76-25 AW

An Evaluation of a Diesel-Powered Taxicab

July 1976

Technology Assessment and Evaluation Branch
Emission Control Technology Division
Mobile Source Air Pollution Control
Environmental Protection Agency

Background

The Environmental Protection Agency receives information about many systems which appear to offer potential for emission reduction or fuel economy improvement compared to conventional engines and vehicles. EPA's Emission Control Technology Division is interested in evaluating all such systems, because of the obvious benefits to the Nation from the identification of systems that can reduce emissions, improve economy, or both. EPA invites developers of such systems to provide to the EPA complete technical data on the system's principle of operation, together with available test data on the system. In those cases in which review by EPA technical staff suggests that the data available show promise, attempts are made to schedule tests at the EPA Emissions Laboratory at Ann Arbor, Michigan. The results of all such test projects are set forth in a series of Technology Assessment and Evaluation Reports, of which this report is one.

The conclusions drawn from the EPA evaluation tests are necessarily of limited applicability. A complete evaluation of the effectiveness of an emission control system in achieving performance improvements on the many different types of vehicles that are in actual use requires a much larger sample of test vehicles than is economically feasible in the evaluation test projects conducted by EPA. For promising systems it is necessary that more extensive test programs be carried out.

As part of an ongoing program to evaluate the feasibility of using the Diesel engine as a powerplant for light-duty vehicles, the EPA has conducted test programs to quantify the exhaust emissions and fuel economy of a number of light-duty Diesel vehicles. Most of the vehicles tested to date have been either production vehicles or manufacturer's prototypes. The remaining vehicles are a mixture of light trucks and passenger cars that have been retrofitted with Diesel engines.

The vehicle evaluated in this test program is a 1975 Dodge Coronet retrofitted with a Diesel engine. The vehicle was assembled by Vehicle Technology, Inc. (College Point, N. Y.), and is typical of a fleet of about sixty Diesel-powered taxicabs operating in the metropolitan New York area.

Test Vehicle Description

The test vehicle is a 1975 Dodge Coronet powered by a Chrysler-Nissan 6 cylinder Diesel engine. The engine conforms to Federal and California regulations for 1975 heavy-duty Diesel engines.

The engine utilizes a prechamber type combustion chamber. The fuel injection pump is manufactured by Diesel-Kiki. The transmission is a Chrysler 3-speed automatic.

The vehicle was tested at an inertia weight of 4500 lbs. A tabulation of other vehicle statistics is presented on the Vehicle Description sheet at the end of this report.

Test Program

Exhaust emission and fuel economy tests were conducted in accordance with the 1975 Federal Test Procedure ('75 FTP) for light-duty Diesel vehicles (Federal Register, June 30, 1975, Vol. 40, No. 126, Part III). In addition to the '75 FTP, testing included the EPA Highway Fuel Economy Test (HFET) and measurement of steady state emissions.

The vehicle was tested at two inertia weights. The first, 4500 lbs., is the correct inertia weight based on the vehicle curb weight. The vehicle was also tested at 3500 lb. Tests at the lower weight give an estimation of exhaust emissions and fuel economy if the engine were to be installed in a lighter chassis.

At both inertia weights, the vehicle was tested twice according to the '75 FTP and HFET. Steady state tests were conducted only at the 4500 lb. inertia weight. Acceleration times from 0-60 mph were also measured at both inertia weights. Acceleration tests were run on a chassis dynamometer.

Test Results

Exhaust emissions and fuel economy of the test vehicle are summarized below:

1975 Federal Test Procedure mass emissions in grams per mile (grams per kilometer) (1)

	HC	CO	NOx	Fuel Economy (Fuel consumption)
4500 lb. - avg. of 2 tests	0.35 (0.22)	1.4 (0.9)	1.85 (1.15)	21.3 miles/gal (11.1 liters/100km)
3500 lb. - avg. of 2 tests	0.63 (0.39)	1.5 (0.9)	1.79 (1.11)	23.9 miles/gal. (9.9 liters/100km)

(1) Values shown in parenthesis denote metric units.

Highway Fuel Economy Test
mass emissions in
grams per mile
(grams per kilometer) (1)

	HC	CO	NOx	Fuel Economy (Fuel consumption)
4500 lb. - avg. of 2 tests	1.12 (0.70)	1.9 (1.2)	1.39 (0.86)	27.5 miles/gal. (8.6 liters/100km)
3500 lb. - avg. of 2 tests	-	1.8 (1.1)	1.37 (0.85)	29.8 miles/gal. (7.9 liters/100km)

(1) Values shown in parenthesis denote metric units.

Individual test results for the '75 FTP, HFET and steady state tests are presented in Tables I-IV (following the text of this report).

Acceleration time from 0-60 mph took 38.8 seconds at 4500 lb. inertia, and 29.7 seconds at 3500 lb. inertia.

The performance of the test vehicle was severely hampered by the shift point calibration of the automatic transmission. Under full throttle acceleration from rest, the transmission shifted into high gear before the vehicle reached 30 mph. No downshift (3-2 shift) occurred under full throttle acceleration above 30 mph.

By manually shifting the automatic transmission, better acceleration rates could be achieved. At 4500 lbs., acceleration time from 0-60 mph was reduced to 27.6 seconds. However, even with this added assist, vehicle performance is at best leisurely.

