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of Transportation

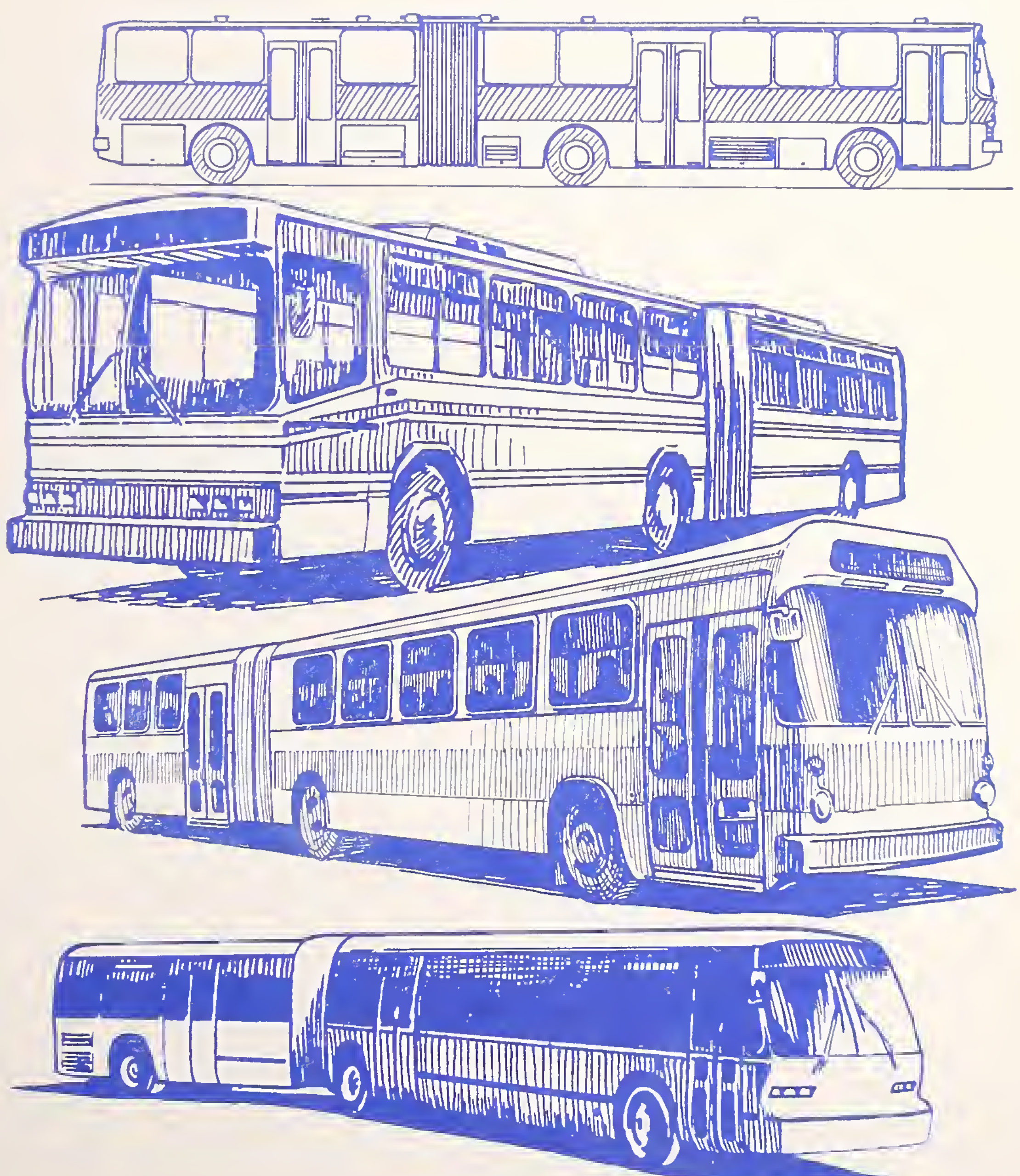
**Urban Mass
Transportation
Administration**

Technology of Articulated Transit Buses

Office of Technical Assistance
Office of Bus and Paratransit Systems
Washington DC 20590

Prepared by:
Transportation Systems Center
Urban Systems Division

October 1982
Final Report



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16. Abstract

This study assembles technical information to increase the transit community's awareness and understanding of the articulated transit coach and its emerging role in urban transportation. The report is organized to provide information on: 1) status of deployment of articulated transit coaches in this country; 2) design and performance aspects of this type of vehicle; and 3) general experiences in the operation and maintenance of articulated buses.

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PREFACE

This study was conducted to assemble technical information to increase the transit communities' awareness and understanding of the articulated transit coach and its emerging role in urban transportation. This study was initiated and sponsored by UMTA's Office of Bus and Paratransit Systems.

The report is organized to provide an understanding of: 1) status of deployment of articulated transit coaches in this country; 2) design and performance aspects of this type of vehicle; and 3) general experiences in the operation and maintenance of articulated buses.

The report was prepared by the Urban Systems Division of the Transportation Systems Center. Important contributions in the identification of foreign producers of articulated buses and the development of comparative specifications (Appendix A & B) were made by Mr. Ted Hawkes, President of Transportation Equipment Development Company.

