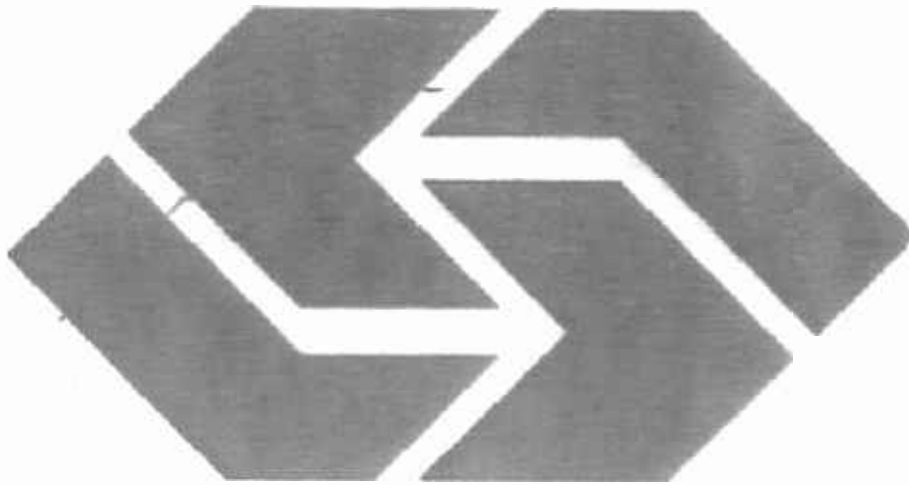


METHANOL STATUS REPORT

JANUARY 1990



**SOUTHERN CALIFORNIA
RAPID TRANSIT DISTRICT**

STATUS REPORT

on

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METHANOL TEST FLEET

JANUARY 1990

by

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1.0 EXECUTIVE SUMMARY

The Southern California Rapid Transit District (SCRTD) is testing the feasibility of operating buses on methanol versus diesel fuel. For the purpose of this test, 30 methanol buses were purchased from the Transportation Manufacturing Corporation (TMC). These 30 are part of a 2582 bus fleet.

The first methanol bus was placed into revenue service on June 12, 1989. As of January 31, 1990, 29 methanol buses were in service. This fleet has operated 303,688 miles since its activation.

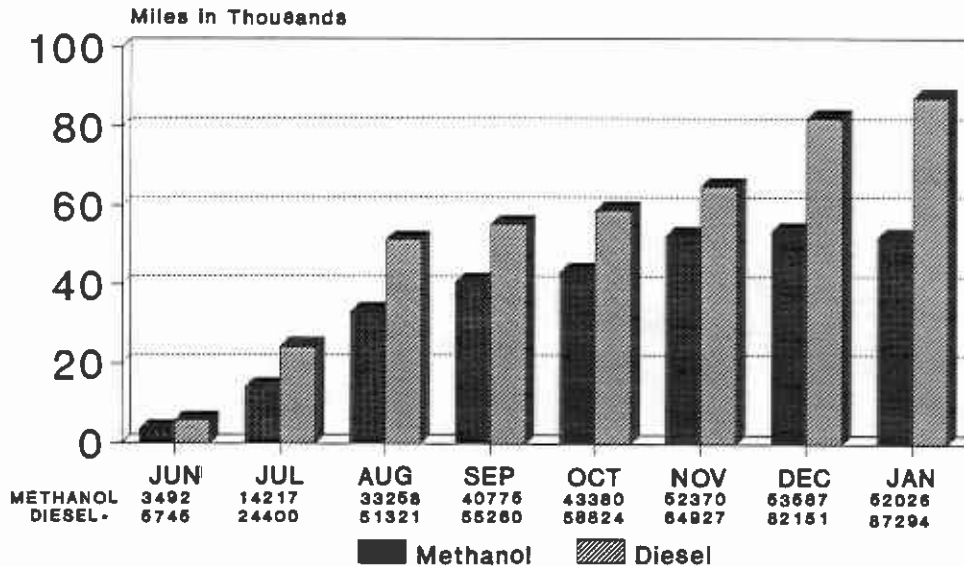
These buses are being operated on heavy city, Central Business District (CBD) transit lines. SCRTD purchased 267 diesel buses from TMC just prior to the methanol bus purchase. Thus a comparison can be made between identical diesel buses under similar operating conditions.

