# AIR EMISSION TEST REPORT
# FOR THE
# VERIFICATION OF AIR POLLUTANT EMISSIONS
# FROM
# ENGINE DYNAMOMETER TEST CELLS

**Prepared for:**

## McLaren Performance Technologies

**Livonia, MI**

**Test Dates: August 9-10, 2022**

**ICT Project No.: 2200160**

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IMPACT
COMPLIANCE & TESTING

# Report Certification

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## McLaren Performance Technologies
## Livonia, MI

**Report Certification**

The material and data in this document were prepared under the supervision and direction of the undersigned.

Impact Compliance & Testing, Inc.

Blake Beddow
Project Manager

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# 1.0 Introduction

McLaren Performance Technologies (McLaren), State Registration No. A8217, operates sixteen (16) engine dynamometer test cells at its facility located in Livonia, Wayne County.

EU-TESTCELLSCC9 is permitted to combust diesel fuel, compressed natural gas and liquified petroleum gas. During the performance testing EU-TESTCELLSCC9 was equipped with a diesel fueled engine. FG-TESTCELLSCC are permitted to combust gasoline. EU-TESTCELLSCC8 was equipped with a gasoline fueled engine. The engines were representative of the typical size and power of engines operated at McLaren.

The field sampling and measurements presented in this report were performed by ICT representatives Blake Beddow, Andrew Eisenberg, and Tyler Harvey on August 9-10.

The exhaust gas sampling and analysis was performed using procedures described in United States Environmental Protection Agency (USEPA) reference test methods.

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# 2.0 Summary of Test Results and Operating Conditions

## 2.1 Purpose and Objective of the Tests

Installation and operation of the equipment is permitted by Michigan Department of Environment, Great Lakes and Energy, Air Quality Division (EGLE-AQD) Renewable Operating Permit (ROP) No. MI-ROP-A8217-2012 and Permit to Install (PTI) No. 32-22, issued McLaren on March 29, 2022. PTI No. 32-22 requires the following performance testing:

*EU-TESTCELLCC9*

*Within 180 days after permit issuance, the permittee shall verify emission rates for CO, PM2.5, and 1,3-butadiene from EU-TESTCELLSCC9, if technically feasible, by testing at the owner's expense, in accordance with Department requirements.*

As presented in the previously submitted Test Plan, testing for 1,3-butadiene is currently not technically feasible at the permitted emission limits.

*FG-TESTCELLSCC*

*Once, during the term of the ROP, the permittee shall verify CO and VOC emission rates from FG-TESTCELLSCC by testing at the owner's expense, in accordance with Department requirements. Testing shall be performed using an approved EPA Method listed in the table below.*

The compliance demonstration consisted of three (3), one-hour test runs for CO and PM2.5, oxygen ($O_2$) and carbon dioxide ($CO_2$) on a diesel engine operated in EU-TESTCELLCC9 (1,3-butadiene testing is currently not technically feasible). The compliance demonstration also consisted of three (3), one-hour test runs for CO and VOC, $O_2$ and $CO_2$ on EU-TESTCELLSCC8 operated in the flexible group FG-TESTCELLSCC.

## 2.2 Operating Conditions During the Compliance Tests

The IC engines operated continuously for the entire performance test time periods.

The diesel engine was operated on a transient test cycle that simulates city driving on a loop (i.e., variable speed and load). The engine operated between 600 to 1,272 revolutions per minute (rpm) and 0 to 353 horsepower (hp). The gasoline engine was operated on a dynamic drive cycle (i.e., variable speed and load). The test settings are representative of common operating points for engines operated at McLaren.

Operational records are presented in Appendix 7.

## 2.3 Summary of Air Pollutant Sampling Results

The gases exhausted from the engine test cell were sampled during emissions testing performed August 9-10, 2022.

Emissions testing was performed on each engine test cells for three (3) 60-minute test runs.

Table 2.1 presents the average engine operating conditions during the test periods.

Table 2.2 presents the average measured CO, VOC, and PM/PM10 emission rates for each engine test cell.