METRIC CONVERSION FACTORS

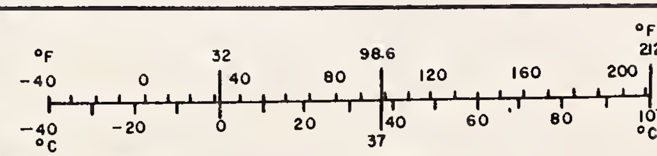
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



REPORT OUTLINE

REPORT OUTLINE (CONTINUED)

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EXECUTIVE SUMMARY

Since the first major demonstration of articulated buses in the mid 1970's and the first purchase in late 1978, interest in articulated buses in U.S. transit service has remained strong. This interest is instigated by public transit agencies' desire to increase passenger capacity, improve productivity and reduce or at least maintain operating costs. Further, the interest is evidenced by the delivery and deployment of over 500 articulated buses to fourteen cities and a current backorder of about another 700 units for a total capital investment of over $300 million.

This study was conducted to provide technical assistance to urban transit managers and state DOT's for use in their analyses and decision-making related to new deployments of articulated transit buses. Operational and maintenance experiences were obtained from each U.S. property currently using these high capacity vehicles. In addition, technical design and performance information was obtained from U.S. producers and numerous foreign articulated bus manufacturers. In general, this report provides status information on articulated bus technology and its performance, to date, in domestic service.

Currently, there are three U.S. producers of articulated transit coaches, M.A.N., Truck and Bus Corp., Crown Coach Corp., and Neoplan, USA. GMC Truck and Coach Division reportedly will enter the market in 1984. To date, only M.A.N. and Crown Coach have any buses on the street and all of these were produced as driveable "bus shells" in Europe and finished to buyer's specification in this country. Very shortly M.A.N. will fabricate the total bus in the U.S. at its new North Carolina manufacturing facility.

There are many European producers of articulated vehicles; this report identifies more than 20 companies that are actively engaged in the fabrication of articulated bus chassis, bodies or the whole bus. Their production facilities and capacities vary widely.

After a few early problems and adjustments, particularly in the air conditioning, electrical system and the automatic transmission, and after special training for mechanics and operators, the articulated coach has performed well in all U.S. transit environments. Although data and opinions vary from location-to-location, the performance of the articulated vehicle has improved to where, in general, its availability for and reliability in revenue service is as good as the newer segments of the U.S. fleet. The fuel economy (2.5-3.5 mpg) is relatively good on a per seat-mile basis, since passenger capacity, both seated and standing, is about 50 percent greater than a conventional, 40-foot coach. Except possibly for very hilly or very narrow routes, the articulated transit coach has been operated successfully on all types of urban and suburban runs. These high capacity vehicles are used during peak ridership hours in all locations on express runs, radial or crosstown routes with high passenger demand and, in many locations, during the off-peak periods as well for up to eighteen revenue service hours per day.

Articulated vehicles typically have been assigned to runs to meet existing high demands or to increase ridership. To better realize and document the full potential of articulated buses in U.S. transit service, it is generally agreed that special planning and scheduling efforts are needed for each location and route.

1.0 INTRODUCTION

The cost of operating bus transit systems in U.S. urban areas continues to rise sharply. Operating expense for transit bus services in this country during 1980 totalled about $4.9 billion dollars - an increase of almost 19 percent over 1979.[1] This translates into an average cost of about $2.90 for every mile of service travelled in 1980. Considering inflation and increases in contracted labor rates and fuel prices since that time, it is estimated that this average cost per vehicle-mile now has risen to $3.50 to $3.75. Transit properties are concerned with this trend, particularly with the eminent elimination of Federal operating subsidy, and are looking at new technology and operating practices to help control bus operating costs.

Although on a nationwide basis mass transit ridership apparently has leveled off, it is arguable that this plateau is caused more by the fact that properties have reached their service capacities than by the conjecture that demand has peaked. It is clear that there is a definite relationship between service (seated and total capacity being important elements of service) and ridership. Many properties continue to increase their ridership on selected routes merely by providing additional vehicles during peak hours. Common practice among transit properties is to run "double-headers" to satisfy high passenger demands. It is recognized that this is a costly method since it requires additional drivers on the payroll to operate the extra vehicles during morning and afternoon peak periods. Again, transit operators are interested in providing better service to meet ridership demands (existing and latent) in the most efficient manner.

Virtually all transit operators in large urban areas have one or both of the following categories of routes:

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1. "Transit Fact Book," 1981, American Public Transit Association

A) Express routes where passengers typically board at one or a few stops at the beginning of the run and off-load at a single stop at the end of the route; or

B) Major arterial routes or corridors, either crosstown or radial, with high peak period, work or school trip ridership and relatively high off-peak demand, as well.

The passenger demand characteristics of such routes could be approaching that which is sufficient to justify the construction of light rail service. Transit operators here again must work within constraints, such as the density of existing construction, availability of right-of-way, and funding, to most appropriately meet the existing passenger demand.

Therefore, for at least the reasons discussed,

- potential reduction in operating costs,
- need to increase capacity (seated and total capacity), and
- potential alternative for fixed, capital-intensive transit modes

domestic transit properties in the past decade have begun to seriously investigate the benefits of high capacity buses, particularly the articulated transit bus.

An articulated bus, for the purpose of this report, is defined as a vehicle designed for carrying passengers, and comprised of two sections permanently joined by a hinge mechanism or "articulated joint" allowing vertical and horizontal relative movement as well as a weather-tight passage for riders moving from one section of the bus to the other.

