SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

AN EVALUATION OF ARTICULATED BUSES
(CA-08-0089)

AUGUST, 1981

Revised 5-1-82

TABLE OF CONTENTS

INTRODUCTION

This is the final report for: An Evaluation of Articulated Buses (SCAG 8052.02/CA-09-0089). The report will review findings, draw conclusions, and make recommendations regarding the District's initial implementation of service and in-service analysis of thirty, AMG/MAN, sixty foot, three door articulated buses (AB) purchased in 1978.

The evaluation will concentrate on three areas of review and analysis:

- Operations
  - Deployment
  - Reliability
  - Productivity
  - On-time Performance
  - Stops and Zones
  - Safety
- Maintenance
  - Road Calls
  - Major Problem Areas
  - Parts Cost Comparison
  - Fuel Mileage Comparison
- Marketing Survey
  - Public and Operator Attitudes

Results of this evaluation are intended to generally guide the District in determining the potential applicability of high capacity articulated buses as well as guide SCRTD in making decisions regarding future acquisitions and utilization.

The over-riding factor behind the initial purchase and subsequent evaluation is for the District to determine if articulated buses can improve the revenue/cost ratio for transit operations.

BACKGROUND

Approximately two-thirds of the cost of transit operations in the U.S. can be attributed to labor costs. In an effort to more efficiently utilize driver and vehicle resources, thirty, sixty foot, three door, AMG/MAN articulated buses were purchased for evaluation.

It is the District's purpose to determine whether or not the characteristics and benefits attributed to articulated buses, could assist the District in better utilizing manpower and equipment to achieve a more cost effective operation.

In order to determine if articulated buses could assist in achieving this goal, the District decided to mix aritculated and standard buses on two heavily patronized local-service bus lines, the 83 and 91 serving Wilshire and Sunset Boulevards in the West Los Angeles area. Since there was a constraining factor of limited carrying capacity on both lines, it was hypothesized that by adding AB's to the lines, capacity and revenue would be improved at little or no increase in operating cost.

From an operation standpoint, Lines 83 and 91 provide an excellent test ground for the AB's. Under conditions of severe overcrowding and chronic traffic congestion, an accurate vehicle performance assessment could be conducted.

Line 83 carries more passengers than any other line in SCRTD's system. It averages 68,500 daily boardings or 77 passengers per vehicle hour; this is more passengers than many rapid rail lines now carry. A total of 93 buses are assigned to the line, and they operate at one minute headways during A.M. and P.M. peak periods.

The residential density within a one mile band along Line 83 averages 15,000 persons per square mile. Employment density averages 22,000 persons per square mile.

Geographically, Line 83 extends from the central business district (CBD) of downtown Los Angeles, westward through the communities of Century City and Beverly Hills terminating in the beach city of Santa Monica. The line is 19.1 one-way route miles in length.

Patronage on Line 91 averages 40,000 daily boardings or 79 passengers per vehicle hour. A total of 50 buses are assigned to the line.

The residential density within a one mile band along Line 91 averages 4,350 persons per square mile while employment density averages 7,455 persons per square mile.

Line 91 extends 16.2 one-way route miles from Los Angeles (CBD) through Hollywood and Century City terminating in Santa Monica.

OPERATIONS

DEPLOYMENT:

In order to determine how articulated buses should be deployed, an inventory of eligible lines was compiled. The criteria used in developing this list were: frequency of service, operating maintenance bases, non-revenue vehicle miles saved, patronage, revenue based on increased carrying capacity, traffic congestion, equipment mix and scheduling. The initial list identified 14 preliminary lines (Appendix I).

Other factors which contributed to the selection of Lines 83 and 91 were:

- Both lines have the highest midday ridership of all candidate lines listed in Appendix I.
- They operate with standees at all hours of the day or night.
- Both lines have a greater capacity to test the articulated's ability to alleviate overloading, and they have high visibility.
- Both lines work out of the same Operating/Maintenance division (3207/3307). This is currently the only division with service bays large enough to accommodate the larger bus.
- Lines 83 and 91 have terminal facilities which are suited to the larger bus.

OPERATIONS (Continued)

- Modification of stops and zones are minimized.
- Both lines operate on wide streets which allow for easy maneuverability.

Service was initiated first on Line 83 in October, 1978 and shortly, thereafter, on Line 91. However, after all buses were received and phased into service, they became so unreliable that the evaluation had to be temporarily cancelled until air conditioning electrical problems could be resolved. The "fix" was so extensive that to correct the problem, a major portion of the electrical system had to be modified. This resulted in a delay of approximately one year before the evaluation could be resumed.

Based on data obtained in March of 1981, articulateds are deployed as follows:

	AM PEAK	BASE PERIOD	PM PEAK
Line 83	10	10	10
Line 91	18	11	18
	28	21	28

Traffic and loading conditions are particularly severe on both Lines 83 and 91. Congestion is common place at all times of the day and night. Heavy stop and go traffic during the AM and PM peak periods is the rule rather than the exception. Operations on these lines are also characterized by bus stop locations approximately every 200 yards and 2 lanes of traffic in each direction.

RELIABILITY:

Concern has been expressed regarding the reliability of AB's. In order to properly address this issue, two evaluation periods were selected. The first evaluation was conducted in March, 1981 during a period of cool weather, and the second evaluation occurred in July, 1981 during hot weather when air conditioning would be required. The July evaluation was decided upon in order to determine if high temperatures and the use of air conditioning would affect the reliability of articulated buses.

Thirty articulated and forty-eight series 3100 G.M.C.'s, model #T8H-5307A were evaluated. During the first evaluation, March 16, 1981 through March 31, 1981, eighty-two (82) percent, or an average of 24.7 out of 30 articulated buses were available for service each day of the test period - Saturday, Sunday and holidays excluded. During the same period, ninety-seven (97) percent, or an average of 46.6 out of 48 G.M.C."s were available for service each day of the evaluation exclusions noted.

During the second test periods, July 20, 1981 through July 31, 1981, the temperature averaged between 83°F and 96°F. As in the March, 1981 evaluation, AB's were compared to G.M.C. model #T8H-5307A buses. Articulated buses exhibited a 51% reliability factor with an average of 15.3 out of 30 buses available for service each day. The G.M.C. buses maintaned a 98% reliability factor with an average of 47 out of 48 buses available for service each day of the evaluation period.

Comparing results from both test periods, the reliability of the G.M.C.'s changed only 1% from 97% reliability to 98%. Much more dramatic, was the change for the articulated buses. They dropped from 82% in March to 51% in July. When reasons for the change were investigated, there was a definite correlation between hot weather, air conditioning and over heating problems which required buses to be taken out of service.

During the interim period between March, 1981 and July, 1981, several reliability spot checks were also conducted. On June 24, 1981, when the temperature reached 103°F, there were only 13 out of 30 AB's available for service. This translates to 43% reliability/availability. On several other occasions reliability was determined to be 77% and 80%. The latter totals were calculated during May, 1981 when the temperatures averaged in the low 70's.

Since no long term reliability tests have been conducted, it is impossible to determine the AB's overall dependability. Weather is a definite factor as it relates to the use of air conditioning and subsequent equipment failure. Trends are discernable with reliability averaging about 80% during optimum weather conditions and 50% to 60% during periods of hot weather.

As improvements have been made to air conditioning and other systems, reliability for the AB's has been improved. However, there does appear to be a point of diminishing returns beyond which additional retrofit programs will not significantly improve the reliability of the articulated buses.

OPERATIONS (Continued)

Although air conditioning continues to be a problem, it should be remembered that currently, this is not the only factor which has affected reliability. Doors, transmissions, heating systems and engine problems combine to account for over 46% of articulated equipment failures (Table V).

PRODUCTIVITY:

A review of passenger carrying characteristics of articulated and standard buses on Lines 83 and 91 reveal that out of 924 total trips completed on both lines during a 4 day evaluation, 153 or 17% were completed by articulated buses.

Of the 153 AB trips, the number of on-board passengers ranged from a low of 2 to a high of 116 with a mean of 61.7 and a standard deviation of 24.2 (Appendix II).

When AB's were compared to conventional buses, seven hundred and seventy-one (771) trips or 83% of a total of 924 were provided by conventional buses. On-board passengers ranged from a low of 0 to a high of 104, with a mean of 53.6 and a standard deviation of 21.1 (Appendix II). Combining data from Line 83 and 91 for all conventional and articulated bus trips (924), the maximum number of on-board passengers ranged from 0 to 116, with a mean of 54.9 and a standard deviation of 21.9 (Appendix II).

Although the AB's exhibited a higher carrying capacity, their potential for eliminating overcrowding on the test lines did not achieve the level of relief originally anticipated. This has been due to several factors. First, the AB's are underpowered. As a result, they are not able to maintain their schedules. As they become late, overcrowding is experienced. This, in turn, results in even further delays. A second factor which contributes to delays has been the attitude of the operators. They tend to be intimidated by the buses' larger size and operate them more cautiously. This results in further delays and subsequent overcrowding. It should also be noted that longer dwell times due to more people boarding and alighting also contributed to the overall problem of delays and overcrowding.

In an effort to assign articulated buses in situations where their carrying capacity could be more effectively utilized, plans to deploy them on Lines 308 and 309 "Limited" service will be initiated in September, 1981.

Schedules will be written to accommodate their slower operation and greater capacity. This should eliminate the bunching experienced with the mixed mode operation and, hopefully, will enable the AB's to run on schedule.

Since AB's will be used on the same bus run each day, it is believed that operators will gain confidence in their ability to operate the equipment. As a result, on-time performance should improve with a corresponding reduction in overcrowding. The proposed operation will be evaluated when placed into service in September, 1981.