During January methanol buses achieved 1.05 miles per gallon (mpg) compared to 3.29 mpg for diesel buses. The engine compression ratio was upgraded on two buses. Fuel injector replacement levels decreased slightly while glow plug replacement levels increased. However, fuel injector reliability remains a major obstacle to the successful deployment of methanol technology.

2.0 MILEAGE ACCUMULATION

The methanol bus fleet accumulated 52,026 miles during the month of January 1990. The project has accumulated 303,688 life miles. Information on mileage accumulated per bus is provided in Table One. Total monthly mileage accumulation is depicted in Figure One.

Figure One
MONTHLY MILEAGE ACCUMULATED
JUNE 1989 TO JANUARY 1990



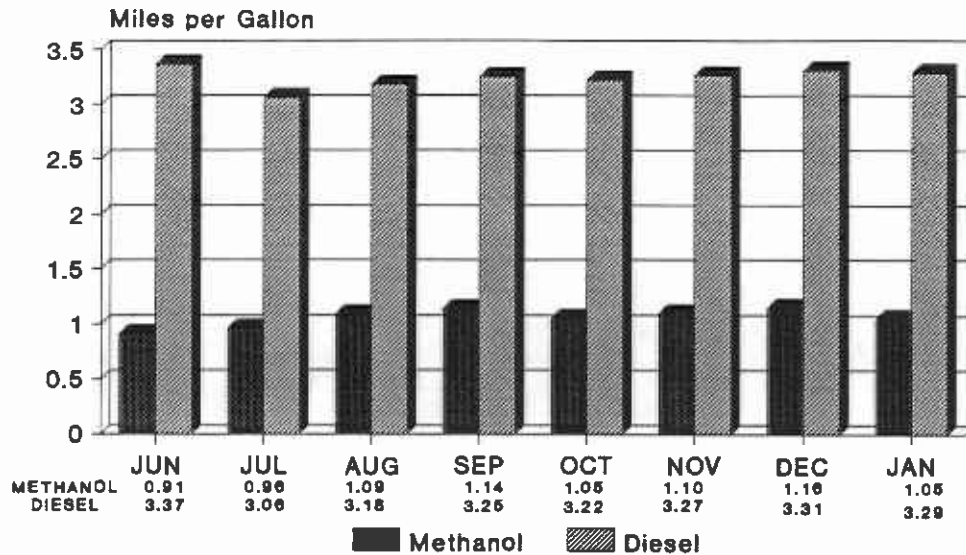
-- Variance in mileage between methanol and diesel fleets can be attributed to diesel fleet operating on weekend service.

3.0 FUEL ECONOMY

The methanol fleet fuel economy average decreased in January from 1.12 miles per gallon (mpg) to 1.05 mpg. The TMC-RTS II diesel comparison fleet fuel economy average remained the same at 3.29 mpg. Fleet fuel economy averages are indicated in Figure Two.

Six methanol buses experienced a dramatic decrease in fuel economy. A review of part replacement and oil sample data suggests that this reduction can be attributed to leaking fuel injectors. The installation of a new engine package in bus 1979 further contributed to lower fuel economy. Excluding these six buses, the fleet fuel economy average would have been 1.09 mpg.

Figure Two
FLEET FUEL ECONOMY AVERAGES
JUNE 1989 TO JANUARY 1990



Methanol vs. Diesel

4.0 ROAD CALLS

There were 26 methanol related road calls during January. "Engine Stalled" continues to be the most frequently reported problem. A breakdown of January methanol related road calls is provided in Figure Three. A comparison of miles between engine related road calls by engine type is provided in Figure Four.