In contrast to the standard-size transit coach, which benefited from development efforts of numerous early U.S. producers (White, Mack, Yellow Coach, Twin Coach, General Motors Corp.), the articulated buses in service in this country, for the most part, are a product of European research and development. As the accompanying chronology of experiences (Table 1) demonstrates, the infusion of articulates into our domestic fleet clearly had its origin in Europe. The growth of the articulated bus market is the result of both intense and able European marketing and the recognition by the U.S. transit community that such a high capacity bus could be efficiently and effectively deployed in urban transit.

TABLE 1
CHRONOLOGY OF ARTICULATED BUS
EXPERIENCE IN THE U.S.*

CHRONOLOGY OF ARTICULATED BUS
EXPERIENCES IN THE U.S.*

1940 -	CLEVELAND; ARTICULATED TROLLEY BUS, SUPER TWIN WITH 58 SEATS; FRANK & WILLIAM FAGEOL, U.S. BUILDERS: 1 BUS, VERTICAL ARTICULATION ONLY.
1946 -	SANTA FE TRAILWAYS; INTERCITY ARTICULATED BUS; 60-FOOT: KAISER INDUSTRIAL, U.S. BUILDERS: 1 BUS.
1948 -	CHICAGO; ARTICULATED TROLLEY BUS, SUPER TWIN WITH 58 SEATS: F&W FAGOEL, U.S. BUILDERS, 1 BUS.
1948 -	OMAHA; ARTICULATED BUS (PROPANE): SUPER TWIN: U.S. BUILDER: 15 BUSES.
1957-8 -	COLORADO; INTERCITY ARTICULATED BUS: KASSBOHRER, GERMAN BUILDER; 6 BUSES.
EARLY 1960's -	CONTINENTAL TRAILWAYS: INTERCITY ARTICULATED BUS CALLED "SUPER GOLDEN EAGLE": KASSBOHRER, GERMAN BUILDER; 5 BUSES.
1965 -	A.C. TRANSIT PURCHASED THE ABOVE 5 "SUPER GOLDEN EAGLES", CONVERTED THE VEHICLE INTO A 77-SEAT TRANSIT COACH AND PLACED IN TRANSBAY EXPRESS SERVICE IN 1966.
1972 -	FORMATION OF "PROJECT SUPER BUS", A CONSORTIUM OF SEVERAL TRANSIT OPERATORS TOGETHER WITH URBAN MASS TRANSPORTATION ADMINISTRATION
1974 -	VOLVO AND MASCHINENFABRIK AUGSBURG - NUERENBERG (M.A.N.) EACH PROVIDED THEIR ARTICULATED TRANSIT BUS FOR DEMONSTRATION AND TEST BY SEVERAL MAJOR TRANSIT PROPERTIES.
1975 -	SEATTLE METRO SOLICITS BIDS.
1976 -	FORMATION OF ARTICULATED BUS COMMITTEE OF TEN TRANSIT SYSTEMS, SOLICITATION FOR BIDS, AWARD TO AM GENERAL AND M.A.N.
1976 -	AWARD OF SEATTLE ORDER FOR 151 60-FOOT ARTICULATED BUSES.
	IN SUBSEQUENT YEARS, NUMEROUS OTHER CITIES HAVE AWARDED CONTRACTS FOR ARTICULATED TRANSIT BUSES FROM THREE DIFFERENT PRODUCERS. FURTHER CHRONOLOGICAL DATA IS PROVIDED IN TABLE 2.

*SOURCE: "DEVELOPMENT AND OPERATION OF HIGH-CAPACITY BUSES IN THE U.S.", CALIFORNIA DEPARTMENT OF TRANSPORTATION, TRANSIT DEVELOPMENT BRANCH, JULY, 1980.

Currently, fourteen U.S. transit properties are operating about 511 (increasing all the time) articulated buses with a cumulative fleet mileage to date of more than 40 million miles. Another 692 articulated buses are on order. Approximately $100 million has been expended by Federal, state, and local governments to purchase the vehicles; future commitments amount to an additional $200 million. The timing appears to be appropriate for a general review of how well the articulated bus has performed in the U.S. transit environment since the first major delivery slightly more than four years ago.

2.0 PURPOSE

This study was conducted to provide technical assistance to urban transit managers and state DOT's for use in their analyses and decision-making related to the deployment of articulated transit buses. The information contained in this report addresses two major aspects of these high-capacity buses:

1) A description of the design and technology of commercially-available articulated buses, both foreign and domestically produced; and

2) A general review of the current domestic operating and maintenance experiences of the articulated buses.

It is hoped that such technical information will increase the transit communities' awareness and understanding of the articulated transit coach and its emerging role in urban transportation.

3.0 OVERVIEW OF ARTICULATED TRANSIT BUS DEPLOYMENT IN THE U.S.

To initiate discussion of articulated bus technology it might be best to first characterize the existing domestic fleet. In this way a proper prespective can be formed on the scope, magnitude and overall status of deployment of this relatively new technology. This will be followed by additional information to suggest future trends in the use of articulated buses for urban transit.

3.1 Current Status of Articulated Bus Fleet

The characteristics of the current fleet of articulated buses are shown in Table 2. There are a number of important findings to be aware of concerning the procurement of articulated buses.

Procurement of articulated transit buses in this country has occurred, to a large extent through the formation of a consortium. Ten of the fourteen properties (all except Louisville, Portland, San Mateo and Seattle) now operating articulated buses were members of the 1976 Caltrans Consortium; nine of the twelve properties expecting delivery (all except Atlanta, Chicago and Seattle) were part of the 1981 Pittsburgh Consortium. Clearly, there are no requirements or standards mandating participation in these groups. As properties and vehicle manufacturers gain experience and the articulated bus market increases, the benefits (such as those gained by economics of scale) of group buys may fade. The procurement of articulated buses in the near future could be conducted very similar to the procurement of standard-size coach. Some evidence of this is the fact that, among others, Milwaukee CTS, MUNI-San Francisco, SEMTA-Detroit, and Jacksonville Transit Authority are all in the process of independently procuring articulated transit buses.