When we examine how effectively both conventional and AB buses are utilizing their available seating capacity, the conventional bus averaged 53.6 passengers or 105%* of their seated load capacity. The higher capacity articulated bus averages 61.7 passengers or 95% of their seated load capacity.

Although the articulated's extra carrying capacity is being used, more effective utilization should result when the new service, previously mentioned, is implemented in September, 1981.

---

* Assumes the use of a 51 seat coach

ON-TIME PERFORMANCE:

When AB's were placed into service, they were substituted for standard buses on a one-for-one basis without scheduling modifications. It was not known whether the articulateds would be able to maintain proper headways. In order to determine their on-time performance, data was collected on Line 83 using Automatic Vehicle Monitoring (AVM) technology. A total of 100 observations/trips were evaluated over a four day period. Running time variation was observed and analyzed for both standard 40' buses* and AB's. A summary of the data is presented in Appendix III.

Observations were made for both eastbound and westbound trips in both limited stop and local service. Data was also collected for three time periods:

- Early Morning (A.M.) 6:30-8:59
- Mid-Day 9:00 A.M. - 3:29 P.M.
- Evening (P.M.) 3:30 - 6:00

Rather than discussing the data in detail, trends will be reviewed. The data is simple and easily interpreted; therefore, a detailed review of the data will be left to the reader.

Eastbound running time variation for articulated buses and standard buses in local service, shows that the AB's require, on an average. 1.9 minutes longer to cover the same distance as a standard bus in the early morning. As time progresses to mid-day and the P.M. periods, 1.3 and 2.9

---

*GMC model T8H-5307A bus manufactured in 1974 were used for study comparison.

additional minutes, respectively, are required by the AB's over the standard coaches when traveling the same distance. The average alotted running time for east and westbound trips on the test line were 79.4 minutes during the A.M. peak period, 86.0 minutes for midday and 91.6 minutes during the P.M. peak period.

Running time variation for eastbound limited service shows a similar pattern. During the A.M., the AB's average 4.5 minutes longer on the same trip, and during the P.M., 5.5 minutes longer. No mid-day limited service was scheduled.

Westbound local service shows similar differences in running time variation. Differences of 4.5, 6.6 and 5.5 minutes occur for the A.M., Mid-day and P.M. periods, respectively. The AB buses consistently take longer to cover the same distances/routes.

The slower operation of the AB's can be attributed to a combination of operator cautiousness, slow acceleration, lower top speed, poor load distribution and longer dwell times.

Westbound limited trips continue the pattern. Differences of 9.7 and 5.7 minutes appear for A.M. and P.M. articulated trips. When looking at the distribution of additional time required by AB's, the mean time for an articulated bus to complete a one-way A.M., Mid-day and P.M. trip as compared to a standard bus is shown below:

OPERATIONS (Continued)

TABLE I

ARTICULATED

Mean Running Time Variation (RTV) &
Standard Deviation in Minutes

	AM	MID-DAY	PM
	RTV/STD. DEV.	RTV/STD. DEV.	RTV/STD. DEV.
Westbound (local)	7.00/ 4.8	8.53/2.96	4.60/4.58
Westbound (limited)	25.50/17.72	---	8.00/0
Eastbound (local)	.60/ .66	2.55/1.16	3.00/5.05
Eastbound (limited)	3.37/ 2.53	---	8.50/8.79

TABLE II

STANDARD BUS

Mean Running Time Variation (RTV) &
Standard Deviation in Minutes

	AM	MID-DAY	PM
	RTV/STD. DEV.	RTV/STD. DEV.	RTV/STD. DEV.
Westbound (local)	.35/8.19	1.90/2.19	-2.50/4.96
Westbound (limited)	7.30/ .50	---	2.23/6.26
Eastbound (local)	- 1.33/ .53	1.20/1.48	.05/3.86
Eastbound (limited)	- 1.13/ .09	---	3.03/2.99

When running standard buses and AB's in a mixed mode operation without schedule modifications, the significance of 1.6 to 12.0 minutes of additional running time per trip for AB's becomes important when you consider that Line 83 maintains 4 minute headways during peak periods. The additional running time certainly explains operation problems which have been experienced -- poor on-time performance, bunching, scheduling and reduced effective capacity in a given period.

STOPS AND ZONES:

With the increased length (60') of the articulated bus over a standard bus (40'), it was recognized that bus stops and zones would have to be lengthened and modified.

Prior to the implementation of service on Lines 83 and 91, a survey was made of bus stop zones on both lines. There were 538 total stops, 302 of which had to be lengthened by a minimum of 20'. This extended these zones from the minimum 80' to 100' or more. A "standard" nearside loading zone is 80' long.

In order to accomplish the required changes, work had to be coordinated in four jurisdictions: City of Los Angeles, County of Los Angeles, City of Beverly Hills and the City of Santa Monica. Appendix IV summarizes the work which was performed in each of these areas.

Initially, the proposed modifications met resistance from the County of Los Angeles. They suggested that because there already existed a severe shortage of parking spaces and extreme traffic congestion in the proposed area of AB operation, more conventional buses should be added. This would reduce headways and provide additional carrying capacity without reducing existing parking.

The District responded to County concerns by pointing out that AB's were capable of carrying in excess of 91* passengers as compared to 71* passengers for a standard coach. As a result, it would take 36 standard 40' buses to equal the carrying capacity of 28 high capacity articulated buses. By using 28 AB's instead of 36 standard buses, the district would save $1,320,000 annually as well as contribute to a lessening of vehicular traffic congestion in the West Los Angeles area.

*Assumes a load capacity of 140%

Under the conditions set forth, the District would not add additional standard coaches when service would be improved at minimal additional cost with the assignment of articulated buses.

All other jurisdictions gave their approval for the required modifications as did the County after reconsideration.

SAFETY:

Prior to implementing service using articulated buses, it was recognized that there were inherent safety problems associated with the use of new equipment. In order to determine the magnitude of potential problems, traffic accidents and passenger accidents were monitored from October 29, 1978 through october 31, 1980.

The District evaluated the operation of 30 articulated buses. AB's, for the period of the evaluation, made up 1.2% of the total fleet, operated 1,322,200 miles or 1.34% of the fleet miles operated. AB's were involved in 236 or 2.1% of the system's 11,215 traffic accidents which occurred during the evaluation period.

Frequency rates show the AB's had a system accident frequency rate of 22.3 accidents for each 100,000 miles of operation while the frequency rate for standard buses was 6.4 accidents per 100,000 miles. The AB accident rate is 3.48 times the fleet average.

Thirty-three percent (33%) or 78 of the 236 accidents occurred when the bus was either making a left or a right turn. In 36% or 28 of the right and left turn accidents, the operpator was not aware of the collision. Many of this type of accident go undetected due to the operator's vision being blocked by the trailing unit and the cushioning effect of the articulated connection between the two units.

In an attempt to alleviate right and left turn accidents, the District posted signs on the rear of the buses which read "CAUTION - CORNER SWINGS DURING TURNS." The effect of the signs on reducing accidents has not yet been determined.

The most common type of traffic accidents which involved AB's during the evaluation are described in Table III.

TABLE III

SCRTD TYPE	REPORTED ACCIDENTS	DESCRIPTION
6	71	Bus making right turn, automobile in left lane struck by left rear corner of bus.
10	7	Bus making left turn, automobile in right lane struck by right rear corner of bus.
28	38	Automobile collides with bus while bus is at bus stop.
16	24	Bus sideswiped by automobile while passing bus.
19	7	Bus collides with automobile parked at curb.

Considering passenger accidents, the articulated buses have been involved in 60 or 2.9% of all passenger accidents in the system during the test period.

The most common types of AB passenger accidents are described below in Table IV.

TABLE IV

SCRTD TYPE	REPORTED ACCIDENTS	DESCRIPTION
53	18	Passenger falls alighting from front door.
63	16	Passenger falls as bus is stopping.

It was determined that the reason for passengers falling when alighting from the front door was due to the configuration of the bottom step. Both sides of the stairs were cut on an angle to give clearance for the doors. This angle sometimes causes a person to hook the heel of a shoe causing them to fall. The potential for the same problem existed for the rear door due to a similar configuration.

Early in its investigation, SCRTD recognized this potential safety hazard. In order to resolve the problem, the District equipped its articulated buses with safety features of its own design. There have been no recorded accidents since the District made these modifications in August, 1978.

OPERATIONS (Continued)

It was not until August, 1979 that the Office of Defect Investigation of the National Highway Traffic Safety Administration notified A.M. General advising them of the allegations of a safety defect. And not until February, 1981 that A.M. General released, for sale, "fix kits" to resolve the problem. Prior to this date, Washington D.C.; Oakland, California; San Rafael, California, and St. Paul, Minnesota transit agencies installed a "fix" identical to or very similar to the one designed by the SCRTD.

Appendix V lists all articulated bus accidents from October 29, 1978 through October 31, 1980.

MAINTENANCE

Since implementing articulated bus service, there have been problems with frequent breakdowns of certain AB components. Repairs and maintenance tasks take longer, parts are more expensive and more difficult to obtain and maintenance facilities are not adequate.

In order to describe and document some of the maintenance problems, a study of AB road calls was conducted. Appendix VI summarizes 15 categories which account for approximately 74% of the problems encountered by articulated buses. In descending order of frequency of occurrence are the following major problem areas:

TABLE V

(Articulated Road Call Problems*)

Doors	13.9%
Transmission	13.2%
Air Conditioning & Heating	9.8%**
Engine	9.5%
Miscellaneous (Accidents, Fire, Grab, Rail, Mirror, Headsign, Vandalism, Throttle)	8.4%
	54.8%

* See Appendix VI for a complete listing of road calls.