Test results for each sampling period are presented in Section 6.0 of this report.

**Table 2.1 Average engine operating conditions during the test periods**

| Engine Parameter | EU-TESTCELLSCC9 | EU-TESTCELLSCC8 |
|---|---|---|
| Engine Speed (RPM) | 707 | 2,530 |
| Engine Torque (ft-lb) | 650 | 148 |
| Engine Power (HP) | 88.8 | 74.6 |
| Fuel Use (gal/hr) | 3.59 | 3.54 |
| Air to Fuel Ratio | | 14.1 |
| Catalyst Inlet Temp. (°F) | 550 | 1,145 |
| Catalyst Outlet Temp. (°F) | 556 | 1,308 |

**Table 2.2 Average measured emission rates for the engine test cells**

| EU-TESTCELLSCC9 | Three-Test Average | Permit Limit |
|---|---|---|
| CO Emission Rate (lb/hr) | 0.0 | -- |
| CO Emission Rate (lb/gal) | 0.0 | 1.1 |
| PM/PM10 Emission Rate (lb/hr) | 0.06 | -- |
| PM/PM10 Emission Rate (lb/gal) | 0.016 | 0.008 |
| **EU-TESTCELLSCC8** | **Three-Test Average** | **Permit Limit** |
| CO Emission Rate (lb/hr) | 0.01 | -- |
| CO Emission Rate (lb/gal) | 0.00 | 0.59 |
| VOC Emission Rate (lb/hr) | 0.01 | -- |
| VOC Emission Rate (lb/gal) | 0.002 | 0.008 |

# 3.0 Source and Sampling Location Description

## 3.1 General Process Description

McLaren operates sixteen (16) engine dynamometer test cells at its facility located in Livonia, Wayne County.

## 3.2 Rated Capacities and Air Emission Controls

The diesel engine was tested has the following capacities:

- Model Year: 2017
- Manufacturer: Cummins
- Model: X15 Efficiency Series
- Peak Power: 450 hp
- Peak Torque: 1,750 lb-ft
- Max Speed: 1,850 rpm

The gasoline engine that was tested has the following capacities:

- Model Year: 2020
- Manufacturer: Ford
- Model: 7.3 L, V8
- Peak Power: 430 hp
- Peak Torque: 475 lb-ft
- Max Speed: 5,900 rpm

The IC engines are permitted to operate with catalytic converters, therefore, during the performance testing the engines were operated with catalytic converter controls.

The diesel engine catalytic converter has the following parameters:

- Manufacturer: Cummins
- Model: Cummins X15 Series Engines

The gasoline engine catalytic converter has the following parameters:

- Manufacturer: Ford
- Model: OEM catalytic converter or equivalent

The catalytic converters achieve the appropriate reduction efficiency when the bed temperature is operated at a minimum temperature of 230 °C.

## 3.3 Sampling Location

Exhaust gas is directed through a muffler and is released to the atmosphere through dedicated vertical exhaust stacks with a vertical release point.

The sampling ports for EU-TESTCELLSCC9 are located after the muffler in a vertical section of the exhaust stack with an inner diameter of 11.25 inches. The stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location that meets the requirements of USEPA Method 1.

The sampling ports for EU-TESTCELLSCC8 are located after the muffler in a vertical section of the exhaust stack with an inner diameter of 9.375 inches. The stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location that meets the requirements of USEPA Method 1.

Appendix 1 provides a diagram of the emission test sampling locations with actual stack dimension measurements.

# 4.0 Sampling and Analytical Procedures

This section provides a summary of the sampling and analytical procedures that were used during the testing periods.