The popularity of the sixty-foot articulated bus, compared to the 55-foot, is demonstrated by the fact that about 82 percent of delivered buses and 78% of the orders are the longer version. All buses in service and on order are 102 inches wide. Transit properties interested in capacity apparently felt the additional five feet worthwhile.

TABLE 2
PROCUREMENT HISTORY
ON U.S. ARTICULATED TRANSIT BUSES *

PURCHASING CITY	DATE OF AWARD	MANUFACTURER	NO. OF BUSES/ LENGTH	DATE OF FIRST DELIVERY	DATE OF LAST DELIVERY	CONTRACT PRICE	ACTUAL PRICE **
DELIVERED							
Atlanta - MARTA	9/24/76	M.A.N.	10/55'	1/27/79	2/27/79	$172,673	N/A
Chicago - CTA	2/14/77	M.A.N.	20/55'	12/27/78	1/27/79	172,673	N/A
Los Angeles - SCRTD	8/27/76	M.A.N.	30/60'	4/78	5/27/78	174,286	N/A
Louisville, KY - TARC	11/8/79	Crown-Ikarus	15/60'	5/14/81	6/26/81	228,000	N/A
Minneapolis - MTC	8/30/76	M.A.N.	20/60'	10/78	12/27/78	174,286	N/A
Oakland - AC Transit	9/07/76	M.A.N.	30/60'	5/78	7/27/78	174,286	N/A
Phoenix - PTS	10/12/76	M.A.N.	20/60'	2/79	3/27/79	174,286	N/A
Pittsburgh- PA Transit	2/28/77	M.A.N.	20/55'	1/78	1/27/79	172,673	N/A
Portland, OR - TRI-MET	4/14/80	Crown-Ikarus	87/60'	10/19/81	12/14/81	231,250	230,482
San Diego - SDTC	8/30/76	M.A.N.	45/60'	7/78	10/27/78	174,286	N/A
San Mateo, CA - Sam Trans	4/22/80	Crown-Ikarus	10/60'	6/29/81	7/24/81	247,447	N/A
San Rafael - GGBHTD	9/8/76	M.A.N.	10/60'	10/78	11/27/78	174,286	N/A
Seattle - METRO	8/31/76	M.A.N.	151/60'	5/78	1/31/79	142,246	N/A
Washington, DC - WMATA	9/20/76	M.A.N.	43/55'	1/27/79	3/27/79	172,673	N/A
			511				
RECENT AWARDS							
Atlanta - MARTA	8/81	Neoplan	46/60'	Summer '82	Fall '82	240,500	N/A
Chicago - CTA	10/80	M.A.N.	125/55'			270,000	269,850
Denver - RTD	7/81	M.A.N.	89/60'			240,144	227,476
Indianapolis - IPTC	7/81	M.A.N.	15/60'			279,577	272,695
Memphis - MATA	7/81	M.A.N.	10/60'			284,683	265,232
Minneapolis - MTC	8/81	M.A.N.	62/60'			279,008	266,174
Nashville - KTRANS	7/81	M.A.N.	15/60'			284,267	264,816
Pittsburgh - PA Transit	7/81	M.A.N.	30/55'			275,679	262,222
San Jose - SCCTD	7/81	M.A.N.	15/60'			290,993	280,755
San Jose - SCCTD	10/81	Crown-Ikarus	10/60'			299,600	
Seattle - METRO	5/80	M.A.N.	202/60'	2/19/82		236,400	239,400
Washington, DC - WMATA	7/81	M.A.N.	32/60'			286,699	267,248
Westchester County, NY	8/81	M.A.N.	41/60'			274,467	272,695
			692				

* As of March 15, 1982
** Reflects changes due to relative currency adjustments and change orders subsequent to award.

N/A = Not Applicable

All of the vehicles delivered to date have been manufacturered by one of two companies - Maschinenfabrik Augsburg-Nuernberg (M.A.N.), West Germany or Ikarus Body and Coach, Hungary.

M.A.N. originally participated in a joint venture with AM General whereby a "driveable shell" was manufactured in Germany and delivered to the U.S. where AM General completed the fabrication to the buyer's specification. This joint venture was terminated by AM General after the 1976 Consortium buy and the first Seattle Metro order. As of January, 1982, the parts supply network came directly under the new M.A.N. Truck and Bus Corp., headquartered in Southfield, MI. In October, 1981, M.A.N. officially opened its manufacturing plant in Cleveland, N.C. Current order backlog of more than 630 articulated buses ensure the plant's production through 1983.

Ikarus Bus and Coach has had and continues to have production arrangements with Crown Coach Corp., Los Angeles, CA. Crown similarly, receives driveable bus shells, expect that these vehicles have already been fitted with U.S. driveline components shipped to Budapest by Crown. After shipment to the U.S., Crown installs such hardware as air conditioning, windows, seating interior trim, body insulation, floor covering, interior lighting, standchions, destination signs, wheelchair lifts, paint, etc. On various future orders Crown is planning domestic installation of engines, axles, transmission, driveshafts and steering, as well.