** This figure (9.8%) is lower than earlier implied due to retrofit programs which have improved air conditioning/heating performance reliability.

Of the aforementioned problems, air conditioning has been the most time consuming. At the time articulated service was first implemented, air conditioning problems accounted for 25% of all road calls for the articulated fleet. A review of air conditioning related problems showed that most were interlock sensor related. Remaining problems were associated with the overall electrical system.

The electrical system was extremely complicated. As a result, it was susceptible to breakdowns with problems being very difficult to locate and isolate. In order to improve the situation, M.A.N., in conjunction with Trane, made retrofits which eliminated half of the relays, all solenoids, and put the air conditioning electrical system on the main engine.

These simplifications resulted in fewer breakdowns and easier repairs. Improvements are reflected in a reduction of road calls of 15.2% from a previous high of 25% for the AB's.

During the evaluation period, 270,217 service miles were accummulated on 29 AB's. The buses averaged 1,016 miles between road calls. When compared to a fleet average of 2,139 miles, the articulateds show a frequency rate twice that of the overall fleet.

Another factor with which the District has had to contend is the higher cost of AB parts. In June, 1981, the Purchasing Department identified a representative sample of articulated and standard bus replacement and maintenance parts. The sample included similar parts which are commonly and frequently used in conjunction with the maintenance and repair of AB's, G.M.C. model T8H-5307A buses and G.M.C. RTS II-04 buses (Appendix VII). The list includes a total of 39 parts.

Averaging the cost of parts for both groups (G.M.C. part costs were combined), articulateds averaged $302.60 per part while G.M.C. part costs averaged $220.42 per part. The AB part costs are, on an average, 38% more expensive than the comparable parts for the G.M.C.'s.

The increase in fuel costs for the AB's is also of concern to the District. In June of 1981, fuel tests were conducted. Eleven articulated and five G.M.C. model T8H-5307A buses were used to test and compare fuel mileage. The test was conducted over a five day period from June 13 through June 17, 1981.

Fuel mileage for the G.M.C.'s ranged from a low of 1.4 m.p.g. to a high of 4.19 m.p.g. while the range for the AB's was from 1.34 m.p.g. to 2.85 m.p.g. Averages for both the AB's and G.M.C.'s were 1.76 m.p.g. and 2.85 m.p.g. respectively. Relating miles per gallon to fuel cost, the articulated buses cost the District 1.62 times more than the G.M.C.'s.

Another problem has been the lack of adequate maintenance facilities for the AB's. Currently, the District has only one maintenance base (West Hollywood) out of 11, which has service bays long enough to accommodate the larger bus. Even then, the bays are too narrow for convenient servicing of AB's.

Two new maintenance and operating facilities are in the process of being built. When completed, they will have service facilities large enough to accommodate any of the high capacity vehicles.

Other AB related factors which have had a major impact on the allocation of maintenance resources have been initial mechanic training costs, general service cycle costs, and 3 axle/turntable maintenance.

MARKETING SURVEY

An on-board survey of riders was conducted in May, 1980 to ascertain passenger opinions regarding the articulated bus and some of its features. On May 28, ten one-way trips on Line 83 and eight one-way trips on Line 91 were surveyed.

Two experienced interviewers distributed and collected self-administered questionnaires. A total of 1,056 usable questionnaires were obtained, approximately a 50% rate of return. The sample error at the 95% confidence level was ± 2.5%. A summary of the analysis is provided in Appendix VIII.

Overall, 67% of the respondents preferred to ride AB's in preference to standard buses. Males and riders under 50 years of age were more often in favor of AB's than were females and riders over 50. Seventy-five percent of the male respondents and 78% of those under 30 preferred articulated buses over standard coaches.

A majority of the respondents in all categories considered the AB's better than standard buses in terms of comfort. Sixty-three percent said the AB's were more comfortable, and 62% said the air conditioning was better.

Over 62% of the respondents thought the AB's were safer and over 93% indicated that it is easier to get a seat. More than 69% of those responding indicated the front entrance of the AB's was easier to use. Females and riders over 50 years old were more likely to claim that the rear exit was harder to use.

MARKETING SURVEY (Continued)

Sixty-one percent of the passengers surveyed preferred to sit in the front section of the bus. Among females, 74% preferred the front, and among respondents over 50, the percentage was 83. The chief reasons for preferring the front were: to watch for stops; avoid the smoking and radio playing and other activities that take place in the rear of the bus; to experience a better ride; to feel safer.

The reason given most often for preferring to ride in the rear of the bus was that it is less crowded and more comfortable. Nearly 83% of the respondents preferred to sit in forward-facing seats.

The line number display at the rear of the AB's was found to be helpful by 73% of the respondents. Most who said the display was not helpful, claimed that they had never seen it or that it was hard to find. A quarter of the respondents indicated the noise level on the AB's is higher than on the standard buses.

CONCLUSION

As was stated earlier, the over-riding factor behind the initial purchase and subsequent evaluation of the AB's, was to determine if they could improve the revenue/cost ratio for the District's transit operations. In order to accomplish this goal, it would be necessary to either reduce the cost of providing service or increase capacity and related revenue with relatively little cost increase.

CONCLUSION (Continued)

In a mixed mode operation without scheduling changes to accommodate the AB's, it was found that neither revenues nor operating cost savings could be maximized. In the case of revenues, they did not increase appreciably because of several factors. First, there must be a capacity-constraint on the existing service. By removing the constraint, ridership will increase causing revenues to improve. Although capacity-constraints were evident on Lines 83 and 91, a second factor, scheduling, was not modified so the AB's additional carrying capacity was never fully realized. With regard to operational cost savings, achieving this goal is dependent upon being able to use fewer buses, thereby, reducing both operator and vehicle costs. Since AB's were substituted on a one-for-one basis without scheduling changes, a savings in buses never occurred.

Generally, when all factors are taken into consideration, AB's in a mixed mode operation, are less cost effective than comparable standard 40' buses. This conclusion is based on findings of increased fuel, maintenance and parts cost; poor on-time performance; reduced equipment reliability; higher initial start up costs and lower productivity than was found for standard G.M.C. coaches to which they were compared. The revenue/cost ratio of .50 and .52 for AB's and standard buses, respectively, supports this conclusion (Appendix IX).

CONCLUSION (Continued)

This is not to say that AB's are not cost effective under different conditions - only that they were not found to be effective under the circumstances described. Further evaluation is planned for the AB's. In September, 1981, the mixed mode operation will be terminated and AB's will be placed in "Limited" service on Line 308. They will be the only buses to provide service on Line 308 during the base period and schedules will be written to accommodate their slower operation and higher capacity. An evaluation as to their cost effectiveness will be prepared and final recommendations will be prepared.

Since the articulated buses on which this report is based were among the first in the U.S., they reflect a highly European configuration. As such, experience on these buses should not be condemnatory of domestic or improved foreign articulated buses.

APPENDICES

APPENDIX I

Candidate lines for articulated service:

a. Line 3 West Sixth - South Central

b. Line 4 Olympic - Melrose

c. Line 5 Hawthorne Blvd. - Union Station

d. Line 6 South Vermont - York Blvd.

e. Line 9 West Jefferson - Huntington Park

f. Line 26 East 1st Street - West Pico

g. Line 28 West 3rd Street - Whittieer Blvd.

h. Line 29 West 7th Street - South San Pedro

i. Line 41 Alvarado Street

j. Line 44 Beverly Blvd. - West Adams

k. Line 50 Florence - Soto

l. Line 83 Wilshire Blvd.

m. Line 91 Hollywood Blvd.

n. Line 95 Vermont - Vernon

APPENDIX II

```
                         ARTICULATED BUSES- VEHICLE NUMBERS 9200-9229

% OF TRIPS  MAX O.B. 0         10        20        30        40        50        60        70        80        90        100
----------  -------- +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+--> %
       .7%     004   !*
      2.0%     009   !**
      2.6%     014   !***
      5.9%     019   !******
      8.5%     024   !********
     11.1%     029   !***********
     14.4%     034   !**************
     20.9%     039   !*********************
     22.9%     044   !***********************
     29.4%     049   !*****************************
     39.2%     054   !***************************************
     46.4%     059   !**********************************************
     56.2%     064   !********************************************************
     63.4%     069   !***************************************************************
     71.2%     074   !***********************************************************************
     79.1%     079   !*******************************************************************************
     83.0%     084   !***********************************************************************************
     86.9%     089   !***************************************************************************************
     91.5%     094   !*******************************************************************************************
     92.8%     099   !*********************************************************************************************
     96.7%     104   !*************************************************************************************************
     98.7%     109   !***************************************************************************************************
     98.7%     114   !***************************************************************************************************
    100.0%     119   !****************************************************************************************************

OF  924 TOTAL TRIPS ON LINES WITH ARTICULATED BUSES. 153 TRIPS WERE PROVIDED BY ARTICULATED BUSES.

AMONG ALL ARTICULATED BUS TRIPS, THE "MAXIMUM PASSENGERS ON BOARD" VALUE RANGED FROM  2 TO 116, WITH A MEAN OF 61.7 AND
A STANDARD DEVIATION OF 24.2
```

