

# VERIFICATION STATEMENT

## GLOBE Performance Solutions

Verifies the performance of

### GESi® Catalytic Converter

Developed by Global Emissions Systems Inc.  
Whitby, Ontario, Canada

In accordance with

## ISO 14034:2016

**Environmental management —  
Environmental technology verification (ETV)**



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John D. Wiebe, PhD  
Executive Chairman  
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February 28, 2018  
Vancouver, BC, Canada



Verification Body  
GLOBE Performance Solutions  
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## Performance claims

The GESi® Catalytic Converter when installed on a Kawasaki™ Model FE120 (serial number FE120D88437) Class I horizontal shaft small off-road (SORE gasoline) ride-on mower engine in comparison to the same engine (124 cc displacement, 4-stroke OTTO) with a Kawasaki™ stock muffler based on ISO 8178–G2 testing (equivalent to the EPA/CARB B-Cycle testing) performed as follows:

For the six mode test cycle:

1. Power increase by  $2.8\% \pm 0.9\%$ ;
2. Nitrogen Oxides (NO<sub>x</sub>) emission reduction by  $96.8\% \pm 0.3\%$ ;
3. Carbon Monoxide (CO) emission reduction by  $57.6\% \pm 1.7\%$ ;
4. Total Hydrocarbons (THC) emission reduction by  $50.2\% \pm 1.4\%$ ; and
5. Total Hydrocarbons plus Nitrogen Oxides (HC<sub>2</sub> + NO<sub>x</sub>) reduction by  $59.6\% \pm 1.0\%$ .

Additionally,

6. The maximum Total Hydrocarbons plus Nitrogen Oxides (HC + NO<sub>x</sub>) emission test result at zero hour operation was 5.9 g/kWh, which is 63% below the EPA standard (16.1 g/kWh) for 2008 and beyond (2008+), and 41% below the 2008+ CARB standard (10.0 g/kWh);
7. The maximum HC + NO<sub>x</sub> emission test result at 125 hour operation was 7.7 g/kWh, which is 52% below the 2008+ EPA standard, and 23% below the 2008+ CARB standard;
8. The maximum CO emission test result at zero hour operation was 150 g/kWh, which is 75% below the 2008+ EPA standard (610 g/kWh), and 73% below the 2008+ CARB standard (549 g/kWh); and
9. The maximum CO emission test result at 125 hour operation was 197 g/kWh, which is 68% below the 2008+ EPA standard, and 64% below the 2008+ CARB standard.

For fast-idle ( $1600 \pm 160$  rpm) mode:

1. No significant difference in the engine power;
2. CO emission reduction by  $99.4\% \pm 6.9\%$ ;
3. THC emission reduction by  $97.4\% \pm 3.0\%$ ;
4. NO<sub>x</sub> emission reduction by  $82.9\% \pm 15.7\%$ ; and
5. HC + NO<sub>x</sub> emission reduction by  $96.7\% \pm 3.0\%$ .
6. 1 Claim was assessed at 95% confidence interval.
7. 2 THC and HC often used interchangeably.

## Technology Description

The GESi® catalytic converter technology is a three way catalytic converter. The converter is composed of a stainless steel shell encompassing a ceramic monolithic catalyst treated with proprietary coatings wrapped in a Refractory Ceramic Fibre compound (RCF) to protect the core and make certain that no emissions bypass the catalytic process. The converter is provided with a steel heat shield to protect the user and the environment as required by the relevant federal, provincial/ state regulations. The GESi® Catalytic Converter operates in all natural ambient air temperatures and atmospheric conditions with no operator adjustments required. Catalytic reaction (light off) occurs at 212°C or greater and the unit is designed to hold the heat where there is intermittent use of the engine.

## Technology Application

The GESi® Catalytic Converter uses ceramic monoliths with proprietary coatings for gas phase catalytic reaction to reduce steady-state emissions of CO, HC and NO<sub>x</sub> from small off-road machines operated on gasoline, such as ride-on mowers.

## Performance Conditions

The GESi® Catalytic Converter was tested at the Intertek Carnot Emissions Services facility (Test Agent or TA), Arlington, Texas in June 2008 according to International Standards Organization ISO 8178-G2, equivalent to United States Environmental Protection Agency (EPA)/California Air Resources Board (CARB B-Cycle), for steady-state emissions at low hour service accumulation. The converter was installed on a horizontal shaft small off-road (SORE gasoline) ride-on mower engine manufactured by Kawasaki™. The engine was a 124cc displacement, 4-stroke OTTO, and the mower was a Class I model FE120 with serial number FE120D88437.

The performance claim verification was based on the data collected during June 9-22, 2008 at the Intertek facility using ISO 8178-G2 (six modes) and the EPA Unleaded Test Gasoline (UTG96) protocol. Two separate and independent sets of tests were carried out on this engine: first in combination with the GESi® Catalytic Converter and second, with the stock Kawasaki™ muffler. The tests were carried out for power and steady-state G2 emissions, namely: CO; THC; NO<sub>x</sub>; and HC + NO<sub>x</sub>. Although particulate matter (PM) was measured and reported, according to the TA (personal communication October 2008) the PM emission results were very low (in the range of 0.006-0.01 g/kWh) and were not the subject of verification.

## Verification

This verification was first completed in October 2008 and has been considered valid for subsequent renewal periods every three (3) years thereafter. The verification was based on information supplied by Global Emissions Systems Inc., and the performance tests conducted by the Test Agent on the Performance Claims related to the GESi® Catalytic Converter installed on a SORE gasoline engine.

The original verification was completed by ORTECH Environmental of Mississauga, Ontario as the Verification Expert (VE) using the Canadian ETV Program's General Verification Protocol (February, 2007). This ETV renewal is considered to meet the equivalency of an ETV verification completed using the International Standard *ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)*.

## What is ISO 14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

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**Verification Statement – GESi® Catalytic Converter – Global Emissions Systems Inc.**

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