

Technical Support Report

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Particulate Measurement -  
Light-Duty Diesel Particulate Baseline Test Results

by

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NOTICE

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Standards Development and Support Branch  
Emission Control Technology Division  
Office of Mobile Source Air Pollution Control  
Office of Air, Noise and Radiation  
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## Introduction

This report summarizes particulate emissions data for 35 different light-duty diesel vehicles and trucks. Particulate (and gaseous) emissions for 25 of these vehicles were determined at the EPA/MVEL facility in Ann Arbor during an on-going light-duty diesel particulate baseline study conducted during 1978. For the 10 other diesel vehicles, particulate emissions were determined from earlier characterization studies conducted at the EPA/MVEL Ann Arbor facility, the EPA/RTP facility, and at Southwest Research Institute.

## Discussion

The 1978 EPA/MVEL data is summarized in Tables I and II. Both particulate and gaseous emissions measurements were made according to the procedure specified in the "Draft Recommended Practice for Measurement of Gaseous and Particulate Emissions from Light-Duty Diesel Vehicles", March 1978, with the following exceptions:

(1) For five of the vehicles listed in Table I, no estimate of particle bound organics can be made because only total hydrocarbon measurements were taken. For the remaining vehicles in Table I, two heated hydrocarbon analyzers were used to determine the particulate bound organics on the filter used for particulate determination.

(2) For the vehicles listed in Table II, the second unheated filter hydrocarbon measurements were taken using an independent (from the particulate sample system) HFID system that was identically matched (both geometrically and in response to HC) to the total hydrocarbon sample system, and differed only in that the first filter and probe were unheated.

(3) Where noted the particulate sample filter temperature exceeded 125°F.

Particulate data from the earlier characterization studies is presented in Table III. Particulate measurements taken during these studies used a procedure that was similar to that specified in the Draft Recommended Practice, except:

- (1) Only total hydrocarbon measurements were taken.
- (2) Where noted particulate measurements were made with fluoropore filters.

TABLE I

Light-Duty Diesel Particulate and Gaseous Emissions Summary  
of Certification and Development Baseline Vehicles