APPENDIX II

(Continued)

```
                         ARTICULATED BUSES- VEHICLE NUMBERS 9200-9229

% OF TRIPS   MAX O.B. 0         1         2         3         4         5         6         7         8         9        10
----------   -------- +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---> %
     .654%     0-004  !*******
    1.307%     5-009  !*************
     .654%    10-014  !*******
    3.268%    15-019  !*********************************
    2.614%    20-024  !**************************
    2.614%    25-029  !**************************
    3.268%    30-034  !*********************************
    6.536%    35-039  !*****************************************************************
    1.961%    40-044  !********************
    6.536%    45-049  !*****************************************************************
    9.804%    50-054  !**************************************************************************************************
    7.190%    55-059  !************************************************************************
    9.804%    60-064  !**************************************************************************************************
    7.190%    65-069  !************************************************************************
    7.843%    70-074  !******************************************************************************
    7.843%    75-079  !******************************************************************************
    3.922%    80-084  !***************************************
    3.922%    85-089  !***************************************
    4.575%    90-094  !**********************************************
    1.307%    95-099  !*************
    3.922%   100-104  !***************************************
    1.961%   105-109  !********************
     .000%   110-114  !
    1.307%   115-119  !*************


OF  924 TOTAL TRIPS ON LINES WITH ARTICULATED BUSES, 153 TRIPS WERE PROVIDED BY ARTICULATED BUSES.

AMONG ALL ARTICULATED BUS TRIPS, THE "MAXIMUM PASSENGERS ON BOARD" VALUE RANGED FROM  2 TO 116, WITH A MEAN OF 61.7 AND
A STANDARD DEVIATION OF 24.2
```

APPENDIX II
(Continued)

```
                                              CONVENTIONAL TYPE BUSES

% OF TRIPS   MAX O.B. 0         10        20        30        40        50        60        70        80        90        100
----------   -------- ---------------------------------------------------------------------------------------------------> %
      2.7%      004   ****
      4.0%      009   *****
      4.4%      016   *****
      6.2%      019   !******
      9.9%      024   !**********
     14.5%      029   ****************
     20.5%      034   !********************
     26.8%      039   !***************************
     34.2%      044   !**********************************
     43.7%      049   !*******************************************
     51.5%      054   !***************************************************
     61.0%      059   !*************************************************************
     69.1%      064   !*********************************************************************
     75.0%      069   ***************************************************************************
     82.6%      074   ***********************************************************************************
     90.0%      079   !******************************************************************************************
     94.9%      084   ***********************************************************************************************
     98.3%      089   !**************************************************************************************************
     99.7%      094   !***************************************************************************************************
     99.9%      099   !***************************************************************************************************
    100.0%      104   !***************************************************************************************************

OF  924 TOTAL TRIPS ON LINES WITH ARTICULATED BUSES, 771 TRIPS WERE PROVIDED BY CONVENTIONAL BUSES.

AMONG ALL CONVENTIONAL BUS TRIPS, THE "MAXIMUM PASSENGERS ON BOARD" VALUE RANGED FROM  0 TO 104, WITH A MEAN OF 53.6 AND
A STANDARD DEVIATION OF 21.1
```

APPENDIX II

(Continued)

```
                                   CONVENTIONAL TYPE BUSES

% OF TRIPS    MAX O.B. 0         1         2         3         4         5         6         7         8         9         10
----------    -------- ----------+---------+---------+---------+---------+---------+---------+---------+---------+----------> %
    2.724%       0-004 !...........................
    1.297%       5-009 !.............
     .389%      10-014 !....
    1.816%      15-019 !..................
    3.632%      20-024 !....................................
    4.669%      25-029 !...............................................
    5.966%      30-034 !............................................................
    6.355%      35-039 !................................................................
    7.393%      40-044 !..........................................................................
    9.079%      45-049 !...........................................................................................
    8.171%      50-054 !..................................................................................
    9.468%      55-059 !...............................................................................................
    8.171%      60-064 !..................................................................................
    5.837%      65-069 !..........................................................
    7.652%      70-074 !.............................................................................
    7.393%      75-079 !..........................................................................
    4.929%      80-084 !.................................................
    3.372%      85-089 !..................................
    1.427%      90-094 !..............
     .130%      95-099 !.
     .130%     100-104 !.

OF  924 TOTAL TRIPS ON LINES WITH ARTICULATED BUSES, 771 TRIPS WERE PROVIDED BY CONVENTIONAL BUSES.

AMONG ALL CONVENTIONAL BUS TRIPS, THE "MAXIMUM PASSENGERS ON BOARD" VALUE RANGED FROM  0 TO 104, WITH A MEAN OF 53.6 AND
A STANDARD DEVIATION OF 21.1
```

APPENDIX II
(Continued)

```
                              COMBINED DATA- ARTICULATED-CONVENTIONAL


% OF TRIPS   MAX O.B. 0         1         2         3         4         5         6         7         8         9         10
----------   -------- +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------> %
    2.361%      0-004 !........................
    1.299%      5-009 !.............
     .433%     10-014 !....
    2.056%     15-019 !.....................
    3.463%     20-024 !...................................
    4.329%     25-029 !...........................................
    5.519%     30-034 !.......................................................
    6.385%     35-039 !................................................................
    6.494%     40-044 !.................................................................
    8.658%     45-049 !.......................................................................................
    8.442%     50-054 !....................................................................................
    9.091%     55-059 !...........................................................................................
    8.442%     60-064 !....................................................................................
    6.061%     65-069 !.............................................................
    7.684%     70-074 !.............................................................................
    7.468%     75-079 !...........................................................................
    4.[illegible]2%     80-084 !................................................
    [illegible]%     85-089 !...................................
    [illegible]%     90-094 !...................
    [illegible]5%     95-099 !...
     .758%    100-104 !........
     .325%    105-109 !...
     .000%    110-114 !
     .216%    115-119 !..


THERE WERE 924 TRIPS WERE PROVIDED BY ALL BUS TYPES.

AMONG ALL TRIPS ON LINES USING ARTICULATED BUSES, THE "MAXIMUM PASSENGERS ON BOARD" VALUE RANGED FROM  0 TO 116, WITH A
MEAN OF 54.9 AND A STANDARD DEVIATION OF 21.9
```

APPENDIX III

RUN TIME (R.T.) VARIANCE

ARTICULATED VS. STANDARD BUSES

			AM Average R.T. Variance in Minutes		MID-DAY Average R.T. Variance in Minutes		PM Average R.T. Variance in Minutes	
DATE OF OBSERVATION	TYPE OF SERVICE	DIRECTION OF TRAVEL	Artic.	Std.	Artic.	Std.	Artic.	Std
5-6-80	Limited	East	5.0	-1.2			2.0	3.1
5-8-80	"	"	1.8	-0.9				0.0
5-9-80	"	"	3.3	-1.2			18.5	7.1
5-14-80	"	"		-1.2			5.0	1.9
		Four Day Average	3.4	-1.1			8.5	3.0

			AM Average R.T. Variance in Minutes		MID-DAY Average R.T. Variance in Minutes		PM Average R.T. Variance in Minutes	
DATE OF OBSERVATION	TYPE OF SERVICE	DIRECTION OF TRAVEL	Artic.	Std.	Artic.	Std.	Artic.	Std
5-6-80	Limited	West	33.0	6.7				8.0
5-8-80	"	"		7.6				0.2
5-9-80	"	"	15.0	7.1			8.0	6.4
5-14-80	"	"	3.0	7.8				-5.7
		Four Day Average	17.0	7.3			8.0	2.3

APPENDIX III

RUN TIME (R.T.) VARIANCE

ARTICULATED VS. STANDARD BUSES

DATE OF OBSERVATION	TYPE OF SERVICE	DIRECTION OF TRAVEL	AM Average R.T. Variance in Minutes		MID-DAY Average R.T. Variance in Minutes		PM Average R.T. Variance in Minutes	
			Artic.	Std.	Artic.	Std.	Artic.	Std.
5-6-80	Local	East	/	-1.8	3.0	2.2	2.0	-0.3
5-8-80	"	"	0.5	-1.8	0.8	0.6		-4.3
5-9-80	"	"	0.0	-0.9	5.3	2.6	8.0	5.1
5-14-80	"	"	1.3	-0.8	1.1	-0.6	-1.0	-0.3
		Four Day Average	0.6	-1.3	2.6	1.3	3.0	0.1

DATE OF OBSERVATION	TYPE OF SERVICE	DIRECTION OF TRAVEL	AM Average R.T. Variance in Minutes		MID-DAY Average R.T. Variance in Minutes		PM Average R.T. Variance in Minutes	
			Artic.	Std.	Artic.	Std.	Artic.	Std.
5-6-80	Local	West	14.0	3.5	12.0	0.0	/	0.0
8-80	"	"	6.5	7.5	7.1	3.8	/	-2.3
5-9-80	"	"	4.5	-11.4	9.7	3.8	7.7	-9.5
5-14-80	"	"	3.0	1.8	5.3	0.0	2.0	1.8
		Four Day Average	7.0	0.4	8.5	1.9	4.9	2.2

(-) Minus numbers denote trips running ahead of schedule.
(+) Positive numbers identify trips running behind schedule.
(0) Indicates on-time performance.
/ Boxes with diagonals reflect trips for which there was no data collected or no trip(s) scheduled.

APPENDIX IV

ARTICULATED BUS STOPS

LINE 83	CITY OF L.A.	COUNTY OF L.A.	BEVERLY HILLS	SANTA MONICA
NO. OF STOPS (281)	171	7	35	68
EXTENSIONS REQUIRED	111	2	24	48
SIGN RELOCATIONS	24	0	22	27
PARKING SPACE REMOVALS	172	0	26	83
COMMENTS	City to paint zones. RTD to do post & sign work.	RTD to paint zones & do post & sign work.	RTD to paint zones & do post & sign work	RTD to paint & do post & sign work.

LINE 91	CITY OF L.A.	COUNTY OF L.A.	BEVERLY HILLS
NO. OF STOPS (257)	168	43	46
EXTENSION REQUIRED	63	23	31
SIGN RELOCATIONS	30	12	30
PARKING SPACE REMOVALS	106	43	73
	City to paint zones. RTD to do post & sign work.	RTD to paint zones & do post & sign work.	RTD to paint zones & do post & sign work.

