

BP ECD DEMONSTRATION PROGRAM

BP developed a new diesel fuel it terms "Emission Control Diesel (ECD). ECD has a maximum sulfur content of 15 ppm, about 10% aromatics by volume, and a nominal cetane number of 60. BP intends to commercialize this ultra-low sulfur diesel fuel in the California marketplace. In order to evaluate ECD, BP assembled a working group of representatives of government, industry, and academia. The objective of this EC-Diesel Technology Validation Program is to evaluate the ECD fuel in combination with passive particulate filter systems in seven fleets over a twelve-month period. Following is a summary of information to date for six of those fleets. This summary will be updated as BP provides additional data.

Ralph's Grocery Class 8 Trucks

Description: A test fleet of twenty 1999 Sterling L-Line Class 8 trucks operated by Ralph's Grocery Company are part of a demonstration program to evaluate the performance of BP Emission Control Diesel (ECD) alone and when used in conjunction with the Johnson-Matthey CRT filter and the Engelhard DPX filter. The grocery trucks are driven on city and suburban roads and interstate highways. Annual mileage accumulation for each truck is approximately 100,000 miles. The demonstration program began on March 1, 2000, and will run through February 2001.

Participants Ralph's Grocery, BP, Johnson-Matthey, Engelhard, West Virginia University

Funding BP, Johnson-Matthey, Engelhard

Vehicles: Identical 1999 Sterling L-Line (Class 8) Model AT9513 Tractors

Engines: 12.7 liter Detroit Diesel Series 60

Status: As of July 2000, each retrofitted truck has accumulated over 50,000 miles without any failures. Table 1 contains information on truck groups and average daily mileage.

Table 1. Characteristics of Ralph's Grocery Test Fleet

Truck Group	Fuel Used	Particulate Filter	No. of Trucks	Ave. Daily Miles	Ave. Monthly Miles
CARB	CARB Diesel	None	5	315	8724
ECD	ECD	None	5	337	8955
ECD + DPX	ECD	Engelhard DPX	5	350	9223
ECD + CRT	ECD	JM CRT	5	337	9492

From January through March 2000, the Ralph's trucks retrofitted with trap systems were emission tested using West Virginia University's transportable chassis dynamometer. Mileage accumulated on the truck/filter system prior to testing ranged between 0 and 11,370 miles. Figure 1 shows the emission test results under one driving schedule, the City-Suburban Heavy Vehicle Route (CSHVR). Particulate matter emissions declined from 0.2 grams per mile (using CARB diesel or ECD) to 0.003 grams per mile with either filter.

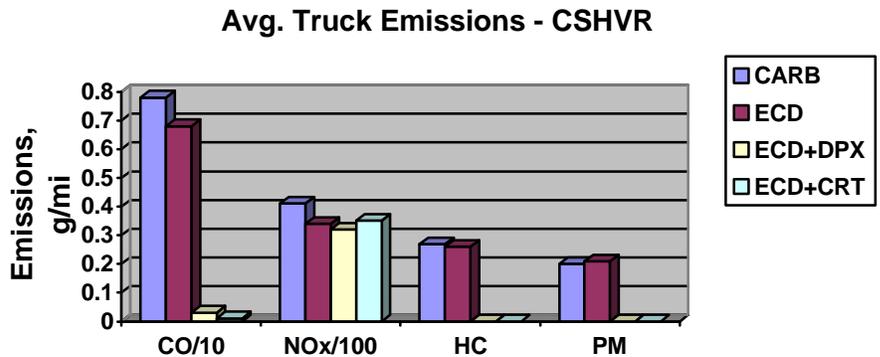


Figure 1. Average Truck Emissions, City Suburban Heavy Vehicle Route

LA County Metropolitan Transportation Authority

Description: The test fleet consists of twenty 1998 New Flyer Low Floor 40-foot buses as a part of the BP ECD demonstration program. Four of the buses have been retrofitted with trap filter systems. Two of the buses are equipped with the Johnson-Matthey CRT filter and two buses are fitted with the Engelhard DPX filter technology. These transit buses operate on both city and suburban routes, often in stop-and-go conditions. The demonstration program began in January 2000, and will run through January 2001.