All data with 18 inch Dilution Tunnel, CVS Flow - 535 SCFM

Data taken during time period 1/79-4/78

Vehicle & ID	Total* HC g/mi	CO g/mi	NOx g/mi	CO <sub>2</sub> g/mi	Filtered** HC g/mi	Particulates g/mi	Particulate Bound Organics % of Total HC	Particulate Bound Organics % of particulate	Fuel Economy mpg	Driving Cycle	Comments
Peugot 504D	0.71***	1.61	1.33	396	--	0.43	--	--	24.2	FTP	Glass fiber particulate filter
504CO-2700783	0.21***	0.68	1.27	306	--	0.34	--	--	33.2	50 mph SS	
Production Vehicle	0.20	0.20	0.97	196	--	0.09	--	--	51.5	20 mph SS	
Oldsmobile 350D	0.62***	1.61	1.84	496	--	0.90	--	--	20.3	FTP	Glass fiber particulate filter
3J29R6M384481	0.29***	1.05	1.45	329	--	0.47	--	--	31.2	50 mph SS	
Prototype Vehicle	0.28	1.18	1.30	318	--	0.48	--	--	32.5	20 mph SS	
Oldsmobile 350D 832D	--	2.10	1.47	504	--	0.96	--	--	20.0	FTP	Glass fiber particulate filter
Prototype Vehicle	--	0.85	1.18	302	--	0.45	--	--	33.8	50 mph SS	
Oldsmobile 350D	0.82	1.88	1.98	546	--	1.04	--	--	18.5	FTP	Glass fiber particulate filter
3N69N8M152915 Production Vehicle	0.20	0.88	1.30	293	--	0.38	--	--	34.5	20 mph SS	
*75 Mercedes Benz 300D	0.23***	0.83	2.00	418	--	0.42	--	--	24.2	FTP	Glass fiber particulate filter
11511412019885 Production Vehicle	0.12***	0.54	1.68	334	--	0.32	--	--	30.5	50 mph SS	
*79 Mercedes Benz 300D	0.28	1.42	2.00	437	0.24	0.83	14.3	4.8	23.2	FTP	+TCGF filter
123D30-826	0.17	0.99	1.68	343	0.17	0.53	0.0	0.0	29.5	HWFE	+TCGF filter Peak filter Temp: 140-145°F
Certification Vehicle	0.19	1.04	1.67	363	0.19	0.55	0.0	0.0	27.5	CFDS	+TCGF filter Peak filter Temp: 143-145°F
*79 Mercedes Benz 300SD	0.14	0.81	1.71	396	0.12	0.45	14.3	4.8	23.2	FTP	+TCGF filter
116D30-817	0.08	0.49	1.75	333	0.08	0.34	0.0	0.0	30.5	HWFE	+TCGF filter Peak filter Temp: 140-150°F
Certification Vehicle	0.11	0.57	1.68	346	0.10	0.35	9.1	2.9	29.3	CFDS	+TCGF filter Peak filter Temp: 140-145°F
*79 Mercedes Benz 240D	0.18	0.98	1.60	367	0.17	0.53	5.6	1.9	27.5	FTP	+TCGF filter
123D24-825	0.17	0.72	1.33	305	0.17	0.32	0.0	0.0	33.2	HWFE	+TCGF filter Peak filter Temp: 140-150°F
Certification Vehicle	0.19	0.82	1.39	326	0.17	0.36	10.5	5.6	31.1	CFDS	+TCGF filter Peak filter Temp: 130-145°F
IHC Scout Traveler****	0.43	2.35	1.55	483	0.37	0.47	14.0	12.8	20.9	FTP	+TCGF filter
296 3.26L Nissan Engine	0.13	0.74	1.44	407	0.10	0.24	23.1	12.5	24.9	HWFE	+TCGF filter Peak filter Temp: 140-145°F
Certification Vehicle	0.26	1.97	1.39	429	0.21	0.35	19.2	14.3	23.5	CFDS	+TCGF filter Peak filter Temp: 130-135°F
Turbo- charged VW Rabbit VR199D	0.12	0.56	0.93	196	0.09	0.20	25.0	15.0	52.3	FTP	+TCGF filter
DOT Special Build Vehicle	0.07	0.27	0.80	167	--	0.17	--	--	60.8	HWFE	+TCGF filter
	0.07	0.26	0.78	164	0.06	0.16	14.3	6.3	61.8	CFDS	+TCGF filter
	0.07	0.50	0.80	147	--	0.21	--	--	68.7	30 mph SS	+TCGF filter

\* TCGF means Teflon coated glass fiber particulate filter.

\*\* Total HC sample system has heated probe and heated filter, similar to certification system.

\*\*\* Filtered HC sample is taken downstream of cold (<125°F) particulate filter.

\*\*\*\* Total HC measured during separate test series (i.e., not simultaneous with particulates and other gaseous emissions).

\*\*\*\*\* EGR equipped.

TABLE II

Light-Duty Diesel Particulate and Gaseous Emissions Summary  
of Certification and Development Baseline VehiclesAll data with 18 inch Dilution Tunnel, CVS Flow = 535 SCFM  
Data taken during time period 7/78-10/78