## 4.1 Summary of Sampling Methods

| | |
|---|---|
| USEPA Method 1 | Exhaust gas velocity measurement locations were determined based on the physical stack arrangement and requirements in USEPA Method 1. |
| USEPA Method 2 | Exhaust gas velocity pressure was determined using a Type-S Pitot tube connected to a red oil incline manometer; temperature was measured using a K-type thermocouple connected to the Pitot tube. |
| USEPA Method 4 | Exhaust gas moisture was determined based on the water weight gain in chilled impingers or using the wet bulb/dry bulb temperature measurement technique. |
| USEPA Method 5 / 202 | Exhaust gas filterable and condensable particulate matter was determined using an isokinetic sampling train. |
| USEPA Method 3A | Exhaust gas $O_2$ and $CO_2$ content was determined using paramagnetic and infrared instrumental analyzers, respectively. |
| USEPA Method 7E | Exhaust gas NOx concentration was determined using chemiluminescence instrumental analyzers. |
| USEPA Method 10 | Exhaust gas CO concentration was measured using an infrared instrumental analyzer. |
| USEPA Method 25A / ALT-096 | Exhaust gas VOC (as NMHC) concentration was determined using a flame ionization analyzer equipped with methane separation column. |

## 4.2 Exhaust Gas Velocity Determination (USEPA Method 2)

The exhaust stack gas velocities and volumetric flow rates were determined using USEPA Method 2 once during each test run. An S-type Pitot tube connected to a red-oil manometer was used to determine velocity pressure at each traverse point across the stack cross section. Gas temperature was measured using a K-type thermocouple mounted to the Pitot tube. The Pitot tube and connective tubing were leak-checked periodically throughout the test periods to verify the integrity of the measurement system.

The absence of significant cyclonic flow at the sampling location was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each velocity traverse point with the planes of the face openings of the Pitot tube perpendicular to the stack cross-sectional plane. The Pitot tube was then rotated to determine the null angle (rotational angle as measured from the perpendicular, or reference, position at which the differential pressure is equal to zero).

Appendix 3 provides exhaust gas flowrate calculations and field data sheets.

## 4.3 Exhaust Gas Molecular Weight Determination (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 $CO_2$ content of the exhaust was monitored using a Servomex 1440D infrared gas analyzer. The $O_2$ content of the exhaust was monitored using a Servomex 1440D gas analyzer that uses a paramagnetic sensor.

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 5.0 of this document). Sampling times were recorded on field data sheets.

Appendix 4 provides $O_2$ and $CO_2$ calculation sheets. Raw instrument response data are provided in Appendix 5.

## 4.4 Exhaust Gas Moisture Content (USEPA Method 4)

Moisture content of the exhaust gas for peak power test, peak torque test, and peak durability test were determined in accordance with USEPA Method 4 using a chilled impinger sampling train. Exhaust gas moisture content measurements were performed concurrently with the instrumental analyzer sampling periods. At the conclusion of each sampling period the moisture gain in the impingers was determined gravimetrically by weighing each impinger to determine net weight gain.

## 4.5 Measurement of PM/PM10 (USEPA Method 5 / 202)

Testing was performed using a combined filterable and condensable particulate matter (PM) sampling train. The filterable and condensable fractions were added to calculate total PM/PM10 emissions (i.e., all filterable and condensable PM emissions were assumed to be in the PM10 size range).

Filterable Particulate Matter Sample Train (USEPA Method 5)

Filterable PM was determined using USEPA Method 5. Exhaust gas was withdrawn from each exhaust stack at an isokinetic sampling rate using an appropriately-sized stainless steel sample nozzle and heated probe. The collected exhaust gas was passed through a pre-tared glass fiber filter that was housed in an independent heated filter box. The back half of the filter housing was connected to the condensable PM impinger train.

Condensable Particulate Matter Sample Train (USEPA Method 202)

Condensable PM (CPM) concentrations were measured in accordance with USEPA Method 202. Following the Method 5 filter assembly, the sample gas travelled through the impinger train which consisted of a condenser, a knock-out impinger, a standard Greenberg-Smith (G-S) impinger (dry), a Teflon-coated CPM filter (with exhaust thermocouple), a modified G-S impinger containing 100 milliliters of deionized water, and a modified G-S impinger containing a known amount of indicating silica gel.

The CPM components of the Method 202 sampling train (dry knockout impinger and dry GS impinger) were placed in a tempered water bath and a pump was used to circulate water through the condenser. The temperature of the bath was maintained such that the CPM filter outlet temperature remained between 65 and 85°F. Crushed ice was placed around the last two impingers to chill the gas to below 68°F.