Neoplan USA Corp. is the newest producer to win an award for articulated buses. Neoplan too will use a combination of a bus shell produced at its parent company's plant in Germany and final fabrication at the new U.S. site in Lamar, CO. Eventually, when the production capacity of the U.S. manufacturing plant increases, Neoplan may manufacture the complete vehicle as it does with the standard 40 foot coach.

All of the bus deliveries to date have involved extensive fabrication in Europe prior to shipment to the U.S. For this and other reasons the delivery time has been quite long. The average length of time from contract award to delivery of the first bus has been about 22 months with delivery time varying from 14 to 28 months. This time should decrease since:

- Properties and vehicle producers are gaining experience in what can be specified and what can be offered.

- Currently two U.S. producers (M.A.N. and Neoplan) are operating manufacturing facilities in this country (General Motors would make the third firm).

- M.A.N. and Neoplan can rely on their parent company, if the situation warrants, to produce driveable bus shells in parallel to production here.

Table 2 also shows that six of the original fourteen properties who now operate articulated buses are procuring more vehicles. In each case except for WMATA in Washington, DC, the properties have ordered more than their original order.

The geographical distribution of articulated bus deliveries and orders is shown in Figure 1. Clearly, the mid-west and far-west dominate in total numbers with Seattle, Portland, and Denver by themselves accounting for almost 44 percent of known current and future orders. However, most regions of the country are represented, although the numbers in some locations may be small.

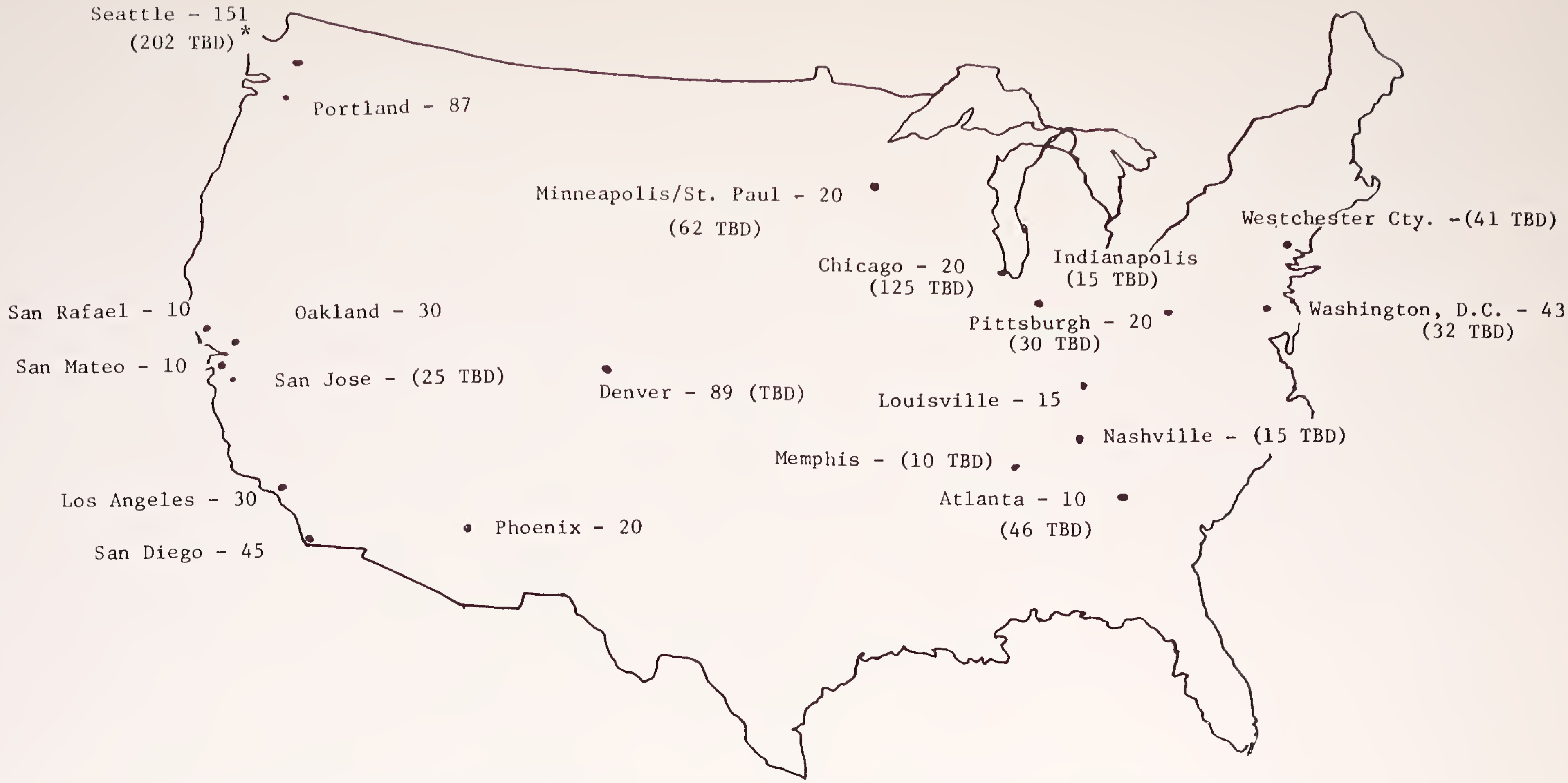
Additional locations actively pursuing the purchase of articulated transit buses include:

- Milwaukee, WI - bid solicitation out for 40 units, no lifts, with a/c;

- New York Consortium of Albany (3 units), Syracuse (12 units) and Rochester;

- Detroit, MI (SEMTA) - bid solicitation out for 14 units with wheelchair lifts;

- Jacksonville, FL - bid solicitation out for 6 units with option for 4 more;



*Delivery commenced in March, 1982.