For fuel economy comparison purposes, the 1975 EPA Gas Mileage Guide gives a '75 FTP fuel economy of 14 miles/gal. and a highway fuel economy of 22 miles/gal. for a comparable Dodge Coronet powered by a 225 cu. in. 6-cylinder Otto cycle engine.

Conclusions

1. The Diesel-powered Dodge demonstrated emission levels below those required by Federal regulations for 1977 light-duty Diesel vehicles. It should be noted that the test vehicle had accumulated only 250 miles at the conclusion of the test program. Further testing would be required to verify that the exhaust emissions do not exceed allowable levels as mileage is accumulated. Federal regulations required that new vehicles meet applicable emission standards for 50,000 miles.

2. Compared to a production 1975 Dodge Coronet powered by a six cylinder engine, the Diesel-Coronet demonstrated about 50% higher city fuel economy and 25% higher highway fuel economy.

3. In its present configuration, the performance capabilities of the Diesel-Coronet are inadequate for some driving. Low speed performance (under 30 mph) is acceptable, but entry onto freeways is difficult because the vehicle cannot achieve enough speed while in the acceleration lane to merge with traffic.

Table I

1975 Federal Test Procedure
mass emissions in
grams per mile
(grams per kilometer) (1)

Test #	HC	CO	CO_2	NOx	miles/gal. (liters/100km)
4500 lb. inertia	0.33	1.3	472.	1.82	21.4
77-2172	(0.21)	(0.8)	(293.)	(1.13)	(11.0)
77-2216	0.37	1.4	481.	1.88	21.1
	(0.23)	(0.9)	(299.)	(1.17)	(11.2)
Average	0.35	1.4	477.	1.85	21.3
	(0.22)	(0.9)	(296.)	(1.15)	(11.1)
3500 lb. inertia	0.63	1.5	430.	1.80	23.5
77-2301	(0.39)	(0.9)	(267.)	(1.12)	(10.0)
77-2278	-	1.5	418.	1.78	24.2
		(0.9)	(260.)	(1.10)	(9.7)
Average	0.63	1.5	424.	1.79	23.9
	(0.39)	(0.9)	(264.)	(1.11)	(9.9)

1977 Federal Emission Standards
for light-duty Diesel vehicles

HC	CO	NOx
1.5 gms/mi	15.0 gms/mi	2.0 gms/mi.

(1) Values shown in parenthesis denote metric units.

Table II

'75 FTP Individual Bag Emissions
in grams per mile

	Bag 1: Cold Transient					Bag 2: Stabilized					Bag 3: Hot Transient				
Test #	HC	NOx	CO_2	CO	MPG	HC	NOx	CO_2	CO	MPG	HC	NOX	CO_2	CO	MPG
4500 lb inertia															
77-2172	0.43	1.76	530.	1.5	19.1	0.20	1.95	454.	1.1	22.3	0.51	1.64	462.	1.5	21.9
77-2216	0.48	1.75	536.	1.6	18.9	0.22	2.03	467.	1.2	21.7	0.57	1.71	467.	1.6	21.6
3500 lb. inertia															
77-2301	0.68	1.70	482.	1.7	21.0	0.52	1.93	420.	1.3	24.1	0.81	1.61	410.	1.7	24.6
77-2278	-	1.65	462.	1.6	21.9	-	1.90	407.	1.3	24.8	-	1.63	404.	1.6	24.9

Table III

Highway Fuel Economy Test
Mass emission in
grams per mile
(grams per kilometer) (1)

Test #	HC	CO	CO_2	NOx	Miles/gal.(liters/100km)
4500 lb. inertia					
77-2173	1.12 (0.70)	1.9 (1.2)	368. (228.)	1.33 (0.82)	27.2 (8.6)
77-2217	-	1.9 (1.2)	362. (225.)	1.44 (0.89)	27.8 (8.5)
Average	1.12 (0.70)	1.9 (1.2)	365. (227.)	1.39 (0.86)	27.5 (8.6)
3500 lb. inertia					
77-2279	-	1.8 (1.1)	335. (208.)	1.36 (0.84)	29.8 (7.9)
77-2302	-	1.7 (1.1)	336. (209.)	1.37 (0.85)	29.8 (7.9)
Average	-	1.8 (1.1)	336. (209.)	1.37 (0.85)	29.8 (7.9)

(1) Values shown in parenthesis denote metric units.

Table IV

Steady State
mass emissions in
grams per mile
(grams per kilometer) (1)

	HC	CO	CO_2	NOx	miles/gal(liters/100km)
Idle	0.01 gm/min.	0.1gm/min.	25.gm/min	0.19 gm/min.	
15 mph	0.17	1.0	296.	1.51	34.1
(24 kph)	(0.10)	(0.6)	(184.)	(0.94)	(6.9)
30 mph	0.56	2.0	264.	1.19	37.9
(48 kph)	(0.35)	1.2	(164.)	(0.74)	(6.2)
45 mph	2.13	2.0	295.	1.24	33.6
(72 kph)	(1.33)	(1.2)	(183.)	(0.77)	(7.0)
60 mph	0.98	1.5	398.	1.54	25.2
(97 kph)	(0.61)	(0.9)	(247.)	(0.95)	(9.3)

(1) Values shown in parenthesis denote metric units.