Participants: BP, Los Angeles MTA, Johnson-Matthey, Engelhard

Funding: BP, Johnson-Matthey, Engelhard

Vehicles: 1998 New Flyer Low Floor 40 foot transit buses

Engines: 1998 Detroit Diesel Series 50

Status: As of October 2000, each retrofitted bus has accumulated over 15,000 miles without any failures. Some initial testing has been completed at ARB's Emission Test Facility (ETF). Tables 2 and 3 show test results for a subset of the buses with and without a CRT trap system under the Central Business District (CDB) cycle, and the New York Bus Cycle (NYBC):

Table 2. Emission Results of MTA Buses with CRT, Central Business District Test Cycle

Buses Tested	Description	CO (g/mi)	NOx (g/mi)	HC (g/mi)	PM (g/mi)	MPG
1	CARB diesel alone	2.33	43.99	0.052	0.18	3.23
1	ECD diesel alone	1.74	46.17	0	0.22	3.10
1	ECD diesel w/ CRT	0.13	36.07	0	0.05	3.52

Table 3. Emission Results of MTA Buses with CRT, NY Business Test Cycle

Buses Tested	Description	CO (g/mi)	NOx (g/mi)	HC (g/mi)	PM (g/mi)	MPG
1	CARB diesel alone	9.63	90.45	0.187	0.78	1.31
1	ECD diesel alone	5.19	102.1	0.006	0.60	1.35
1	ECD diesel w/ CRT	0.24	94.38	0	0.16	1.47

The use of BP ECD and a CRT trap resulted in an average PM emission reduction of 77 percent over four different test schedules. This reduction in emissions is less than what was expected by the program participants. At this time, there seems to be an understanding of why better performance was not achieved and technical improvements are planned to improve overall efficiencies. Additional testing is scheduled to be performed prior to the end of 2000.

BP Amoco Tanker Truck Demonstration

Description: The test fleet consists of twenty-nine 1995-96 Kenworth Class 8 trucks used for fuel transport throughout Southern California. Ten of the trucks have been retrofitted with trap filter systems. Five of the trucks are equipped with the Johnson-Matthey CRT filter and five trucks are fitted with the Engelhard DPX filter technology. The tanker trucks are driven on city and suburban roads and interstate highways. Annual mileage accumulation for each truck is typically in excess of 100,000 miles. The demonstration program began in January 2000, and will run through December 2000.

Participants: BP, Johnson-Matthey, Engelhard

Funding: BP, Johnson-Matthey, Engelhard

Vehicles: 1995-96 Kenworth Class 8 Tractors

Engines: 10.8 liter Cummins M11 330 hp

Status: As of October 2000, each retrofitted truck has accumulated over 100,000 miles without any failures. Some initial testing has been completed. Below are test results for trucks with and without a CRT trap system under the City-Suburban Heavy Vehicle Route (CSHVR). Tanker trucks equipped with the CRT filter and fueled with ECD diesel emitted 90% lower CO, 92% lower HC, and 96% lower PM than the test vehicles produced operating on CARB diesel without the CRT.

Table 4. Emission Results of BP Tanker Trucks with CRT

Trucks Tested	Description	CO (g/mi)	NOx (g/mi)	HC (g/mi)	PM (g/mi)	MPG
2	CARB diesel alone	3.13	16.48	1.35	0.58	5.55
2	ECD diesel alone	2.89	14.66	1.24	0.56	5.36
2	ECD diesel w/ CRT	0.32	13.93	0.11	0.03	5.24

San Diego School District

Description: The test fleet consists of thirty school buses within the San Diego School District. Ten of the buses have been retrofitted with trap filter systems. Five of the buses are equipped with the Johnson-Matthey CRT filter and five

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buses are fitted with the Engelhard DPX filter technology. A typical San Diego school bus duty cycle comprises both city and suburban driving. These daily routes include hill climbing and require the buses to achieve speeds up to 60 miles per hour. The demonstration program began in January 2000, and will run through December 2000.