Sample Recovery and Analysis (USEPA Method 5 / 202)

At the conclusion of each one-hour test period, the sample train was leak-checked and disassembled. The sample nozzle, probe liner, and filter holder were brushed and rinsed with acetone. The recovered particulate filter and acetone rinses were stored in sealed containers and transferred to Enthalpy Analytical, Inc. (Durham, North Carolina) for gravimetric measurements.

The impingers were transported to the recovery area where they were weighed. The exhaust gas contained minimal amounts of moisture. Therefore, the CPM portion of the sample train did not follow the nitrogen purge step of Method 202. The glassware (between the particulate filter and CPM filter) was rinsed with DI water, acetone, and hexane in accordance with the Method 202 sample recovery procedures. The CPM filter and recovered rinses were clearly and uniquely labeled and transferred to Enthalpy Analytical, Inc. for analysis.

Diluent gas content (Method 3A $O_2$ and $CO_2$) measurements were performed with each of the PM/PM10 isokinetic sampling periods.

Appendix 2 provides the PM/PM10 laboratory report. Appendix 4 provides PM/PM10 calculation sheets.

## 4.6 CO Concentration Measurements (USEPA Method 10)

CO pollutant concentrations in the EU-TESTCELLCC9 and EU-TESTCELLSCC8 exhaust gas streams were determined using a Thermo Environmental Instruments, Inc. (TEI) Model 48i infrared CO analyzer.

Throughout each test period, a continuous sample of the 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 4 provides CO calculation sheets. Raw instrument response data are provided in Appendix 5.

## 4.7 Measurement of VOC (USEPA Method 25A / ALT-096)

The VOC emission rate was determined for EU-TESTCELLSCC8 by measuring the nonmethane hydrocarbon (NMHC or NMOC) concentration in the exhaust gas. NMHC pollutant concentration was determined using a TEI Model 55i Methane / Nonmethane hydrocarbon analyzer. The TEI 55i analyzer contains an internal gas chromatograph column that separates methane from non-methane components. The concentration of NMHC in the sampled gas stream, after separation from methane, is determined relative to a propane standard using a flame ionization detector in accordance with USEPA Method 25A.

The USEPA Office of Air Quality Planning and Standards (OAQPS) has issued an alternate test method approving the use of the TEI 55i-series analyzer as an effective instrument for measuring NMOC from gas-fueled RICE (ALT-096).

Samples of the exhaust gas were delivered directly to the instrumental analyzer using the Teflon® heated sample line to prevent condensation. The sample to the NHMC analyzer was not conditioned to remove moisture. Therefore, VOC measurements correspond to standard conditions with no moisture correction (wet basis).

Prior to, and at the conclusion of each test, the instrument was calibrated using mid-range calibration (propane) and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document).

Appendix 4 provides VOC calculation sheets. Raw instrument response data for the NMHC analyzer is provided in Appendix 5.

# 5.0 QA/QC Activities

## 5.1 Flow Measurement Equipment

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

The absence of cyclonic flow for each sampling location was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each of the velocity traverse points with the planes of the face openings of the Pitot tube perpendicular to the stack cross-sectional plane. The Pitot tube was then rotated to determine the null angle (rotational angle as measured from the perpendicular, or reference, position at which the differential pressure is equal to zero).

## 5.2 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 delivered calibration gas values ranging from 0% to 100% (in 10% step increments) of the USEPA Protocol 1 calibration gas that was 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.

## 5.3 Instrumental Analyzer Interference Check

The instrumental analyzers used to measure 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.

## 5.4 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 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 the 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 determining the instrument response against the initial instrument calibration readings.

At the beginning of each test day, appropriate high-range, mid-range, and low-range span gases followed by a zero gas were introduced to the NMHC analyzer, in series at a tee connection, which is installed between the sample probe and the particulate filter, through a poppet check valve. After each one-hour test period, mid-range and zero gases were re-introduced in series at the tee connection in the sampling system to check against the method's performance specifications for calibration drift and zero drift error.

