

# THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM



U.S. Environmental Protection Agency



## ETV Joint Verification Statement

<b>TECHNOLOGY TYPE:</b>	<b>MOBILE DIESEL ENGINE AIR POLLUTION CONTROL</b>
<b>APPLICATION:</b>	<b>CONTROL OF EMISSIONS FROM MOBILE DIESEL ENGINES IN HIGHWAY USE BY SELECTIVE CATALYTIC REDUCTION AND A CATALYZED CONTINUOUSLY REGENERATING TRAP</b>
<b>TECHNOLOGY NAME:</b>	<b>SCCRT®, VERSION 1, SELECTIVE CATALYTIC REDUCTION WITH A CATALYZED CONTINUOUSLY REGENERATING TRAP</b>
<b>COMPANY:</b>	<b>JOHNSON MATTHEY PLC</b>
<b>ADDRESS:</b>	<b>380 LAPP ROAD MALVERN, PA 19355 (610) 254-5373 FAX: (610) 971-3116</b>
<b>WEB SITE:</b>	<a href="http://www.jmusa.com">http://www.jmusa.com</a>
<b>E-MAIL:</b>	<a href="mailto:joshia@jmusa.com">joshia@jmusa.com</a>

The U.S. Environmental Protection Agency (EPA) created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by accelerating the acceptance and use of improved and cost-effective technologies. The ETV Program seeks to achieve this goal by providing high-quality, peer-reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

The ETV Program works in partnership with recognized standards and testing organizations; stakeholder groups, which consist of buyers, vendor organizations, permittees, and other interested parties; and with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer-reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance (QA) protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The Air Pollution Control Technology Center (APCT Center), which is one of six centers under the ETV Program, is operated by RTI International<sup>1</sup> (RTI) in cooperation with EPA's National Risk Management Research Laboratory. The APCT Center has evaluated the performance of an emission control system consisting of a selective catalytic reduction (SCR) technology with a catalyzed continuously regenerating trap (CCRT).

## ENVIRONMENTAL TECHNOLOGY VERIFICATION TEST DESCRIPTION

All tests were performed in accordance with the *Test/QA Plan for the Verification Testing of Selective Catalytic Reduction Technologies for Highway, Nonroad and Stationary Use Diesel Engines* and the *Test-Specific Addendum to ETV Mobile Source Test/QA Plan for Johnson Matthey for the SCCRT<sup>®</sup>, v.1 System*. These documents are written in accordance with the applicable generic verification protocol and include requirements for quality management and QA; procedures for product selection and auditing of the test laboratories; and the test reporting format.

The mobile diesel engine air pollution control technology was tested in February 2011 at Southwest Research Institute. The performance verified was the percentage of emissions reduction achieved by the technology for particulate matter (PM), nitrogen oxides (NO<sub>x</sub>), hydrocarbons (HC), and carbon monoxide (CO) relative to the performance of the same baseline engine without the technology in place. Operating conditions were documented, and ancillary performance measurements also were made. A summary description of the ETV test is provided in [Table 1](#).

**Table 1. Summary of the Environmental Technology Verification Test**

Test type	Highway Transient Federal Test Procedure
Engine family	6CEXH0661MAV
Engine make–model year	Cummins – 2006 ISM 330
Service class	Highway, heavy-duty diesel engine
Engine rated power	330 hp at 1800 rpm
Engine displacement	10.8 L, inline six cylinder
Technology	Johnson Matthey SCCRT <sup>®</sup> , v.1
Technology description	SCR combined with a CCRT
Test cycle or mode description	One cold-start and multiple hot-start tests according to FTP and one SET for baseline engine, degreened, and aged systems
Test fuel description	Ultra–low-sulfur diesel fuel with 15 ppm sulfur maximum
Critical measurements	PM, NO <sub>x</sub> , HC, and CO
Ancillary measurements	CO <sub>2</sub> , NO, NO <sub>2</sub> (by calculation), NH <sub>3</sub> , soluble organic fraction of PM, exhaust backpressure, exhaust temperature, and fuel consumption

Note: CO<sub>2</sub> = carbon dioxide, FTP = Federal Test Procedure, hp = horsepower, NO = nitric oxide, NO<sub>2</sub> = nitrogen dioxide, NH<sub>3</sub> = ammonia, ppm = parts per million, rpm = revolutions per minute, SET = Supplemental Emission Test.

