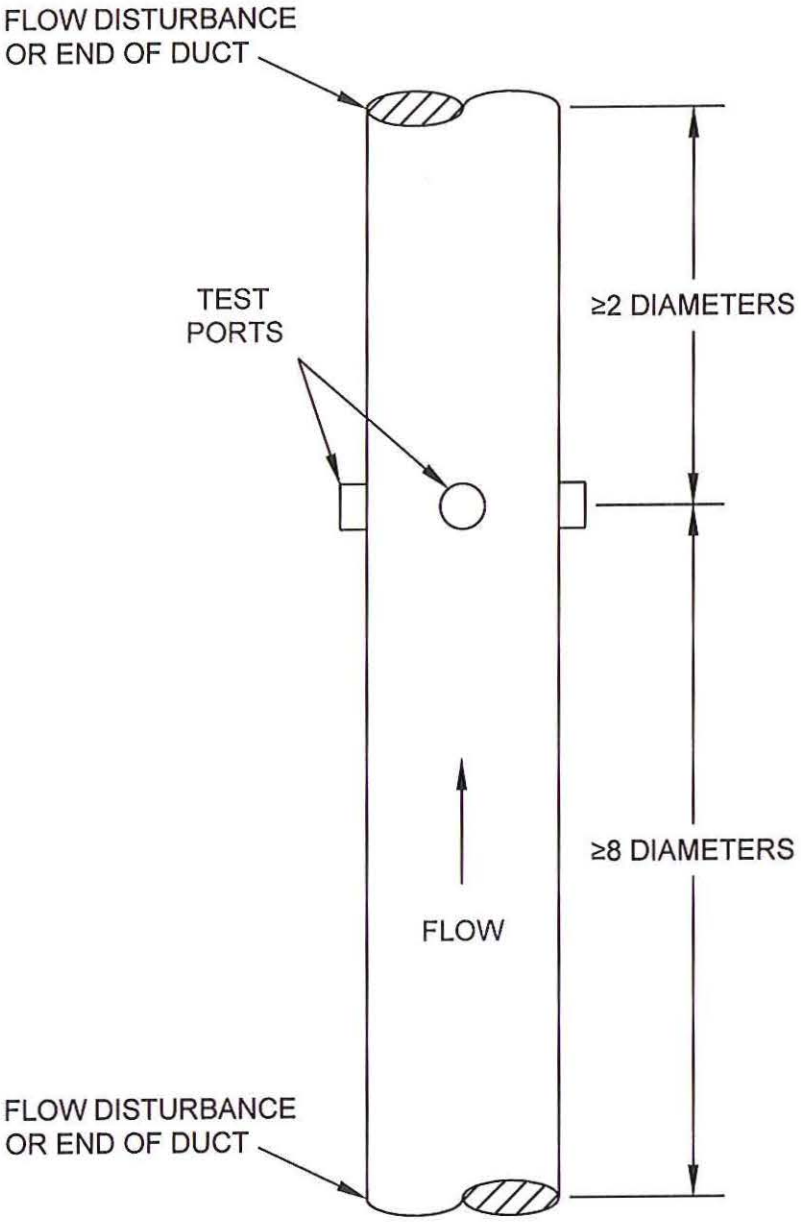

figure 7.1

FLOW MEASUREMENT
SAMPLE PORT LOCATIONS
McLaren Performance Technologies
Livonia, Michigan

www.ghd.com