Vehicle & ID	Total HC gm/mi	CO gm/mi	NOx gm/mi	CO2 gm/mi	Filtered* HC gm/mi	Particu- lates** gm/mi	Particulate Bound Organics % of Total HC	Particulate Bound Organics % of Particulate	Fuel Economy MPG	Test Cycle	Comments
Oldsmobile 350	0.59	1.51	1.49	458	0.36	0.84	39.0	27.4	22.1	FTP	
93HF127	0.32	0.92	1.20	334	0.20	0.40	37.5	30.0	30.3	HWFE	Peak filter temp:150-155°F
'79 Cert Vehicle	0.37	1.07	1.27	367	0.24	0.52	35.1	25.0	27.6	CFDS	Peak filter temp:150-155°F
Oldsmobile 260	0.58	1.35	1.67	409	0.38	0.73	34.5	27.4	24.6	FTP	
93HF149	0.20	0.75	1.48	312	0.14	0.45	30.0	13.2	32.9	HWFE	Peak filter temp:130-135°F
'79 Cert Vehicle	0.28	0.91	1.54	327	0.14	0.53	50.0	26.4	31.0	CFDS	Peak filter temp:128-132°F
Oldsmobile 260	0.60	1.49	1.56	412	0.35	1.02	41.7	24.5	24.4	FTP	
93HF-84482F	0.22	0.89	1.24	304	0.13	0.57	40.9	15.8	33.2	HWFE	Peak filter temp:135°F
'79 FE Vehicle	0.36	1.06	1.34	328	0.19	0.67	47.2	25.4	30.8	CFDS	Peak filter temp:134-137°F
Oldsmobile 260	0.69	1.91	1.62	391	0.34	0.96	50.7	36.5	25.7	FTP	
93HF181	0.19	0.72	1.22	270	0.10	0.58	47.4	15.5	37.5	HWFE	
'79 Cert Vehicle (5 spd)	0.27	1.31	1.34	306	0.13	0.87	51.9	16.1	33.0	CFDS	
Chev Pickup 350											
BTJ9-168F	0.78	1.58	1.52	501	0.48	0.59	38.5	50.8	20.2	FTP	
'79 Cert Vehicle	0.64	1.16	1.41	398	0.27	0.33	57.8	97.4	25.3	HWFE	Peak filter temp:130-135°F
(2 hole inject)	0.64	1.23	1.24	407	0.31	0.39	51.6	84.6	24.8	CFDS	Peak filter temp:130-135°F
Chev Pickup 350											
BTJ9-168F	0.73	1.60	1.47	508	0.42	0.61	42.5	50.8	19.8	FTP	
Non-Cert Config	0.44	1.05	1.29	406	0.24	0.30	45.5	66.7	24.9	HWFE	Peak filter temp:130-135°F
(3 hole inject)	0.50	1.18	1.30	420	0.25	0.42	50.0	59.5	24.1	CFDS	Peak filter temp:130-135°F
odge Truck	0.54	2.61	1.82	469	0.43	0.61	20.4	18.0	21.4	FTP	
8356	0.35	1.37	1.57	403	0.23	0.33	52.2	36.4	25.1	HWFE	Peak filter temp:155-160°F
'79 Cert Vehicle (4 spd)	0.36	1.95	1.60	420	0.27	0.45	33.3	20.0	24.0	CFDS	Peak filter temp:150-155°F
'77 Mercedes300D	0.25	1.35	1.36	463	0.17	0.79	32.0	10.1	21.8	FTP	
23.130-12017745	0.08	0.73	1.25	363	0.06	0.47	25.0	4.3	27.8	HWFE	
Special Build/ turbo Chgd w/EGR	0.10	0.83	1.24	383	0.08	0.56	20.0	3.6	26.4	CFDS	
Volkswagen Dash.	0.52	1.19	0.98	262	0.30	0.32	42.3	68.8	38.3	FTP	
06 Z 2466	0.30	0.64	0.78	198	0.17	0.25	43.3	52.0	50.9	HWFE	
'79 Cert Vehicle (4 spd)	0.46	0.84	0.81	220	0.25	0.25	45.7	84.0	45.8	CFDS	
Volkswagen Rab.	0.51	1.01	0.87	238	0.24	0.23	52.9	100.0	42.4	FTP	
06 Z 2465	0.20	0.41	0.58	172	0.09	0.11	55.0	100.0	58.9	HWFE	
'79 Cert Vehicle (5 spd)	0.35	0.68	0.65	190	0.18	0.18	43.6	94.4	53.0	CFDS	
Vpel Rekord-E	0.51	1.52	2.12	319	0.33	0.47	35.3	38.3	31.5	FTP	
AS1224695	0.84	0.81	2.02	267	0.65	0.34	22.6	55.9	37.6	HWFE	
Modified Product Vehicle w/o over drive (3.89 axle) (4 spd)	0.80	1.09	1.93	279	0.54	0.40	32.5	65.0	36.1	CFDS	
Vpel Rekord-E	0.13	1.35	1.50	271	0.11	0.78	15.4	2.6	37.3	FTP	
AS1224695	0.11	0.61	1.17	228	0.07	0.36	36.4	11.1	44.4	HWFE	
Modified Product Vehicle w/over drive (2.70 axle) (4 spd)	0.14	0.82	1.19	237	0.10	0.47	23.6	8.5	42.6	CFDS	
ugeot 302D	0.87	1.69	1.16	362	0.54	0.29	37.9	100.0	27.3	FTP	
32	0.21	0.69	1.12	307	0.12	0.20	42.9	45.0	32.6	HWFE	Peak filter temp:135-145°F
'79 Cert Vehicle (4 spd)	0.35	0.96	1.09	317	0.24	0.21	33.3	57.1	31.4	CFDS	Peak filter temp:150-155°F
nt'l Harv Scout	0.27	1.40	1.40	407	0.20	0.32	25.9	21.9	24.8	FTP	
00	0.16	0.64	1.55	383	0.10	0.26	37.5	23.1	26.5	HWFE	Peak filter temp:140-145°F
'79 Cert Vehicle (4 spd)	0.17	1.26	1.41	379	0.11	0.28	35.3	21.4	26.7	CFDS	Peak filter temp:135-140°F
Mercedes 240D***	0.15	--	--	--	--	0.35	--	--	--	FTP	
3312-920	0.07	--	--	--	--	0.25	--	--	--	HWFE	
'79 Cert Vehicle											
See unknown Specifications											