Beginning of table description. Table 1 is titled Summary of the Environmental Technology Verification Test. The table lists the type of test conducted, the critical and ancillary measurements taken, the characteristics of the test engine, and the technology undergoing verification testing. End of table description.

<sup>1</sup> RTI International is a trade name of Research Triangle Institute.

## VERIFIED TECHNOLOGY DESCRIPTION

The Johnson Matthey SCCRT<sup>®</sup>, v.1 technology is a urea-based SCR system combined with a CCRT filter designed for on-highway light, medium, and heavy heavy-duty diesel, urban and non-urban bus, exhaust gas recirculation (EGR)- or non-EGR–equipped engines for use with commercial ultra–low-sulfur diesel fuel (ULSD) conforming to 40 *Code of Federal Regulations* 86.1313-2007.

This verification statement describes the performance of the tested technology on the diesel engine and fuels identified in Table 1 and applies only to the use of the Johnson Matthey SCCRT<sup>®</sup>, v.1 system on highway engines fueled by ULSD (15 parts per million [ppm] or less) fuel.

The monitoring and notification system that was functionally tested and used with this technology includes sensors for urea level and leakage detection and a mechanism to interrupt engine restart in the event of an empty urea tank.

## VERIFICATION OF PERFORMANCE

The Johnson Matthey SCCRT<sup>®</sup>, v.1 system achieved the reduction in tailpipe emissions shown in **Table 2** compared to baseline operation without the system installed on the test engine. In Table 2, “degreened” refers to a system with 25-124 hours of accumulated run time while “aged” refers to a system with over 1000 hours of accumulated run time. Additionally, the functional test results indicated proper operation of the monitoring and warning system.

**Table 2a. Verified Emissions Reductions:  
Mean Emissions Reduction (%)**

System Type	Fuel	PM	NO <sub>x</sub>	HC	CO
Degreened	ULSD	94	76	94	89
Aged	ULSD	92	73	92	87

**Table 2b. Verified Emissions Reductions:  
95% Confidence Limits on the Emissions Reduction (%)**

System Type	Fuel	PM	NO <sub>x</sub>	HC	CO
Degreened	ULSD	91 to 98	75 to 77	80 to <sup>a</sup>	69 to <sup>a</sup>
Aged	ULSD	89 to 95	72 to 74	77 to <sup>a</sup>	66 to <sup>a</sup>

<sup>a</sup> The upper limit of the emissions reduction could not be distinguished from 100% with 95% confidence.

Beginning of table description. Table 2 is titled Verified Emissions Reductions. The table describes the verified emissions reduction percentages for the degreened and aged systems for particulate matter, nitrogen oxides, hydrocarbons, and carbon monoxide. 95% confidence limits for these reductions are also listed. End of table description.

The APCT Center quality manager has reviewed the test results and quality control (QC) data and has concluded that the data quality objectives given in the generic verification protocol and test/QA plan have been attained. APCT Center QA staff have conducted technical assessments of the test laboratory procedures and of the data handling. These assessments confirm that the ETV tests were conducted in accordance with the EPA-approved test/QA plan.

This verification statement verifies the emissions characteristics of the Johnson Matthey SCCRT<sup>®</sup>, v.1 system for the stated application. Extrapolation outside that range should be done with caution and an understanding of the scientific principles that control the performance of the technology. This verification focuses on emissions. Potential technology users may obtain other types of performance information from the manufacturer.

In accordance with the generic verification protocol, this verification statement is valid, commencing on the date below, indefinitely for application of the Johnson Matthey SCCRT<sup>®</sup>, v.1 system within the range of applicability of the statement.

signed by Sally Gutierrez

8/22/2011

signed by Jason Hill

8/8/2011

Sally Gutierrez

Date

Jason Hill

Date

Director

Director

National Risk Management Research Laboratory

Air Pollution Control Technology Center

Office of Research and Development

RTI International

United States Environmental Protection Agency

**NOTICE:** ETV verifications are based on an evaluation of technology performance under specific, predetermined criteria and the appropriate quality assurance procedures. EPA and RTI make no express or implied warranties as to the performance of the technology and do not certify that a technology will always operate as verified. The end user is solely responsible for complying with any and all applicable federal, state, and local requirements. Mention of commercial product names does not imply endorsement.