Figure Three
METHANOL RELATED ROAD CALLS
JANUARY 1990

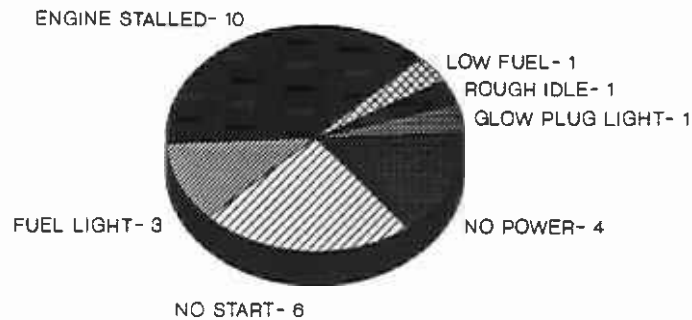
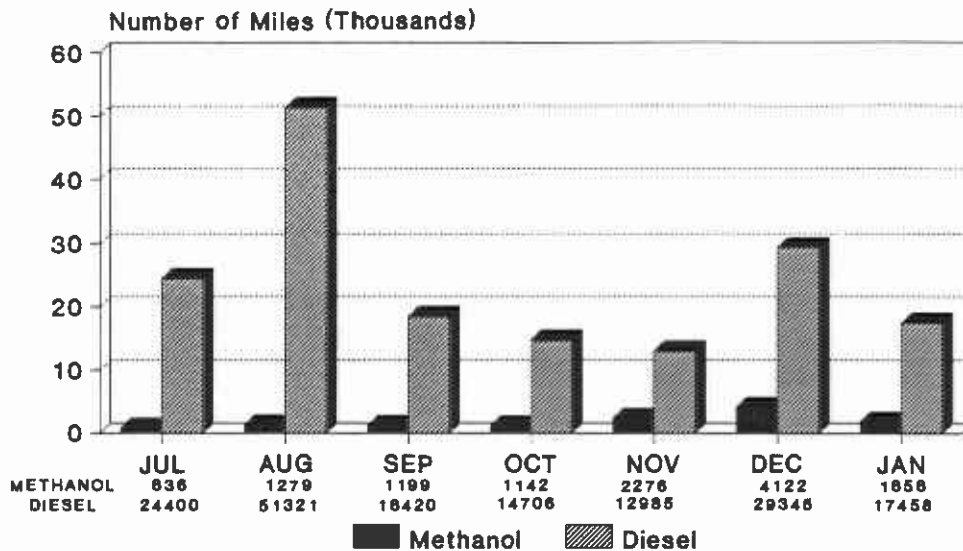


Figure Four
MILES BETWEEN ENGINE RELATED ROADCALLS
JULY 1989 TO JANUARY 1990



Methanol vs. Diesel

5.0 ENERGY CONSUMPTION

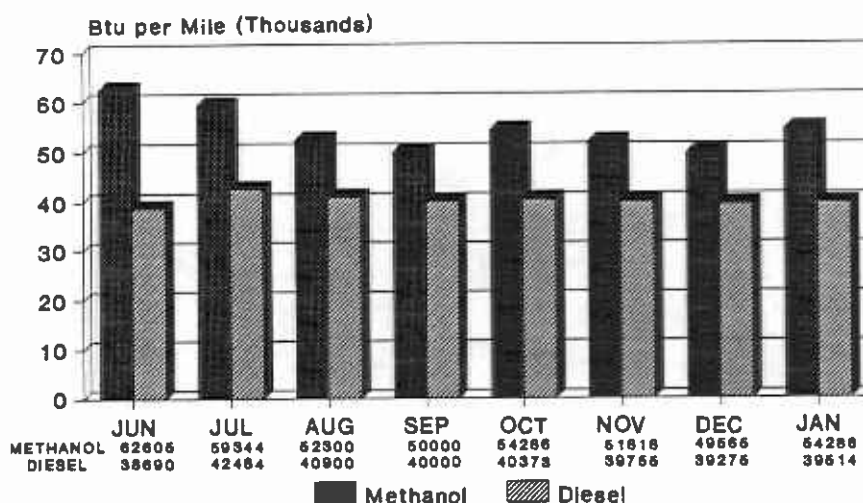
An energy consumption average can be calculated to compare test fuel economy data. This average compares the energy needed to power a methanol bus the same distance as its diesel counterpart and is measured in British Thermal Units (Btu) per mile. The lower the Btu's needed per mile, the more efficient the fuel's energy transference.