TOTAL: 2 Lines 538 Stops

REVISED: 6-23-78

APPENDIX IV (continued)

ARTICULATED BUS STOPS

LINE NO. 83

TOTAL STOPS	281
TERMINALS	4
NEARSIDE STOPS	201
FARSIDE STOPS	78
MIDBLOCK STOPS	2
TRANSFER POINTS	26

RESTRICTED SIGNS (NO RED CURBS)	11
ZONES 110 FEET OR LONGER	87
ZONES NEEDING ADDITIONAL RED CURB:	
CITY OF LOS ANGELES	111
CITY OF BEVERLY HILLS	24
CITY OF SANTA MONICA	48
TOTAL:	281

NOTE: 24 zones in Beverly Hills to be extended by RTD Maint. January 27, 1978

APPENDIX IV (continued)

ARTICULATED BUS STOPS

LINE NO. 91

TOTAL STOPS	257
TERMINALS	4
NEARSIDE STOPS	178
FARSIDE STOPS	67
MIDBLOCK STOPS	6
FREEWAY STOPS	6
TRANSFER POINTS	32

RESTRICTED SIGNS (NO RED CURB)	8
ZONES 110 FEET OR LONGER	54

ZONES NEEDING ADDITIONAL RED CURB:

CITY OF LOS ANGELES	115
CITY OF BEVERLY HILLS	38
LOS ANGELES COUNTY	42
TOTAL:	257

NOTE: 38 zones in Beverly Hills and 42 zones in Los Angeles County to be extended by RTD Maint.

APPENDIX V

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9227	11/1/78	51,600	11/3/78	Struck vehicle making R/turn in front of bus
			2/1/79	Sideswiped other vehicle while passing
			7/16/79	Vehicle operator claims bus struck vehicle
			10/20/79	Struck post with right side of vehicle
			10/29/79	Passenger caught foot in rear door
			6/23/80	Turning right, struck veh with L/rear corner
9228	1/2/78	53,200	1/27/79	Turning right, struck veh with L/rear corner
			2/24/79	Passenger fell alighting front door
			7/16/79	Sideswiped by passing vehicle
			8/11/79	Passenger fell on moving bus
			10/30/79	Vehicle cut into left side of bus
			12/14/79	Turning right struck veh with L/rear corner
			12/20/79	Turning right struck veh with L/rear corner
			3/15/80	Turning right struck veh with L/rear corner
			4/17/80	Struck fire hydrant with R/rear corner
			5/20/80	Turning right struck veh with L/rear corner
			6/8/80	Turning right struck veh with L/rear corner
			6/15/80	Turning right struck veh with L/rear corner
			6/17/80	Turning right struck veh with L/rear corner
			6/24/80	Turning right struck veh with L/rear corner
			7/15/80	Turning right struck veh with L/rear corner
9229	1/4/79	54,500	2/28/79	Sideswiped by passing vehicle
			3/17/79	Passenger fell in moving bus
			8/6/79	Struck by veh while standing in pass. zone
			10/16/79	Sideswiped other District bus
			11/2/79	Struck by veh while standing in pass. zone

APPENDIX V (continued)

s No.	Date in Service	Miles Operated	Date of Accident	Summary of Accident
9229 (Continued)				
			2/5/80	Passenger fell exiting front door
			7/18/80	Passenger fell alighting front door
9200	6/9/79	49,500	6/21/79	Passenger fell on stopped bus
			6/27/79	Vehicle sideswiped bus
			7/4/79	Vehicle operator claims bus struck vehicle
			12/3/79	Mini bus collided with bus
			3/27/80	Vehicle sideswiped by left rear corner of bus
			7/31/80	Turning right stuck vehicle with left/rear corner
			8/14/80	Collided with vehicle parked at curb
			9/12/80	Turning right struck vehicle with left/rear corner
			10/17/80	Turning right struck vehicle with left/rear corner
9201	10/30/78	53,600	11/1/78	Vehicle sideswiped bus
			12/11/78	Turning left struck vehicle with right/rear corner
			3/3/79	Collision with bus in yard
			7/5/79	Vehicle sideswiped bus
			10/18/79	Passenger fell alighting front door
9202	1/4/79	51,400	3/15/79	Vehicle pulling from parking lot struck left side of bus

APPENDIX V (continued)

Bus No.	Date in Service	Miles Operated	Date of Accident	Summary of Accident
9200	6/9/79	49,500	6/21/79	Passenger fell on stopped bus
			6/27/79	Vehicle sideswiped bus
			7/4/79	Vehicle operator claims bus struck veh
			12/3/79	Mini bus collided with bus
			3/27/80	Veh sideswiped by L/rear corner of bus
			7/31/80	Turning right struck veh with L/rear corner
			8/14/80	Collided with veh parked at curb
			9/12/80	Turning right struck veh with L/rear corner
			10/17/80	Turning right struck veh with L/rear corner
9201	10/30/78	53,600	11/1/78	Vehicle sideswiped bus
			12/11/78	Turning left struck veh. with R/rear cor
			3/3/79	Collision with bus in yard
			7/5/79	Vehicle sideswiped bus
			10/18/79	Passenger fell alighting front door
9202	1/4/79	51,400	3/15/79	Veh pulling from parking lot struck left side of bus
			5/8/79	Skidded and struck curb with R/rear corner
			9/25/79	Collided with veh parked at curb
			10/18/79	Collided with veh parked at curb
			11/19/79	Struck while in passenger loading zone
			12/21/79	Passenger fell in moving bus
			12/28/79	Passenger fell on stopped bus
9203	2/9/79	44,400	2/24/79	Passenger fell alighting rear door
			4/18/79	Collided with bus in yard

APPENDIX V (continued)

s No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9203 (Continued)			11/12/79	Sideswiped other vehicle
			5/5/80	Moving from curb, collided with auto
			6/18/80	Moving from curb, collided with auto
			7/24/80	Collided with stationary object
			8/20/80	Vehicle cut into bus
			9/12/80	Turning right, struck veh with left/rear corner
9204	10/29/78	46,900	10/31/78	Vehicle sideswiped bus
			12/6/78	Passenger fell on stopping bus
			12/20/78	Turning right struck vehicle with left/rear corner
			2/27/79	Turning right struck vehicle with left/rear corner
			3/24/79	Struck in passenger loading zone
			4/6/79	Turning right struck vehicle with left/rear corner
			6/1/79	Passenger fell on starting bus
			10/7/79	Struck in rear by vehicle
			11/1/79	Sideswiped by passing vehicle
			12/7/79	Struck in passenger loading zone
			3/14/80	Turning right struck veh with left/rear corner
			6/2/80	Sideswiped other R.T.D. bus
			7/7/80	Collided with veh parked at curb

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
			8/8/80	Veh from right broadsided bus
9205	10/29/78	50,900	12/7/78	Making left turn struck veh with right/rear corner
			1/4/79	Struck in passenger loading zone
			1/26/79	Sideswiped another bus
			8/3/80	Collision in intersection
			9/12/80	Moving from bus zone, collided with vehicle
			9/27/80	Passenger fell on bus moving straight
9206	1/1/79	49,300	12/29/78	Vehicle broadsided right side of bus
			4/10/79	Passenger fell on stopping bus
			7/5/79	Struck in loading zone
			7/10/79	Making R/turn struck veh with left rear corner
			7/20/79	Passenger fell on moving bus
			11/8/79	Moving from passenger zone struck vehcile
			12/8/79	Struck pulling away from curb
			12/12/79	Passenger fell on stopping bus
			2/11/80	Struck in loading zone
			5/1/80	Turning right, struck veh with left/rear corner
			5/12/80	Pass. fell alighting rear door

APPENDIX V (continued)

us No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9206 (Continued)			10/22/80	Passenger fell on stopping bus
9207	10/29/78	48,100	1/1/79	Passenger fell on bus
			1/28/79	Struck by vehicle cutting into curb
			2/5/79	Passenger twisted ankle
			3/12/79	Passenger fell on stopping bus
			3/27/79	Making R/turn struck veh with left/rear corner
			5/29/79	Passenger fell on standing bus
			7/17/79	Making right turn struck veh with left/rear corner
			10/24/79	Struck while in passenger loading zone
			11/30/79	Struck while in passenger loading zone
			11/30/79	Passenger fell alighting front door
			1/18/80	Making right turn, struck veh with left/rear corner
			6/12/80	Vehicle sideswiped bus
			6/15/80	Vehicle sideswiped bus
			7/2/80	Moving from curb, collided with vehicle
			7/3/80	Turning right, struck veh with
			7/18/80	Vehicle sideswiped bus

APPRNDIX V (continued)

Bus No.	Date of Service	Miles Operated	Accident	Summary of Accident
9207 (Continued)			9/22/80	Vehicle sideswiped bus
9208	10/30/78	11,200	None	
9209	11/1/78	44,200	3/2/79	Passenger fell alighting front door
			3/31/79	Pulling from curb struck veh
			5/31/79	Sideswiped by passing vehicle
			7/19/79	Making R/turn, struck veh with left/rear corner
			7/28/79	Struck while in passenger loading zone
			11/26/79	Sideswiped by passing vehicle
			2/29/80	Turning right, struck veh with left/rear corner
			6/24/80	Struck while in passenger zone
			7/3/80	Struck while in passenger zone
			7/16/80	Turning left, struck veh with right/rear corner
			8/22/80	Turning left, struck veh with right/rear corner
9210	1/11/79	50,700	3/9/79	Turning right, struck veh with left/rear corner
			4/19/79	Struck vehicle parked at curb
			5/22/79	Passenger hurt foot on standing bus
			9/27/79	Passenger fell on stopping bus