The instruments were calibrated with USEPA Protocol 1 certified concentrations of $CO_2$, $O_2$, $NO_x$, and CO in nitrogen and zeroed using hydrocarbon free nitrogen. The NMHC (VOC) instrument was calibrated with USEPA Protocol 1 certified concentrations of propane in air and zeroed using hydrocarbon-free air. A STEC Model SGD-710C ten-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

## 5.5 System Response Time

The response time of the sampling system was determined prior to the compliance test program 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.

Sampling periods did not commence until the sampling probe had been in place for at least twice the greatest system response time.

## 5.6 Meter Box Calibrations

The dry gas meter sampling console used for moisture testing was calibrated prior to and after the testing program. This calibration uses the critical orifice calibration technique presented in USEPA Method 5. The metering console calibration exhibited no data outside the acceptable ranges presented in USEPA Method 5.

The digital pyrometer in the metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

Appendix 6 presents test equipment quality assurance data ($NO_2$ – NO conversion efficiency test data, instrument calibration and system bias check records, calibration gas certifications, interference test results, meter box calibration records, and field equipment calibration records).

## 5.7 Particulate Matter Recovery and Analysis

All recovered particulate matter samples were stored and shipped in certified trace clean amber glass sample bottles with Teflon® lined caps. The liquid level on each bottle was marked with a permanent marker prior to pick-up and the caps were secured closed with tape. Samples of the reagents used in the test event (200 milliliters each of deionized high-purity water, acetone and hexane) were submitted with the samples for analysis to verify that the reagents used to recover the samples have low particulate matter residues.

The glassware used in the condensable PM impinger trains was washed and rinsed prior to use in accordance with the procedures of USEPA Method 202. The glassware was not baked prior to use; therefore, ICT used the field train proof blank option provided in USEPA Method 202. Analysis of the collected field train proof blank rinses (sample train rinse performed prior to use) indicated a total of 13.0 milligrams (mg) of recovered PM from the sample train. In addition, a field train recovery proof blank was performed following the second sampling period. Analysis of the field train recovery proof blank resulted in 3.74 mg of recovered PM from the sample train. The reported condensable PM test results were blank-corrected according to the method (USEPA Method 202 allows a blank correction of up to 2 mg).

## 5.9 Laboratory QA/AC Procedures

The particulate matter analyses were conducted by a qualified third-party laboratory according to the appropriate QA/QC procedures specified in the USEPA Methods 5 and 202 and are included in the final report provided by Enthalpy Analytical.

# 6.0 Results

## 6.1 Test Results and Allowable Emission Limits

Air pollutant emission measurement results for each test period are presented in Tables 6.1 through 6.2.

The performance testing for EU-TESTCELLSCC9 is specified in Special Condition No. V.1. of PTI No. 33-22. PTI No. 33-22 specifies the following emission rates:

- 1.1 lb CO/gal; and
- 0.008 lb PM2.5/gal.

The performance testing for FG-TESTCELLSCC is specified Special Condition No. V.1. of PTI No. 33-22. PTI no. 33-22 specifies the following emission rates:

- 0.59 lb CO/gal; and
- 0.008 lb VOC/gal.

The measured air pollutant concentrations and emission rates for FG-TESTCELLSCC is less than the allowable limits specified in PTI No. 33-22. The measured CO concentrations and emission rates for EU-TESTCELLSCC9 is less than the allowable limits specified in PTI No. 33-22. The measured PM2.5 emission rates exceeds the allowable limits specified in PTI No. 33-22

## 6.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing for all pollutants was performed in accordance with USEPA methods and the submitted Test Protocol. The test cells were operated at set points that are representative of common set points of the engines operated by McLaren.

On August 10, 2022 an initial test run was started on EU-TESTCELLSCC8. It was later determined that the engine was not running long enough to provide sufficient heat to the catalyst to provide representative testing conditions. Once the engine had been running long enough and the catalyst temperature was verified, an additional three (3) test runs were performed on the test cell. These three test runs (Runs 2-4) were used to calculate emission factors.