Methanol buses averaged 54,286 Btu per mile, while diesel buses averaged 39,514 Btu per mile. This is depicted in Figure Five.

6.0 FUEL INJECTORS

A total of 446 fuel injectors have been replaced as of January 31, 1990. Fuel injector replacement levels decreased 24 percent from December 1989 to January 1990. However, the actual number of injectors replaced remained high. A total of 64 injectors were replaced during January. A breakdown of methanol related parts replacements, including fuel injectors replaced per bus, is provided in Table Two.

Figure Five
EQUIVALENT ENERGY CONSUMPTION
JUNE 1989 TO JANUARY 1990



Methanol vs. Diesel

7.0 GLOW PLUGS

Glow plug replacement levels increased to their highest monthly total during January. A total of 66 glow plugs were replaced. The majority of these glow plugs were damaged when faulty glow plug controllers allowed unregulated voltage to reach the glow plug. A comparison of glow plug and fuel injector replacements is provided in Figure Six.

8.0 RETROFIT PROGRAMS

The three primary retrofit programs are:

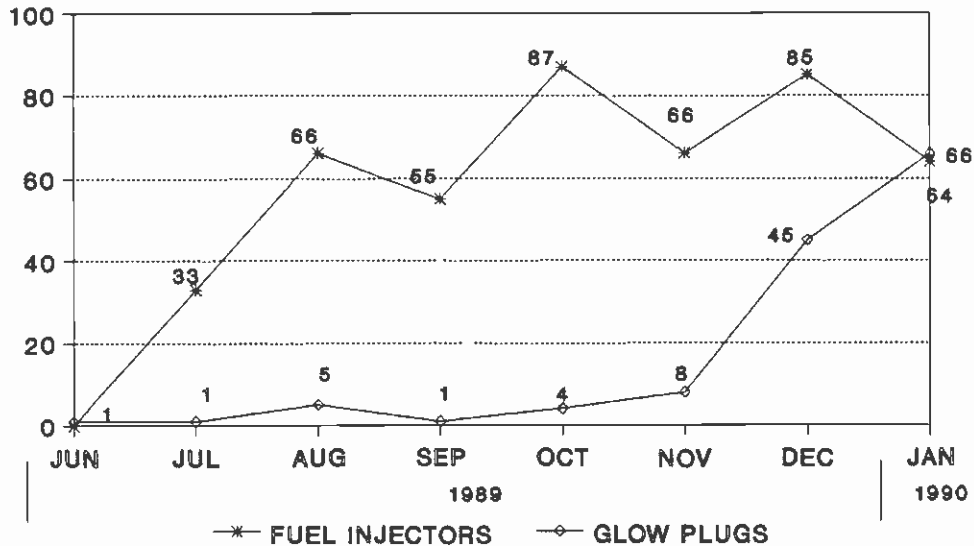
- Engine upgrade to 23:1 piston compression ratio.
- Exhaust catalyst installation.
- Vertical exhaust installation.

The engine compression ratio upgrade was started in December 1989. Fifteen buses are scheduled to be modified during the first phase of this retrofit program. As of January 31, 1990, five buses were modified.

The exhaust catalyst installation is scheduled to begin in February 1990. Catalysts will be installed in all 30 methanol buses.

The vertical exhaust modification was completed on one bus during January. Seventeen additional buses need to be modified.