- \* Filtered HC sample is taken downstream of a cold (125°F) teflon coated glass fiber filter.
- \*\* All particulate samples were taken with teflon coated glass fiber filters.
- \*\* Limited gaseous emissions because of CVS bag switching problem.
- \*\* Total HC sample system has heated probe and heated filter, similar to certification system.

TABLE 111

Light-Duty Diesel Particulate and Gaseous Emissions Summary  
from Characterization Studies

Vehicle & ID	Total HC gm/mi <sup>a</sup>	CO gm/mi	NOx gm/mi	Particulates gm/mi	Fuel Economy mpg	Driving Cycle	Comments
'75 Mercedes 240D 10066208 Production Vehicle	0.29 -- --	0.97 -- --	1.27 -- --	0.48 0.31 0.36	25.7 33.7 --	FTP HWFE CFDS	Data was taken at SwRI with glass fiber filters used for particulates.
'75 Mercedes 300D 12019885 Production Vehicle	0.16 -- --	0.85 -- --	1.72 -- --	0.49 0.39 0.37	23.8 30.0 --	FTP HWFE CFDS	Data was taken at SwRI with glass fiber filters used for particulates.
'74 Peugeot 204D 71-DTN Production Vehicle	1.11 -- --	1.71 -- --	0.68 -- --	0.38 0.30 0.24	35.9 43.8 --	FTP HWFE CFDS	Data was taken at SwRI with glass fiber filters used for particulates.
'74 IH 10D Pick-up 4H1C0DHB23906 powered by Perkins 6-247 diesel	0.72 -- --	2.87 -- --	1.50 -- --	0.81 0.54 0.49	25.7 28.3 --	FTP HWFE CFDS	Data was taken at SwRI with glass fiber filters used for particulates.
'77 VW Rabbit 1763188714 Production Vehicle (California)	0.37 -- --	0.79 -- --	0.87 -- --	0.29 0.25 0.26	42.7 53.7 --	FTP HWFE CFDS	Data was taken at SwRI with glass fiber filters used for particulates.
'73 Datsun-Nissan Production Vehicle	0.25 --	1.10 --	1.37 --	0.30 0.33	26.2 33.8	FTP HWFE	Data was taken at EPA/RTP with glass fiber filters used for particulates.
'75 Peugeot 504D Experimental Vehicle	0.49 -- --	1.45 -- --	2.30 -- --	0.51 0.40 0.31	26.4 35.9 --	FTP HWFE CFDS	Data was taken at EPA/RTP with glass fiber filters used for particulates.
'75 Postal Van 6100957 Production Vehicle	0.14 -- --	1.47 -- --	2.54 -- --	0.47 0.24 0.27	29.9 37.8 --	FTP HWFE CFDS	Data was taken at EPA/NVEL with fluoropore filters used for particulates.
'75 Dodge Coronet WT41CSA206937 NYC taxi powered by Chrysler-Nissan diesel	0.26 -- --	1.22 -- --	1.82 -- --	0.19 0.17 0.17	22.4 25.7 --	FTP HWFE CFDS	Data was taken at EPA/NVEL with fluoropore filters used for particulates.
'75 Mercedes 300D Production Vehicle	0.16 -- --	0.92 -- --	2.17 -- --	0.43 0.25 0.27	23.8 29.5 --	FTP HWFE CFDS	Data was taken at EPA/NVEL with fluoropore filters used for particulates.

<sup>a</sup> Total HC sample system has heated probe and heated filter, similar to certification system.