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9210 (Continued)			11/15/79	Turning right, struck veh with left/rear corner
			12/30/80	Moving to curb, left/rear corner struck right/side of veh
			1/3/80	Vehicle struck bus in passenger loading zone
			6/19/80	Turning left, collided with vehicle ahead
			8/10/80	Struck while parked in bus zone
			10/10/80	Passenger fell boarding
9211	10/29/78	53,200	1/26/79	Passenger fell alighting front door
			2/1/79	Passenger fell alighting front door
			2/5/79	Sideswiped by passing vehicle
			4/12/79	Turning right, struck veh with left/rear corner
			4/21/79	Turning right, struck veh with left/rear corner
			7/8/79	Turning right, struck veh with left/rear corner
			9/26/79	Turning right, struck veh with left/rear corner
			10/2/79	Vehicle pulled from driveway into bus
			10/30/79	Passenger fell on stopping bus

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
			10/30/79	Passenger fell on stopping bus
9211 (Continued)			2/18/80	Turning right struck veh with left/rear corner
			2/26/80	Turning right struck veh with left/rear corner
			5/29/80	Struck vehicle in rear
			6/11/80	Vehicle sideswiped bus
			9/2/80	Turning right, struck veh with left/rear corner
9212	10/29/78	57,300	11/17/78	Passenger fell alighting front door
			11/29/78	Passenger fell on stopping bus
			12/22/78	Sideswiped by passing vehicle
			3/4/79	Collided with another District bus
			6/26/79	Turning right, struck veh with left/rear corner
			10/26/79	Sideswiped by passing vehicle
			1/26/80	Sideswiped other District bus
			3/4/80	Turning right, struck veh with left/rear corner
			5/5/80	Passenger fell alighting front door
			5/31/80	Turning left, collided with veh ahead
			6/20/80	Turning left struck vehicle with right/rear corner

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9212 (Continued)			7/22/80	Passenger fell alighting front door
			8/5/80	Passenger fell on stopping bus
			9/20/80	Vehicle sideswiped bus
9213	10/29/78	40,500	11/16/78	Turning right, struck veh with left/rear corner
			11/28/78	Struck standing in passenger zone
			4/10/79	Turning right, struck veh with left/rear corner
			7/4/79	Turning right, struck veh with left/rear corner
			10/21/79	Passenger fell alighting front door
			3/20/80	Pulling into zone, collided with moving vehicle
			9/10/80	Collides with veh, making right turn
9214	10/29/78	55,900	2/15/79	Collided with vehicle parked at curb
			5/20/79	Turning right, struck veh with left/rear corner
			7/31/79	Turning right, struck veh with left/rear corner
			8/15/79	Struck vehicle making left turn

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9214 (Continued)			10/1/79	Turning right, struck veh with left/rear corner
			11/6/79	Struck in passenger loading zone
			3/19/80	Passenger fell on standing bus
			4/8/80	Passenger fell alighting rear door
			4/30/80	Struck vehicle making left turn
			10/23/80	Collision with bus in yard
9215	11/15/78	42,600	1/23/79	Passenger caught fingers in door
			1/26/79	Struck vehicle making right turn
			4/3/79	Turning right, struck veh with left/rear corner
			4/12/79	Passenger fell alighting rear door
			5/26/79	Struck standing in passenger loading zone
			10/26/79	Collided with District bus at corner
			1/3/80	Passenger fell on stopping bus
			4/2/80	Struck standing in passenger loading zone
			10/31/80	Turning left, struck veh with right/rear corner
9216	10/29/78	52,500	11/3/78	Struck standing in passenger loading zone

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9216 (Continued)			11/21/78	Passenger fell exiting front door
			1/23/79	Vehicle ran into side of bus
			2/12/79	Sideswiped by passing vehicle
			3/1/79	Collided with light post
			9/28/79	Struck in passenger loading zone
			10/26/79	Struck in passenger loading zone
			11/26/79	Struck in passenger loading zone
			4/7/80	Struck vehicle in rear
			4/28/80	Vehicle sideswiped by passing bus
			5/9/80	Turning left, struck veh with right/rear corner
			5/20/80	Struck in loading zone
			6/16/80	Passenger fell on stopping bus
			6/25/80	Collision with vehicle making right/turn
			7/8/80	Turning right, struck veh with left/rear corner
			8/14/80	Struck in loading zone
9217	11/7/78	43,700	3/1/79	Sideswiped by passing vehicle
			4/6/79	Vehicle cut into bus
			4/9/79	Vehicle cut into bus
			5/25/79	Pulling in zone, struck vehicle
			8/24/79	Vehicle struck by left/rear corner of bus moving to curb

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9217 (Continued)			9/25/79	Struck vehicle in rear
			10/23/79	Turning right, struck veh with left/rear corner
			11/1/79	Struck in passenger loading zone
			11/14/79	Passenger fell exiting front door
			12/12/79	Turning right, struck veh with left/rear corner
			12/22/79	Passenger fell exiting rear door
			1/10/80	Struck standing in passenger loading zone
			3/4/80	Passenger fell on starting bus
			3/14/80	Vehicle struck bus in rear
			4/29/80	Turning right, struck veh with left/rear corner
			5/9/80	Turning right, struck veh with left/rear corner
			6/25/80	Turning right, struck veh with left/rear corner
9218	1/21/79	53,700	2/12/79	Struck standing in passenger loading zone
			3/24/79	Turning right, struck veh with left/rear corner
			9/22/79	Vehicle struck bus in rear

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9218 (Continued)			12/17/79	Struck veh making right turn in front of bus
			2/8/80	Passenger fell alighting front exit door
			3/19/80	Struck left post with right side mirror
			3/20/80	Struck fire plug with right rear corner
			8/11/80	Struck in loading zone
			8/27/80	Collision with bus in yard
9219	12/20/78	17,200	4/16/80	Struck tree with right side mirror
			6/4/80	Vehicle cut into bus
			9/25/80	Collision with bus in yard
			10/9/80	Turning right, struck veh with left/rear corner
9220	12/20/78	48,800	2/27/79	Passenger fell exiting front door
			5/7/79	Struck standing in passenger loading zone
			5/24/79	Sideswiped by passing vehicle
			8/17/79	Passenger fell on stopping bus
			3/18/80	Making right turn, struck veh with left/rear corner
			5/29/80	Passenger fell on stopping bus

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9220 (Continued)			8/29/80	Passenger fell on stopping bus
			9/23/80	Sideswiped by other R.T.D. bus
9221	10/30/80	60,400	12/29/78	Struck standing in passenger loading zone
			1/30/79	Struck standing in passenger loading zone
			1/31/79	Struck other District bus while passing
			2/22/79	Vehicle pulled from driveway into side of bus
			3/13/79	Struck standing in passenger loading zone
			3/18/79	Turning right, struck veh with left/rear corner
			11/27/79	Sideswiped by passing vehicle
			1/3/80	Struck standing passenger loading zone
			6/24/80	Collision with bus in yard
			8/22/80	Passenger falls alighting front door
			10/9/80	Turning right, struck veh with left/rear corner
9222	10/29/78	46,700	3/28/79	Vehicle struck by bus pulling to curb
			5/4/79	Sideswiped by passing vehicle

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9222 (Continued)			12/14/79	Passenger fell boarding standing bus
9223	12/20/78	49,700	5/23/79	Sideswiped other District bus
			7/9/79	Turning right, struck veh with left/rear corner
			8/12/79	Struck vehicle in rear
			9/18/79	Sideswiped by passing vehicle
			10/12/79	Passenger caught in rear door
			11/21/79	Turning right, struck veh with left/rear corner
			11/21/79	Turning right, struck veh with left/rear corner
			2/29/80	Struck standing in passenger loading zone
			4/4/80	Moving from zone, struck passing vehicle
			5/6/80	Turning left, collision with vehicle from ahead
			5/6/80	Turning left, collision with vehicle from ahead
			5/20/80	Struck in loading zone
			5/24/80	Passenger fell alighting front door
			5/29/80	Bus sideswipes vehicle while passing

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9224	12/20/78	45,000	12/20/78	Turning left, struck veh with right/rear corner
			1/12/79	Vehicle backed into bus
			1/16/79	Struck parked vehicle
			1/17/79	Turning right, struck veh with left/rear corner
			3/18/79	Struck parked vehicle
			6/19/79	Turning right, struck veh with left/rear corner
			7/31/79	Pulling into passenger zone, struck moving vehicle
			9/27/79	Struck vehicle, making right turn in front of bus
			10/5/79	Vehicle turning into driveway struck by bus
			11/16/79	Struck vehicle making right/ turn in front of bus
9225	12/21/78	56,400	12/27/78	Turning right, struck veh with left/rear corner
			1/4/79	Passenger fell alighting front door
			1/4/79	Turning right, struck by veh from left
			1/14/79	Passenger fell exiting rear door

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9225 (Continued)			1/25/79	Passenger fell standing in bus
			2/3/79	Turning right, struck veh with left/rear corner
			4/6/79	Struck standing in passenger zone
			4/9/79	Turning right struck veh with left/rear corner
			4/11/79	Turning right struck veh with left/rear corner
			4/26/79	Turning right struck veh with left/rear corner
			11/9/79	Turning right struck veh with left/rear corner
			1/17/80	Struck tree with right side mirror
			3/29/80	Struck pedestrian
			4/9/80	Turning right struck veh with left/rear corner
			6/22/80	Collision with stationery object
			7/18/80	Bus sideswipes veh from opposite direction
9226	10/30/78	52,500	11/28/78	Turning right struck veh with left/rear corner
			1/11/79	Sideswiped by passing vehicle