Figure Six
 FUEL INJECTOR/GLOW PLUG
 MONTHLY REPLACEMENT TOTALS



9.0 OIL CONSUMPTION

SCRTD is testing two different brands of engine oil in the methanol fleet. The majority of the fleet is using an oil provided by Lubrizol. Five buses are using an oil provided by UNOCAL. Both oils have been specifically formulated for use in methanol engines. Bus oil consumption totals are provided in Table Three.

Engine oil samples are being taken every 1000 miles for the first 6000 miles of bus operation. Samples are taken every 3000 miles thereafter. Each sample is analyzed for contaminant sources, fuel dilution, viscosity, water and wear metal sources. Bus oil sample totals are also provided in Table Three.

10.0 CONCLUSIONS

Glow plug replacement levels have increased over a two month period. Although glow plugs do not pose as serious a problem as fuel injectors, this steady increase still merits careful review.

Fuel injectors continue to be a significant project concern. A reduction in the amount of leaking and plugged fuel injectors is imperative before methanol buses will obtain the same level of reliability as their diesel counterpart.

TABLE 1

MONTHLY METHANOL / DIESEL COMPARISON

(JANUARY 1, 1990 --> JANUARY 31, 1990)

DATE	IN-SERVICE	IN-SERVICE	IN-SERVICE	IN-SERVICE	IN-SERVICE	EQUIVALENT	
IN-SERVICE	METHANOL	MILEAGE	FUEL	DIESEL	MILEAGE	FUEL	ENERGY
	BUS	ACCUMULATED	ECONOMY	BUS	ACCUMULATED	ECONOMY	RATIO
	#	(MI)	(MI/GAL)	#	(MI)	(MI/GAL)	[MO]
		[MO/TOT]	[MO]		[MO/TOT]	[MO]	
06/19/89	1970	2042/14920	0.97	2170	3217/23454	3.48	3.59 : 1
07/31/89	1971	N/A	N/A	2171	2561/18899	3.23	N/A
	1972			2172			
07/06/89	1973	2155/14221	1.07	2173	3591/23477	3.36	3.14 : 1
07/06/89	1974	1147/16540	1.01	2174	2602/21322	3.22	3.19 : 1
08/04/89	1975	N/A	N/A	2175	N/A	N/A	N/A
06/12/89	1976	2101/16256	0.92	2176	3492/24005	3.30	3.59 : 1
08/16/89	1977	N/A	N/A	2177	3128/9501	3.23	N/A
08/02/89	1978	1800/13555	1.08	2178	3315/20599	3.29	3.05 : 1
07/18/89	1979	601/11007	0.81	2179	3959/20744	3.38	4.17 : 1
09/05/89	1980	1455/9769	0.98	2180	N/A	N/A	0.00 : 1
08/03/89	1981	2073/14264	1.10	2181	3811/20841	3.17	2.88 : 1
10/26/89	1982	2464/6497	1.07	2182	2493/10595	3.21	3.00 : 1
06/12/89	1983	1714/13315	1.14	2183	3338/27980	3.24	2.84 : 1
10/30/89	1984	2244/5513	1.08	2184	3545/11477	3.28	3.04 : 1
10/17/89	1985	2692/8778	1.08	2185	N/A	N/A	N/A
07/18/89	1986	1234/14160	0.98	2186	2995/19235	3.30	3.37 : 1
11/08/89	1987	2445/6795	1.07	2187	2463/6033	3.26	3.05 : 1
10/31/89	1988	N/A	N/A	2188	3682/10877	3.47	N/A
11/28/89	1989	2648/5129	1.12	2189	3891/6223	3.18	2.84 : 1
11/28/89	1990	2152/4878	1.09	2190	4176/8249	3.21	2.94 : 1
12/01/89	1991	2483/4198	1.07	2191	2786/6661	3.24	3.03 : 1
11/21/89	1992	2316/5195	1.14	2192	3931/6937	3.37	2.96 : 1
12/06/89	1993	2062/4032	0.95	2193	3568/6960	3.53	3.72 : 1
12/14/89	1994	2668/3724	1.11	2194	3605/6399	3.27	2.95 : 1
07/06/89	1995	2171/15147	1.11	2195	3535/25186	N/A	N/A
07/31/89	1996	2524/12759	1.04	2196	3617/18471	3.25	3.13 : 1
07/31/89	1997	2515/13511	1.15	2197	2627/17747	N/A	N/A
08/16/89	1998	2509/12717	1.13	2198	4005/21551	3.28	2.90 : 1
06/12/89	1999	1811/17012	1.10	2199	3361/26788	3.32	3.02 : 1
FLEET TOTAL		52026/303688		87294/420131			
FLEET AVERAGE			1.05			3.29	3.13 : 1