Participants: San Diego School District, BP, Johnson-Matthey, Engelhard

Funding: BP, Johnson-Matthey, Engelhard

Vehicles: 1998 Amtram 3000RE/International School Buses

Engines: 8.7 liter International 530E, 275 hp

Status: As of October 2000, each retrofitted bus has accumulated over 25,000 miles without any failures. Some initial testing has been completed. Table 5 shows preliminary test results for buses with and without a DPX trap system under the City-Suburban Heavy Vehicle Route (CSHVR):

Table 5. Emission Results for School Buses with DPX filters

Buses Tested	Description	CO (g/mi)	NOx (g/mi)	HC (g/mi)	PM (g/mi)	MPG
2	CARB diesel alone	2.51	20.19	0.55	0.22	4.70
2	ECD diesel alone	2.25	18.12	0.48	0.19	4.57
2	ECD diesel w/ DPX	0.15	16.25	0.00*	0.00*	4.79

*non-detectable emissions

Test results indicate that school buses equipped with the DPX filter and fueled with ECD have dramatically lower emissions of hydrocarbons (HC), and particulate matter (PM) than the CARB-fueled buses without the DPX filters.

Hertz Equipment Rental

Description: The test fleet consists of twenty medium-duty flatbed-type trucks within the Hertz equipment service fleet. Ten of the trucks have been retrofitted with trap filter systems. Five of the trucks are equipped with the Johnson-Matthey CRT filter and five trucks are fitted with the Engelhard DPX filter technology. These trucks operate on both city and suburban routes, and are primarily used to respond to repair calls for Hertz rental equipment customers. The demonstration program began in March 2000, and will run through March 2001.

Participants: Hertz, BP Amoco, Johnson-Matthey, Engelhard

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Funding: BP Amoco, Johnson-Matthey, Engelhard

Vehicles: 1997 and 1999 Ford F-250, 450, 550

Engines: Cummins

Status: As of October 2000, each retrofitted truck has accumulated nearly 10,000 miles without any failures. A subset of four trucks will be emissions tested. The emissions test plan for the Hertz fleet includes the EPA Federal Test Procedure for light-duty vehicles. Emissions testing of the Hertz fleet will be done at the University of California at Riverside (CECERT).

Los Angeles City Sanitation

Description: The test fleet consists of fifteen Peterbilt chassis refuse haulers and Kenworth T-800 dump trucks within the Los Angeles City Sanitation fleet. Five of the buses are equipped with the Johnson-Matthey CRT filter and five buses are fitted with the Engelhard DPX filter technology. A subset of four refuse haulers will be emissions tested. These trucks are used predominantly in the city and operate at low speeds under stop and go operation. The demonstration program began in March 2000, and will run through February 2001.

Participants: LA City Sanitation, BP Amoco, Johnson-Matthey, Engelhard

Funding: BP Amoco, Johnson-Matthey, Engelhard

Vehicles: Peterbilt Refuse Hauler and Kenworth T-800 dump truck

Engines: Cummins ISM 305V (haulers)
Cummins ISM 370 (dump trucks)

Status: As of October 2000, each retrofitted truck has accumulated over 12,000 miles without any failures. Initial testing began in November 2000 and West Virginia University is conducting the emissions testing using their transportable emissions laboratory. Preliminary data indicate PM, CO, and HC emission reduction levels similar to other demonstration programs. In addition to the ten trucks outfitted with either the CRT or DPX systems, the remaining five trucks include three operating with CARB diesel and without a filter, and two trucks using ECD and without a filter.

Diesel Activities: Mobile Vehicles and Equipment