APPENDIX V (continued)

Bus No.	Date of Service	Miles Operated	Date of Accident	Summary of Accident
9226 (Continued)			9/19/79	Passenger fell alighting front door
			11/2/79	Sideswiped by passing vehicle
			11/29/79	Turning right struck veh with left/rear corner
			11/30/79	Turning right struck veh with left/rear corner
			4/18/80	Turning left struck veh with right/rear corner

APPENDIX VI

ARTICULATED BUS

ROAD CALLS

ENGINE		34	12.78%
Cooling System	15		
Fuel System	1		
Low Oil	3		
No Start	1		
Slow Bus	8		
Smoke	2		
Stall	4		
TRANSMISSION		3	1.13%
Noisy	1		
No Shift	2		
ELECTRICAL		47	17.67%
Battery	1		
Exterior Lights	1		
Interior Lights	4		
Passenger Signal	17		
Switch/Fuses	24		
DOORS		50	18.8%
Front	7		
Interlock	5		
Rear	34		
Slow	4		
RADIO		2	.75%
No Receive	1		
No Send	1		
MISCELLANEOUS		30	11.28%
Accident	10		
Fire	1		
Grab Rail	1		
Headsign	10		
Mirrors	3		
Vandalism	3		
Throttle	2		

APPENDIX VI (continued)

ROAD CALLS (CONTINUED)

BRAKES		17	6.39%
Lock	11		
Hand	2		
Pull/Grab	4		
TIRES		12	4.51%
Flat	12		
STEERING		2	.75%
Hard	2		
UNDER CARRIAGE		17	6.39%
Air Bags	1		
Chassis	14		
Noise	2		
WINDOWS & GLASS		6	2.25%
Cracked	3		
Swinging	3		
AIR CONDITIONING & HEATING		35	13.16%
Air	35		
FARE BOX		1	.38%
No Light	1		
AIR SYSTEM		1	.38%
Leak	1		
WIPERS		9	3.38%
Not Working	9		

TOTAL SERVICE MILES	270,217
AVERAGE PER BUS	9,317
MILES PER ROAD CALL	1,016

APPENDIX VII

PARTS COST COMPARISON

ARTICULATED VS. G.M.C. RTS-II

PARTS NUMBER	DESCRIPTION	COST	
		Artic.	Std.
81.25301.6038	Horn Assy.	21.93	
1892242	Horn Assy.		33.96
51.05801.6035	Oil Pan	1.048.42	
5106785	Oil Pan		62.09
86.25100.1001	Head Light	12.68	
5966200	Head Light		7.21
81.25503.0130	Switch Hazard	12.60	
675558	Switch Hazard		2.50
86.63700.1001	Sun Visor	115.19	
2058108	Sun Visor		69.96
81.50110.0147	Brake Drum Front	245.57	
793430	Brake Drum Front		177.09
51.04401.6158	Cam Shaft	798.63	
8921402	Cam Shaft		228.55
51.05563.5016	Housing Oil Cooler	253.34	
2419674	Housing Oil Cooler		65.18
81.06601.0035	Engine Fan	93.56	
719656	Engine Fan		179.79

APPENDIX VII (continued)

PARTS COST COMPARISON

ARTICULATED VS. G.M.C. RTS-II

PARTS NUMBER	DESCRIPTION	COST	
		Artic.	Std.
51.01201.0218	Liner, Cyl.	115.89	
5107176	Liner, Cyl.		50.16
51.02310.0073	Ring Starter Gear	71.77	
5110893	Ring Starter Gear		43.70
51.02301.7337	Flywheel	439.77	
5107635	Flywheel		621.15
51.02115.6006	Sprocket, Crnkshft	116.45	
5117588	Sprocket, Crnkshft		23.24
51.01110.6413	Bearing Main (St.)	19.84	
5196319	Bearing Main (St.)		7.61
51.01111.6415	Bearing Thrust (St.)	68.25	
5117005	Bearing Thrust (St.)		2.56
51.04410.0121	Bushing Camshaft Br.	8.65	
5196026	Bushing Camshaft Br.		12.27
51.01401.6049	Housing Flywheel	503.10	
5101701	Housing Flywheel		990.37
51.05601.0047	Core Oil Cooler	226.96	
8531655	Core Oil Cooler		230.85

APPENDIX VII (continued)

PARTS COST COMPARISON

ARTICULATED VS. G.M.C. RTS-II

PARTS NUMBER	DESCRIPTION	COST	
		Artic.	Std.
51,09100,7082	Turbo Charger	1,083.60	
5101509	Turbo Charger		839.65
86,41600,3002	Rear Bumper	115.16	
2060186	Rear Bumper		779.17
81.15101.0067	Engine Muffler	365.89	
233102	Engine Muffler		235.51
81.43610.6033	Leveling Valve	31.66	
4992908	Leveling Valve		46.64
51.10101.6015	Fuel Injector	60.56	
5229970	Fuel Injector		96.08
8127110.6015	Speedometer	71.27	
5658854	Speedometer		119.20
51.02501.7236	Piston Assy	375.31	
5149048	Piston Assy		313.47
86.16000.6056	Starter	855.45	
1114739	Starter		543.19
51.05100.6135	Oil Pump	216.02	
5102019	Oil Pump		293.27

APPENDIX VII

PARTS COST COMPARISON

ARTICULATED VS. G.M.C. RTS-II

PARTS NUMBER	DESCRIPTION	COST	
		Artic.	Std.
81.44201.6056	Knuckle Assy.	439.91	
795458	Knuckle Assy.		526.33
81.39105.6670	Eng. Drive Line	954.82	
799692	Eng. Drive Line		81.17
81.73803.5024	Fuel Filler Door	41.20	
723887	Fuel Filler Door		76.59
86/25500.3002	Door Control Valve	118.86	
2076911	Door Control Valve		109.93
81.50220.0650	Front Brake Lining	32.47	
2039541	Front Brake Lining		12.70
81.52130.6063	Valve Assy. Brake	602.15	
2017708	Valve Assy. Brake		103.30
51.54000.7059	Air Compressor	785.42	
2036708	Air Compressor		569.87
81.06101.6150	Engine Radiator	1.162.73	
719652	Engine Radiator		714.70
81.26401.6039	Wiper Motor	127.01	
796743	Wiper Motor		96.49

APPENDIX VII (continued)

PARTS COST COMPARISON

ARTICULATED VS. G.M.C. RTS-II

PARTS NUMBER	DESCRIPTION	COST	
		Artic.	Std.
51.05502.0027	Shell Oil Fltr Bowl	48.48	
2419674	Shell Oil Fltr Bowl		70.96
81.33118.0007	Filter Oil (Trans)	22.94	
2054371	Filter Oil (Trans)		167.25
5977068	Water Mod. Valve	117.79	
2490770	Water Mod. Valve		29.70

APPENDIX VIII

Results

"Do you personally prefer to ride on the other RTD buses, or on the articulated buses?"

	All Respondents	Under 30	30-49	50+ Older	Male	Female
Prefer articulated buses	66.9%	77.9%	71.1%	49.7%	75.2%	61.3%
Prefer regular buses	33.1%	22.1%	28.9%	50.3%	24.8%	38.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

937 Respondents

Except for respondents under 30 years of age, there are no significant shifts in opinion regarding preference for the articulated bus. If anything, the under 30 group is more in favor of the articulated bus than when first polled on the subject 14 months previously. When responses are compared by gender, a significantly higher proportion of male respondents prefer the articulated bus.

"Compared to the other RTD buses, how do you compare the comfort of the articulated bus?:"

	All Respondents	Under 30	30-49	50+ Older	Male	Female
More comfortable	63.4%	71.6%	65.1%	44.5%	68.2%	58.1%
As comfortable	25.9%	22.1%	25.4%	32.7%	24.6%	27.8%
Less comfortable	10.7%	6.3%	9.6%	22.8%	7.2%	14.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

1,000 Respondents

As in the previous study, a majority of respondents under 50 years of age find the articulated bus more comfortable than a standard coach. Males voted in favor of the articulated bus more often than females did. Females in fact, were twice as likely to consider the articulated bus less comfortable than a regular bus.

APPENDIX VIII (continued)

"Compared to other RTD buses, how is the air conditioning on the articulated buses?:"

	All Respondents	Under 30	30-49	50+ Older	Male	Female
Better	61.9%	64.7%	62.4%	54.6%	66.0%	56.8%
The Same	29.7%	27.5%	28.4%	36.8%	27.2%	32.6%
Worse	8.3%	7.7%	9.1%	8.6%	6.8%	10.6%
Total	99.9%	99.9%	99.9%	100.0%	100.0%	100.0%

875 Respondents

A majority of respondents in all groups said that the air conditioning on the articulated bus is better than on the standard coach.

Compared to other RTD buses, how does the noise level inside the articulated bus?:"

	All Respondents	Under 30	30-49	50+ Older	Male	Female
More	25.5%	20.7%	31.7%	19.0%	21.1%	29.2%
The Same	46.6%	43.4%	46.8%	65.4%	45.3%	48.4%
Less	27.9%	35.9%	21.5%	15.6%	33.6%	22.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

907 Respondents

Nearly 47% of the respondents (and a surprising 65% of respondents over 50 years old) discerned no difference between the noise level on the two types of bus. Of the respondents who did note a difference, males and respondents under 30 were more likely to say that the noise level inside the articulated bus is less than on a standard bus. About 30% of female respondents and those between the ages of 30 and 49 thought articulated buses are noiser than regular buses.

"Do you think the articulated buses are safer than other RTD buses?"