TABLE 2

METHANOL ENGINE RELATED PART REPLACEMENT

(JANUARY 1, 1990 --> JANUARY 31, 1990)

BUS #	IN SERVICE	GLOW PLUGS [MO/TOT]	GLOW PLUG CONTROLLER [MO/TOT]	REPLACE INJECTORS [MO/TOT]	FUEL FILTERS [MO/TOT]	OTHER [MO]
1970	X	1/4		6/19	0/5	
1971	X	10/11	1/1	0/8	1/5	HALON DISC
1972						
1973	X	1/1		0/10	1/4	
1974	X	1/6		4/25	1/3	
1975	X			0/9	1/5	
1976	X	0/7	0/6	4/29	1/4	
1977	X	13/14	2/2	3/15	0/2	
1978	X	6/9	0/2	3/17	0/4	
1979	X	6/12	1/2	1/23	0/4	ECM PROM
1980	X		0/1	0/13	0/1	
1981	X	7/15		5/21	0/3	
1982	X	0/13	0/2	1/8	0/1	
1983	X	6/6		1/21	0/2	23:1 UPGRD
1984	X	0/1		1/7	0/1	
1985	X	0/7		2/18	1/2	
1986	X	6/17	1/1	2/24	0/1	
1987	X			4/11	0/1	
1988	X	0/6			0/1	
1989	X	0/6		3/11	1/2	
1990	X	0/6	0/1	6/8	1/2	
1991	X	0/6	0/1	3/7	1/2	
1992	X			1/3	1/2	
1993	X			4/11	0/1	ECM PROM
1994	X			3/9	1/2	
1995	X			0/26	1/3	
1996	X	2/4		0/12	0/5	23:1 UPGRD
1997	X	0/6	0/1	0/42	1/3	
1998	X			1/17	1/3	
1999	X	7/8	2/4	6/22	0/3	
TOTALS	29	66/165	7/24	64/446	14/77	

Table 3

METHANOL OIL CONSUMPTION

(JANUARY 1, 1990 TO JANUARY 31, 1990)

BUS NUMBER	OIL CONSUMPTION (Qt) [MO/TOT]	NUMBER OIL SAMPLES [MO/TOT]	OIL & FILTER CHANGE [MO/TOT]
1970	12/80	1/13	0/5
1971	2/22	2/8	1/2
1972	N/A	N/A	N/A
1973	3/23	1/11	1/4
1974	7/23	1/11	1/4
1975	2/20	1/9	1/4
1976	4/35	2/11	2/4
1977	0/41	0/7	1/2
1978	3/34	1/10	1/3
1979	4/42	1/9	2/4
1980	4/24	1/8	0/2
1981	8/45	0/10	1/6
1982	7/16	4/7	1/4
1983	3/40	1/11	1/3
1984	12/26	2/5	1/2
1985	12/45	0/7	1/3
1986	3/42	3/13	2/5
1987	8/13	3/7	1/2
1988	11/33	2/4	0/0
1989	10/10	3/5	1/2
1990	3/4	2/4	1/2
1991	4/4	3/4	1/2
1992	6/10	3/5	1/2
1993	8/8	3/4	0/2
1994	10/12	4/4	0/1
1995	4/48	2/12	1/4
1996	5/33	1/8	1/3
1997	9/42	0/9	0/2
1998	13/35	1/9	1/4
1999	8/41	0/13	0/4
Total	181/851	58/238	25/87