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 CRANKCASE EMISSIONS CONTROL**
TECHNOLOGY NAME:	**DONALDSON COMPANY, INC. SERIES 6100 DIESEL OXIDATION CATALYST MUFFLER AND SPIRACLE CLOSED CRANKCASE FILTRATION SYSTEM**
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The U.S. Environmental Protection Agency (EPA) has 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. ETV 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.

ETV works in partnership with recognized standards and testing organizations; stakeholder groups, which consist of buyers, vendor organizations, permitters, 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 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 (APCTVC), one of six centers under the ETV Program, is operated by Research Triangle Institute (RTI), in cooperation with EPA's National Risk Management Research Laboratory. The APCTVC has evaluated the performance of an emissions control system consisting of an exhaust oxidation catalyst and crankcase emission control device for mobile diesel engines, the Donaldson Company, Inc. Diesel Oxidation Catalyst Muffler, Series 6100 Catalyst Formulation, and the Spiracle™ Closed Crankcase Filtration System.

ETV TEST DESCRIPTION

All tests were performed in accordance with the general test plan *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 the Donaldson Company, Inc. diesel oxidation catalyst muffler and Spiracle™. These documents are written in accordance with the applicable generic verification protocol and include requirements for quality management, quality assurance, procedures for product selection, auditing of the test laboratories, and test reporting format.

The mobile diesel engine air pollution control technology was tested at Southwest Research Institute. The performance verified was the percentage emission reduction achieved by the technology for particulate matter (PM), nitrogen oxides (NO_x), hydrocarbons (HC), and carbon monoxide (CO) relative to the performance of the same baseline engine without the technology in place. The percentage emission reduction is relative to the total emissions from the tailpipe and crankcase vent. 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), heavy-duty cycle
Engine Family	WDDXH12.7EGD
Engine Make–model year	Detroit Diesel Corporation Series 60–1998
Service Class	Heavy Duty Diesel
Engine Rated Power	299 kW (400 bhp) @ 1,800 rpm
Engine Displacement	12.7 L
Technology	Donaldson Company, Inc. Diesel Oxidation Catalyst Muffler, Series 6100 Catalyst and Spiracle™ Closed Crankcase Filtration System
Technology description	A ceramic oxidation catalyst matrix wash-coated with catalyst, packaged in a muffler-sized can for retrofit installation by a moderately skilled mechanic. Blow-by filter in a closed-loop configuration. No engine modifications required.
Test cycle or mode description	One cold-start and three hot-start tests according to FTP test plus measurement of baseline crankcase particulate emissions
Test fuel description	EPA standard low-sulfur and ultralow-sulfur No. 2 diesel fuels per 40 CFR Part 86.1313
Critical measurements	PM, NOx, HC, and CO
Ancillary measurements	NO, CO_2, engine blow-by pressure and exhaust back-pressure, exhaust temperature, fuel consumption, exhaust PM soluble organic fraction (SOF), and crankcase particulate emissions

VERIFIED TECHNOLOGY DESCRIPTION

This verification statement is applicable to the *Donaldson Company, Inc. Diesel Oxidation Catalyst Muffler (Series 6100 Catalyst Formulation) and Spiracle™ Closed Crankcase Filtration System*. According to the vendor, the Donaldson Company, Inc. Diesel Oxidation Catalyst Muffler with Series 6100 Catalyst Formulation is packaged and marketed for use on diesel engines from 150 to 600 bhp. The unit whose performance was verified had part number 5190B2396. It is applicable to engines fueled by ultralow sulfur (15 ppm or less) diesel fuel. The Donaldson Spiracle™ Closed Crankcase Filtration System uses two filtration stages integrated into a single, replaceable filter cartridge. The system whose performance was verified has part number S040004.

This verification statement describes the performance of the tested technology on the diesel engine and fuels identified in Table 1. The performance was measured for a degreened device. A degreened device has been operated a brief period before testing (25 to 125 hours) to achieve a stable emissions reduction.

VERIFICATION OF PERFORMANCE

The Donaldson Company, Inc. Diesel Oxidation Catalyst Muffler (Series 6100) and the Spiracle™ Closed Crankcase Filtration Systems achieved the emissions reduction shown in Table 2 at the stated conditions. The emissions reduction is relative to the total emissions from the tailpipe and crankcase vent.

Table 2. Verified Emissions Reductions for System Consisting of a Donaldson Company, Inc. Diesel Oxidation Catalyst Muffler with Series 6100 Catalyst Formulation and the Spiracle™ Closed Crankcase Filtration System

	Fuel		Mean Emissions Reduction [a] (%)				95% Confidence Limits on the Emissions Reduction (%)			
Device type	Baseline	Controlled	PM	NO_x	HC	CO	PM	NO_x	HC	CO
Degreened	LSD	ULSD	34	[b]	[b]	31	30-37	[b]	[b]	26-36
Degreened	ULSD	ULSD	29	1.8	42	35	23-35	1.2-2.4	28-57	32-38

[a] Emissions reduction from baseline of tailpipe plus crankcase emissions.

For the purposes of determining the status of the technology in regard to EPA's voluntary diesel retrofit program, the prospective user is encouraged to contact EPA's Office of Transportation and Air Quality (OTAQ) or visit the retrofit program web site at http://www.epa.gov/otaq/retrofit/.

The APCTVC QA Officer 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. EPA and APCTVC quality assurance staff have conducted technical assessments at the test laboratory and of the data handling. These 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 *Donaldson Company, Inc. Diesel Oxidation Catalyst Muffler (Series 6100) and the Spiracle™ Closed Crankcase Filtration System with diesel fuels* 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 technologies. This verification focused 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 *Donaldson Company, Inc. DCM Oxidation Catalyst Muffler (Series 6100) and the Spiracle™ Closed Crankcase Filtration System with diesel fuels* within the range of applicability of the statement.

Original signed by H.W. McKinnon *9/15/03*
Date

Hugh W. McKinnon, MD
Director
National Risk Management Research Laboratory
Office of Research and Development
United States Environmental Protection Agency

Original signed by J.R. Farmer *9/30/03*
Date

Jack R. Farmer
Program Director
Air Pollution Control Technology Verification Center

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 expressed 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.