	All Respondents	Under 30	30-49	50+ Older	Male	Female
Yes	62.3%	65.8%	57.5%	58.2%	66.1%	57.3%
No	37.7%	34.2%	42.5%	41.8%	33.9%	42.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

783 Respondents

A majority of respondents in all categories said the articulated buses are safer than other RTD buses. Males and respondents under 30 years of age were more likely to think that the articulated buses are safer.

"Is it usually easier for you to find a seat on the articulated bus than on the regular bus?"

	All Respondents	Under 30	30-49	50+ Older	Male	Female
Yes, I can usually get a seat on the articulated bus	93.3%	93.1%	95.1%	94.3%	95.4%	91.3%
No, I often have to stand on the articulated bus	6.7%	6.9%	4.9%	5.7%	4.6%	8.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

817 Respondents

Over 90% of the respondents in each category indicated that they can usually get a seat on the articulated bus.

"If you have a choice of seats, do you prefer to sit on the forward-facing seats or on the side-facing seats?"

	All Respondents	Under 30	30-49	50+ Older	Male	Female
Forward-facing	82.8%	82.4%	87.6%	90.9%	86.0%	82.1%
Side-facing	17.2%	17.6%	12.4%	9.2%	14.0%	17.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

978 Respondents

Preference for forward-facing seats was expressed by nearly 83% of the respondents, a proportion not significantly different than the 86% reported in the 1979 survey of articulated bus riders. Age appears to influence seat configuration, with the preference for forward-facing seating increasing as respondents get older.

"Compared to the entrance on other RTD buses, how do you personally find the entrance to the articulated bus?"

	All Respondents	Under 30	30-49	50+ Older	Male	Female
Easier to Use	69.1%	72.7%	71.3%	64.9%	73.6%	66.0%
No different	21.7%	21.7%	18.7%	19.3%	20.1%	22.5%
Harder to Use	9.2%	5.6%	10.0%	15.8%	6.3%	11.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

936 Respondents

Findings in regard to this variable do not differ significantly from those of the previous study. About 70% of the respondents said the entrance to the articulated bus is easier for them to use. The proportion of riders who said otherwise rises with age. Females were nearly twice as likely as males to note that they found the entrance to the articulated bus more difficult to use.

"Compared to the rear exit on other RTD buses, how do you personally find using the rear exit on the articulated buses?"

	All Respondents	Under 30	30-49	50+ Older	Male	Female
Easier	51.1%	56.7%	50.0%	39.3%	56.7%	44.7%
No different	27.5%	26.5%	24.5%	28.8%	23.8%	32.0%
Harder to Use	21.4%	16.7%	25.5%	31.9%	19.6%	23.2%
Total	100.0%	99.9%	100.0%	100.0%	100.0%	99.9%

912 Respondents

Few significant differences in regard to this variable were noted between the findings on this and the previous study. A significantly lesser proportion of female respondents did report on the later study that they found the rear exit on the articulated bus harder to use.

There is an obvious direct relationship between age of respondent and likelihood of finding the rear exit harder to use. Respondents over 50 are twice as likely as those under 30 to report more difficulty using the rear exit.

"If you have a choice, do you prefer to sit in the front coach of the articulated bus, or in the back coach?"

	All Respondents	Under 30	30-49	50+ Older	Male	Female
Front Coach	61.4%	50.3%	58.5%	83.0%	47.2%	73.9%
Back Coach	38.6%	49.7%	41.5%	17.0%	52.8%	26.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

912 Respondents

A preference for riding in the front coach is shared by a majority of respondents. This preference apparently becomes more pronounced as the respondents get older. Respondents under 30 were about evenly divided in their opinions, whereas 83% of respondents over 50 prefer the front coach. The proportion of female repondents opting in favor of the front coach was more than half again as high as the proportion of males stating such a preference.

The reasons given by respondents for their coach preference are shown in the following tables.

APPENDIX VIII (continued)

PREFER FRONT COACH

Reason	All Respondents	Male	Female
Visibility, watch for stop	25.4%	22.6%	28.9%
Away from smoking dope, radios, wierdos, etc.	12.9	14.0	10.7
Better ride quality	11.5	15.1	9.4
More comfortable	11.5	15.1	8.2
Feel safer	9.3	5.4	10.1
Easier to exit	8.6	4.3	11.9
Less walk to seat	5.7	4.3	6.3
"Habit", "Just prefer it"	5.0	8.6	3.8
Better air condition	2.5	3.2	2.5
Closer to driver	2.5	1.1	3.8
Less noisy	2.2	2.2	2.5
To watch people	.7	2.2	.0
Less crowded	.4	.0	.0
Cleaner	.4	1.1	.0
Total	100.0%	100.0%	100.0%

279 Respondents

APPENDIX VIII (continued)

PREFER REAR COACH

Reason	All Respondents	Male	Female
Less crowded	36.8%	40.0%	35.8%
More comfortable	12.6	13.6	10.4
"Habit","Just prefer it"	10.0	10.0	10.4
Easier to exit	7.9	3.6	13.6
Better air condition	6.3	5.5	9.0
Can smoke, "More fun"	6.3	3.6	7.5
Front for elderly and handicapped	5.3	4.5	6.0
Better view	3.7	5.5	1.5
Seats available	3.2	4.5	1.5
Feel safer	2.6	2.7	3.0
To watch people	2.6	2.7	.0
Better ride quality	1.6	2.7	.0
Away from driver	1.1	.9	1.5
Total	100.0%	99.8%	100.0%

190 Respondents

Of those respondents who prefer riding in the front coach, about 25% do so in order to be able to watch for their stop. Another quarter of respondents gave reasons of personal comfort (more comfortable, better air conditioning, less noisy). Thirteen percent of the respondents said they prefer the front coach because riders in the back coach smoke cigarettes and marijuana, play radios, steal, fight and "hassle" other riders. In addition, another 12% of the respondents said they feel safer in front coach or want to be closer to the driver.

Of those respondents who prefer riding in the rear coach, 40% say that it is less crowded than the front coach. Personal comfort (more comfortable, better air conditioning, better ride quality) figured in the responses given by 20.5% of the respondents. Over 7% of the respondents preferring the rear coach said they wanted to be away from the driver so they could smoke, and generally be with friends and have more fun in the rear coach.

"The bus line number is displayed on a sign at the rear of the articulated buses. Do you find this sign helpful?"

	All Respondents	Under 30	30-49	50+ Older	Male	Female
Yes	78.2%	77.1%	76.8%	80.1%	77.9%	77.8%
No	21.8%	22.9%	23.2%	19.9%	22.1%	22.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

844 Respondents

Nearly 80% of the respondents agree that the route number display at the rear of the bus is helpful. The reasons they find it helpful are shown in the following table along with the reasons why other respondents do not find the display helpful.

REAR ROUTE SIGN HELPFUL

Reason	All Respondents	Male	Female
Identifies my bus	64.5%	60.9%	70.4%
To know if I missed my bus	24.9%	27.3%%	21.6%
Can estimate time with next bus	5.1%	6.2%	4.0%
Don't have to run to front to see headsign	3.8%	4.3%	3.2%
Identify bus if you leave something on board or there is an accident	1.7%	1.2%	.8%
Total	100.0%	99.9%	100.0%

293 Respondents

APPENDIX VIII (continued)

REAR ROUTE SIGN NOT HELPFUL

Reason	All Respondents	Male	Female
Never noticed it/ hard to find	66.7%	62.5%	70.0%
Don't need it	19.8%	12.5%	27.5%
Frustrating to know you've just missed your bus	13.6%	25.0%	2.5%
Total	100.0%	100.0%	100.0%

833 Respondents

The following tables describe survey respondents in terms of age and gender.

Respondents Age	All Respondents	Male	Female
Under 18	11.5%	11.0%	12.0%
18-29	41.1	44.6	37.0
30-39	17.4	20.1	14.8
40-49	8.4	7.9	9.2
50-61	9.6	7.0	12.5
62 and older	12.0	9.3	14.5
	100.0%	99.9%	100.0%

833 Respondents

Respondents Gender:		
	Male	50.4%
	Female	49.6%
	Total	100.0%

904 Respondents

APPENDIX IX

Revenue/Cost Ratio

	COST CATEGORY	STANDARD BUS	ARTICULATED BUS
1.	Labor	$ 14.87	$ 15.84
2.	Insurance	5.16	5.16
3.	Supplies	8.96	12.99
4.	Road Calls	0.67	1.39
5.	Subtotal	$ 29.66	$ 35.88
6.	Overhead @ 96%	28.47	33.96
7.	Subtotal	$ 58.13	$ 69.84
8.	General & Administrative @5.7%	3.31	3.98
9.	TOTAL	$ 61.44*	$ 73.82*

* Total cost for a single one-way trip on Line 83.

APPENDIX IX

Calculations
Revenue/Cost Ratio

1. Labor -

Standard bus:

$$\$10.27/\text{Hr.} \times \left(\frac{85.67 \text{ mins.}}{1.42 \text{ Hr.}} + 1.18 \text{ min.}^{*}\right) = \underline{\$14.87}$$

Articulated bus:

$$\$10.27/\text{Hr.} \times \left(\frac{85.67 \text{ mins.}}{1.42 \text{ Hr.}} + 6.89 \text{ mins.}^{*}\right) = \underline{\$15.84}$$

2. Insurance -

Standard & Articulated Buses:

$0.27/mile x 19.1 miles = $ 5.16

3. Supplies -

Standard bus:

$0.45/mile x 19.1 miles = $ 8.96

Articulated bus:

$0.68/mile x 19.1 miles = $12.99

4. Road Calls -

Standard bus:

$0.035/mile x 19.1 miles = $ 0.67

Articulated bus:

$0.073/mile x 19.1 miles = $ 1.39

*Average additional running time.