(TBD) = To Be Delivered.

FIGURE 1
DISTRIBUTION OF DOMESTIC FLEET
OF
ARTICULATED TRANSIT BUSES

Other transit locations with more or less firm plans for acquisition of articulated transit buses include:

- Newark, NJ - for 117 units plus option for 100 more;
- Portland, OR - for 87 units;
- Los Angeles, CA - for 30 units;
- Chicago, IL - for 100 units;
- San Antonio, TX - for 20 units;
- Phoenix, AR - for 15 units;
- Cleveland, OH - in planning;
- Honolulu, HI - for 15 units;
- San Francisco, CA - for 50 units plus an option for 50 more;
- Providence, RI - for 5 units;
- El Paso, TX - for 5 units.

All articulated buses contracted for to date have used Federal (UMTA) subsidy together with state and local participation. The total purchase amount expended for buses already delivered is about $100 million. An additional amount of approximately $200 million will be required to pay for new bus orders. Figure 2 graphically depicts the increase in capital cost over the past six years associated with domestic purchases of articulated buses. A corresponding increase is also shown for prices paid for 40-foot Advanced Design Buses (ADB) and "newlooks". The broad range of prices indicated in these curves is the result of numerous factors, including the extent and cost of options ordered, the number of buses ordered, the extent of "design" rather than performance contained in the bid specification, and, possibly, even the reputation of the property for exceptionally tough inspections and extensive warranty claims. From this chart it can be seen that the average cost today for an articulated order would be in the $275,000 range.