**Table 6.1 Measured exhaust gas conditions and air pollutant emission rates for EU-TESTCELLSCC9**

| Test No.<br>Test date<br>Test period (24-hr clock) | 1<br>8/9/2022<br>0845-0915, 0920-0950 | 2<br>8/9/2022<br>1040-1110, 1115-1145 | 3<br>8/9/2022<br>1245-1315, 1325-1355 | Three Test Average |
|---|---|---|---|---|
| Exhaust Gas Composition | | | | |
| $CO_2$ content (% vol) | 1.93 | 1.84 | 1.90 | 1.88 |
| $O_2$ content (% vol) | 19.2 | 19.3 | 19.2 | 19.2 |
| Moisture (% vol) | 3.38 | 3.22 | 3.12 | 3.24 |
| Exhaust gas temperature (°F) | 149 | 154 | 162 | 155 |
| Exhaust gas flowrate (dscfm) | 829 | 855 | 852 | 845 |
| Exhaust gas flowrate (scfm) | 858 | 883 | 879 | 874 |
| Carbon Monoxide | | | | |
| CO conc. (ppmvd) | 0.00 | 0.00 | 0.00 | 0.00 |
| CO emissions (lb/hr) | 0.00 | 0.00 | 0.00 | 0.00 |
| CO emissions (lb/gal) | 0.00 | 0.00 | 0.00 | 0.00 |
| *Permit Limit (lb/gal)* | - | - | - | *1.1* |
| Particulate Matter | | | | |
| Sampled volume (dscf) | 51.3 | 53.0 | 52.9 | 52.4 |
| Filterable catch (mg) | *25.1* | 3.76 | 3.12 | 10.66 |
| Condensable catch (mg) | 4.09 | 39.5 | 5.56 | 16.4 |
| Total catch (mg) | 29.2 | 43.3 | 8.68 | 27.1 |
| Total PM/PM10 emissions (lb/hr) | 0.06 | 0.09 | 0.02 | 0.06 |
| Total PM/PM10 emissions (lb/gal) | 0.018 | 0.026 | 0.005 | 0.016 |
| *Permit Limit (lb/gal)* | - | - | - | *0.008* |

**Table 6.1 Measured exhaust gas conditions and air pollutant emission rates for EU-TESTCELLSCC8**

| Test No.<br>Test date<br>Test period (24-hr clock) | 1<br>8/10/2022<br>1035-1135 | 2<br>8/10/2022<br>1225-1325 | 3<br>8/10/2022<br>1345-1445 | Three Test Average |
|---|---|---|---|---|
| Exhaust Gas Composition | | | | |
| $CO_2$ content (% vol) | 1.10 | 1.15 | 1.13 | 1.13 |
| $O_2$ content (% vol) | 20.3 | 20.2 | 20.1 | 20.2 |
| Moisture (% vol) | 2.93 | 2.29 | 3.56 | 2.93 |
| Exhaust gas temperature (°F) | 141 | 136 | 151 | 143 |
| Exhaust gas flowrate (dscfm) | 1,346 | 1,346 | 1,294 | 1,329 |
| Exhaust gas flowrate (scfm) | 1,386 | 1,378 | 1,341 | 1,368 |
| Carbon Monoxide | | | | |
| CO conc. (ppmvd) | 1.96 | 1.90 | 3.31 | 2.35 |
| CO emissions (lb/hr) | 0.01 | 0.01 | 0.02 | 0.01 |
| CO emissions (lb/gal) | 0.00 | 0.00 | 0.00 | 0.00 |
| *Permit Limit (lb/gal)* | - | - | - | *0.59* |
| Volatile Organic Compounds | | | | |
| VOC conc. (ppmv) | 0.49 | 0.68 | 0.94 | 0.71 |
| VOC emissions (lb/hr) | 0.005 | 0.006 | 0.009 | 0.007 |
| VOC emissions (lb/gal) | 0.001 | 0.002 | 0.002 | 0.002 |
| *Permit Limit (lb/gal)* | - | - | - | *0.008* |