

Emissions from Transit Buses – Report to the Board of Health (August 27, 2003)

Attachments:

- Table 1: Summary of Emissions from In-Service Transit Buses (grams/mile)
Table 2: Summary of Emissions from In-Service Transit Buses (grams/mile) using various pollution control measures

Table 1 Summary of Emissions from In-Service Transit Buses (grams/mile)

	# of Buses (2)	NO _x		PM		CO		CO ₂		THC(3)		NMOC	
		Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Overall													
CNG (1)	77	19.6	9.7 - 30.4	0.03	0.01 - 0.10	8.46	0.30 - 21.80	2431	2026 - 2785	17.51	9.30 - 26.06	1.7	0.6 - 3.2
Diesel (1)	72	29.2	22.0 - 54.5	0.70	0.02 - 2.53	6.53	0.10 - 23.50	2716	2472 - 2886	1.48	0.00 - 3.30		
Hybrid	9	17.3	12.9 - 27.7	0.09	0.01 - 0.20	0.56	0.01 - 0.20	2011	1654 - 2472	0.17	0.01 - 0.49		
Newer buses only (engine years 1996-2001)													
CNG	57	19.1	9.7 - 27.5	0.03	0.02 - 0.10	7.70	0.30 - 15.20	2431	2026 - 2785	19.22	15.20 - 26.06	1.7	0.6 - 3.1
Diesel	28	27.3	23.8 - 28.3	0.22	0.02 - 0.77	2.02	0.10 - 4.80	2716	2472 - 2886	0.14	0.00 - 0.46		
Hybrid	9	17.3	12.9 - 27.7	0.09	0.01 - 0.20	0.56	0.01 - 0.20	2011	1654 - 2472	0.17	0.01 - 0.49		

(1) One set of tests run by the California ARB included one CNG-fueled bus, and one diesel bus (tested with trap and catalyst). According to the technical report the results were not corrected for the "tunnel blank" (i.e. background levels), and that "in some instances, the total PM levels measured during tunnel background tests are often at similar levels as the actual PM filter samples collected." It also appears that this methodology was different from the other methodologies used in testing other buses. These three bus tests were excluded from the summaries.

(2) Refers to the minimum total number of buses tested (where reported). The number tested in any one study ranged from 1 to 24. Each bus was run through a number of test cycles, usually 3-4, which was averaged to produce the mean emissions numbers. For some studies, the individual bus data is available, while for others only the summary data was provided. The means reported here are the means of the summary results from each of the studies.

(3) Total hydrocarbons (THC) are generally measured for the diesel and hybrid buses. For the CNG buses, non-methane organic carbons (NMOC) are measured, with methane sometimes measured separately. This relates to EPA regulatory standards and the different implications/effects of methane and non-methane carbon compounds. For this summary, where NMOC and methane were reported separately, they were combined to provide a THC measure.

Table 2 Summary of Emissions from In-Service Transit Buses (grams/mile) using various pollution control measures (1,2)

	# of Buses (3)	NO _x		PM		CO		CO ₂		THC(4)		NMOC	
		Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
CNG – no treat	49	22.4	18.1 - 27.5	0.04	0.02 - 0.10	9.3	2.60 - 15.20	2343	2026 - 2605	17.8	--		
CNG – cat.	8	15.7	9.7 - 25.0	0.02	0.02 - 0.02	6.1	0.30 - 12.70	2520	2343 - 2785	19.58	15.20-26.06	1.7	0.6 - 3.2
Diesel w/LSD + none	14	29.7	29.3 - 30.2	0.53	0.29 - 0.77	4.5	4.20 - 4.80	2545	2472 - 2619	--	--		
Diesel w/LSD + cat.	4	27	24.0 - 30.1	0.23	0.22 - 0.24	2.55	2.10 - 3.00	2789	2779 - 2800	0.18	0.14 - 0.22		
Diesel w/ULSD + cat	6	26.8	25.3 - 28.3	0.14	0.11 - 0.16	1.85	1.20 - 2.50	2765	2644 - 2886	0.28	0.09 - 0.46		
Diesel w/ULSD + trap	5	26.3	23.8 - 31.1	0.07	0.02 - 0.14	0.13	0.10 - 0.20	2747	2513 - 2875	0.03	0.00 - 0.06		
Hybrid w/LSD + trap	6	16.2	13.3 - 19.2	0.07	0.01 - 0.12	0.1	0.10 - 0.10	2041	1820 - 2262	0.11	0.08 - 0.14		
Hybrid w/ULSD + no treat.	1	13.2	--	0.2	--	2.1	--	1654	--	0.49	--		
Hybrid w/ULSD + trap	2	20.3	12.9 - 27.7	0.01	0.01 - 0.01	0.25	0.10 - 0.40	2160	1848 - 2472	0.06	0.01 - 0.11		

(1) none = after treatment specified as "none" or not mentioned; cat = oxidation catalyst; trap = particulate trap

(2) LSD = low sulphur diesel, approx 300-500 ppm sulphur; ULSD = ultra low sulphur diesel, max of 30 ppm sulphur

(3) Refers to the minimum total number of buses tested (where reported). The number tested in any one study ranged from 1 to 24. Each bus was run through a number of test cycles, usually 3-4, which was averaged to produce the mean emissions numbers. For some studies, the individual bus data is available, while for others only the summary data was provided. The means reported here are the means of the summary results from each of the studies.

(4) Total hydrocarbons (THC) are generally measured for the diesel and hybrid buses. For the CNG buses, non-methane organic carbons (NMOC) are measured, with methane sometimes measured separately. This has to do with EPA regulatory standards, and the different implications/effects of methane and non-methane carbon compounds. For this summary, where NMOC and methane were reported separately, they were combined to provide a THC measure.

References:

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