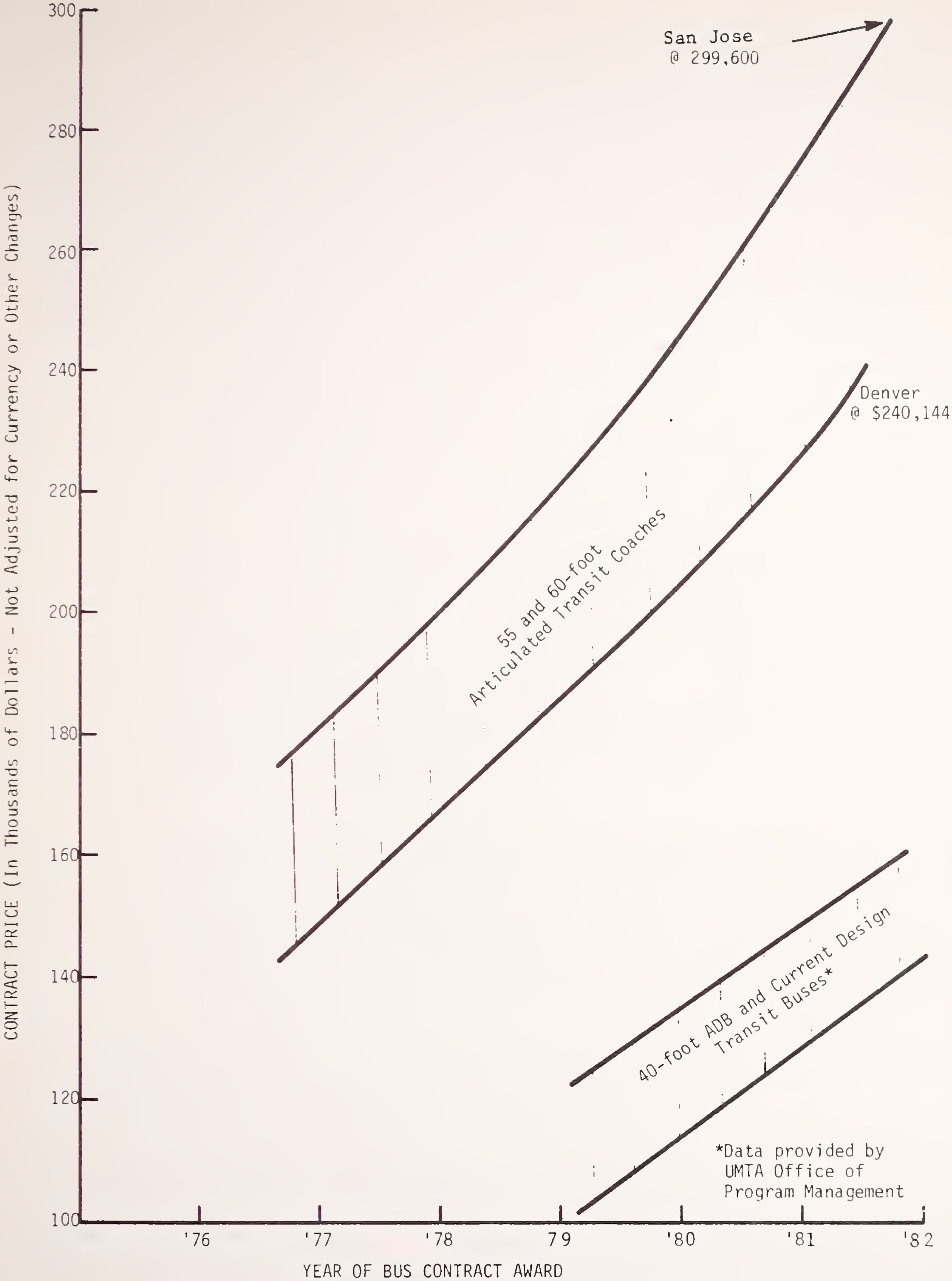


FIGURE 2

RELATIVE CONTRACT PRICES:
ARTICULATED AND CONVENTIONAL
TRANSIT COACHES

A comparison of the capital costs of articulated vs. standard 40-foot buses can be misleading. Using a current average cost of $160 thousand for a 40-foot coach, the capital cost per seat computes to about $3,400 for the standard-size coach and about $3,900 for the articulated bus. However, to completely understand the tradeoffs and the potential benefits of articulated buses, direct operating costs over the useful life must be compared. To justify procurement of articulated buses, transit properties have analyzed potential cost savings that could result from substituting articulated buses for standard-size vehicles. To perform this comparison, properties have identified the number of bus hours per day which could be saved using articulated buses. This is obviously closely tied to specific routes, patronage, service levels and labor and fringe benefit costs. Viewing the justification on the basis of savings caused by substitution implies some associated headway increases and schedule changes as well. Other properties have argued that since their existing bus capacity is inadequate and people are being left at the bus stops, deployment of articulated buses, with its large capacity, appears to be the most cost-effective manner to capture unsatisfied passenger demands. Although both reasons for procuring articulated buses (operating cost savings from substitution and ridership increase) appear logical, there has been little documented to indicate the magnitude of the apparent benefits.

Figure 3 graphically shows the characteristics of the articulated bus market in the U.S. At best, it has been sporadic. After an initially flurry of orders in 1976 little occurred until 1980. The only optimistic trend is two strong years of bus orders in 1980 and 1981 and potentially a good year in 1982.

3.2 Future Trends in Articulated Bus Deployment

The transit bus market, in general, has always been difficult to forcast. It is heavily influenced if not controlled by the level of Federal capital subsidy. Although hard to quantify, the market appears to be adversely affected by Federal requirements, such as the past mandate of full

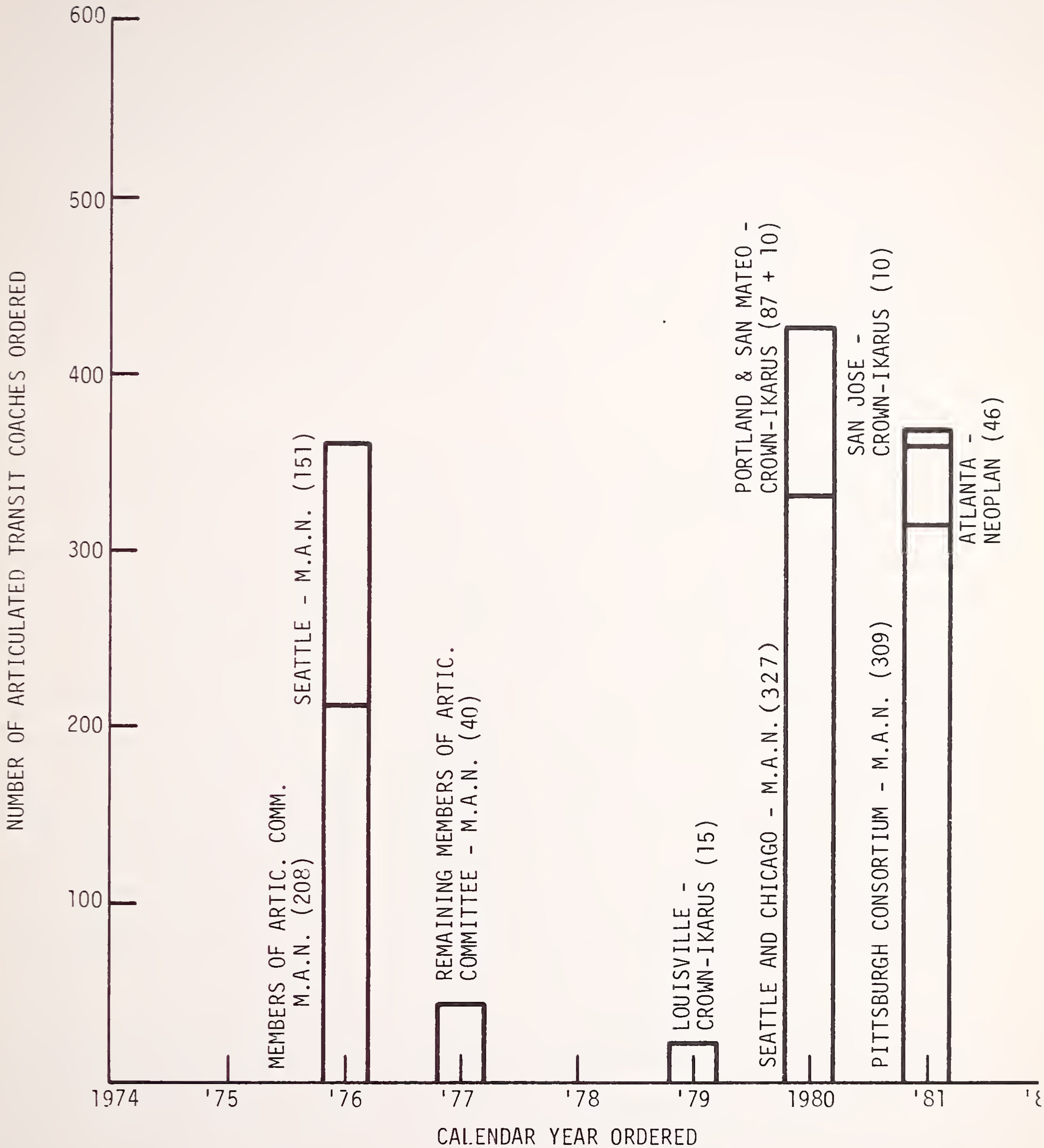


FIGURE 3. CHARACTERISTICS OF THE ARTICULATED BUS MARKET IN THE U.S.

