

**THE ENVIRONMENTAL TECHNOLOGY VERIFICATION  
PROGRAM**



U.S. Environmental Protection Agency



**ETV Joint Verification Statement**

**TECHNOLOGY TYPE:** MOBILE DIESEL ENGINE AIR POLLUTION CONTROL

**APPLICATION:** CONTROL OF EMISSIONS FROM MOBILE DIESEL ENGINES IN HIGHWAY USE BY DIESEL OXIDATION CATALYSTS AND DIESEL PARTICULATE FILTERS

**TECHNOLOGY NAME:** PCRT2<sup>®</sup> 1000, VERSION 2, FILTER + DIESEL OXIDATION CATALYST

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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 Verification Center (APCT Center), one of six centers under the ETV Program, is operated by RTI International<sup>1</sup> in cooperation with EPA's National Risk Management Research

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

Laboratory. The APCT Center has evaluated the performance of an emission control system consisting of a flow-through partial filter combined with a diesel oxidation catalyst (DOC).

## ETV TEST DESCRIPTION

All tests were performed in accordance with the *Test/QA Plan for the Verification Testing of Diesel Exhaust Catalysts, PM Filters, and Engine Modification Technologies for Highway and Nonroad Use Diesel Engines* and the *Test-Specific Addendum to ETV Mobile Source Test/QA Plan for Johnson Matthey for the PCRT2<sup>®</sup> 1000, V.2 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 August 2008 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 were also made. A summary description of the ETV test is provided in **Table 1**.

**Table 1. Summary Description of the ETV Test**

Test type	Highway Transient Federal Test Procedure (FTP)
Engine family	YCEXH0661MAH
Engine make–model year	Cummins – 2000 ISM350 ESP
Service class	Highway, heavy-duty diesel engine
Engine rated power	350 hp at 1800 rpm
Engine displacement	10.8 L, inline six cylinder
Technology	Johnson Matthey PCRT2 <sup>®</sup> 1000, v.2
Technology description	Flow-through partial filter combined with a DOC
Test cycle or mode description	One cold-start and multiple hot-start tests according to FTP test 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), soluble organic fraction of PM, exhaust backpressure, exhaust temperature, and fuel consumption

hp = horsepower, rpm = revolutions per minute, CO<sub>2</sub> = carbon dioxide, NO = nitric oxide, NO<sub>2</sub> = nitrogen dioxide

## VERIFIED TECHNOLOGY DESCRIPTION

The Johnson Matthey PCRT2<sup>®</sup> 1000, v.2 system is a partial continuously regenerating technology (PCRT) system that consists of a flow-through partial filter combined with a DOC. The system is designed for low temperature exhaust resulting from intermittent loads from medium and heavy heavy-duty diesel on-highway non-urban bus engines. 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 PCRT2<sup>®</sup> 1000, v.2 system on highway engines fueled by ultra–low-sulfur diesel (ULSD) (15 ppm or less) fuel.

## VERIFICATION OF PERFORMANCE

The Johnson Matthey PCRT2<sup>®</sup> 1000, v.2 system achieved the reduction in tailpipe emissions shown in **Table 2**

compared to baseline operation without the system.

**Table 2. Verified Emissions Reductions**

Device Type	Fuel	Mean Emissions Reduction (%)				95% Confidence Limits on the Emissions Reduction (%)			
		PM	NO <sub>x</sub>	HC	CO	PM	NO <sub>x</sub>	HC	CO
Degreened	ULSD	55	0.99	96	74	37 to 73	- <sup>a</sup>	- <sup>b</sup>	73–75
Aged	ULSD	43	-0.24	92	68	26 to 61	- <sup>a</sup>	86–97	66–69

<sup>a</sup> The emissions reduction could not be distinguished from zero with 95% confidence.

<sup>b</sup> The emissions reduction could not be quantified or distinguished from 100% with 95% confidence.

The APCT Center quality manager has reviewed the test results and quality control 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 PCRT2<sup>®</sup> 1000, v.2 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 PCRT2<sup>®</sup> 1000, v.2 system* within the range of applicability of the statement.

*signed by Sally Gutierrez*      *03/20/09*  
 Sally Gutierrez                      Date  
 Director  
 National Risk Management Research Laboratory  
 Office of Research and Development  
 United States Environmental Protection Agency

*signed by Jenia Tufts*                      *03/13/09*  
 Jenia Tufts                                      Date  
 Director  
 APCT Center  
 RTI International

**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.