accessibility for mobility-impaired. Transit properties often take a "wait-and'see" attitude, such that when a new mandate is issued many properties may delay bid solicitations until the procedure and potential impacts are clear. For these and other reasons, the market for transit buses in general is erratic. Orders for 35 and 40 foot coaches totalled about 3000 vehicles for calendar year 1981, while for 1980 the total was slightly less than 2000 vehicles.

The articulated bus market, as evidenced by the data presented in Figure 3, appears to suffer the same problem of unpredictability. However, there are indications that in the future the articulated bus market could be stable and vigorous. This is based on current trends in urban characteristics,as well as recent actions by the vehicle supply industry.

The use of articulated buses in the U.S. for either urban or intercity transit was strongly influenced by the apparently favorable experiences in European deployments. For a number of reasons, including higher fuel and auto prices, different trip patterns in the urban area, urban population and population density, and a greater commitment to public transportation, numerous foreign cities have expanded the use of high-capacity vehicles to where, in many cases, they represent a significant portion of their fleet. To date the economic, social and political structure of the U.S. and its cities have not reached that of Europe. It is doubtful that Mass Transit in the U.S. will ever come close to achieving the share of ridership common in foreign cities. However, there are indications in current trends in urban characteristics, such as increasing population of some cities, fewer auto sales and increasing public transit consciousness, that some U.S. cities could approach, <u>as an upper bound</u>, similar fleet mixes and characterisitcs as similar-sized European cities.

In addition, there have been some recent activities that indicate that the market for articulated buses will continue to grow.

- Construction of the M.A.N. Truck and Bus Corp. manufacturing facilities in Cleveland, NC, requiring an investment of approximately $13 million. Production capacity will soon be about 400 buses/yr.

- Development of an articulated transit coach by the GMC, Truck and Coach Division. Furthermore, statements by Division General Manager, R. W. Truxell, indicate that he perceives a market of up to 650 units/year later in this decade (Automotive News, 10-12-81).

- Active marketing of their articulated bus by Neoplan USA.

- Demonstrations, displays and short-term loans of M.A.N. articulated buses throughout the country to introduce the new technology to transit personnel and the riding public.

- Plans by Scania of America to introduce and demonstrate their articulated bus during the Summer of 1982.

- Agreement to demonstrate the DAC articulated bus (1 or 2 units) from Rumania at Metropolitan Suburban Bus Authority, NY.

- Agreement to demonstrate one or two units of the Magirus-Deutz articulated bus at PA Transit in Pittsburgh in the Spring of 1982.

- The decision by General Motors of Canada Limited in the late 1970's to develop an articulated transit bus and production and sale of 53 units to Ministry of Transportation and Communications Division of the Government of Ontario.

These activities suggest that the vehicle supply industry has already begun to stimulate U.S. transit properties. The marketing intensity and responsiveness of the supply industry, together with economic, social and political changes will, to a large degree, control the future demand for articulated transit buses.

4.0 GENERAL CHARACTERISTICS OF ARTICULATED BUS TECHNOLOGY

This section provides information on design characteristics and fabrication techniques of representative articulated transit coaches of both domestic and foreign manufacture. The depth of technical detail is structured to provide, at a minimum, a good working-level understanding of the technology of articulated buses for those in the transit community who are currently unfamiliar with this type of transit vehicle. Some basic understanding of standard-size transit buses is assumed so that in most instances the design characteristics discussed here are primarily those peculiar to articulated transit buses. The information in this section was obtained from discussions with numerous manufacturers, review of existing articles and review of manufacturer's brochures. A list of representative North American and European manufacturers of articulated vehicles is provided in Appendix A. The discussion in this section is supplemented by vehicle-specific specification and performance data provided in Appendix B. Additional design characteristics, directly related to operational or maintenance problems experienced early-on by the transit properties, are contained in the following sections, as well.

4.1 Profiles of Domestic Manufacturers of Articulated Buses

Currently there are three domestic articulated bus manufactuers:

1) Crown Coach Corporation;
2) M.A.N. Truck and Bus Corp., and
3) Neoplan U.S.A.

Since these companies form the articulated bus supply industry in this country at this time (GMC is not currently in production), it is worthwhile to understand a little of the background and structure of these companies and their European affiliations.*

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*Excerpted from "Entry and Competition in the Transit Bus Manufacturing Industry", Weiers and Rossetti, U.S. DOT, Transportation Systems Center, March, 1982.

Crown Coach Corp. of Los Angeles, CA has been a builder of transit-type school buses for well over 40 years. The company diversified in the 1950's to produce firetrucks and intercity coaches. Seeking growth opportunities, the company has recently entered into a joint venture with Ikarus Body and Coach Works, Budapest, Hungary, to produce articulated transit buses. The design is derived from the Ikarus articulated bus and Crown uses Ikarus as a subcontractor supplying various body parts. By using U.S. built components throughout, Crown has attempted to differentiate its bus from its principle competition, M.A.N., which uses a German engine, transmission, etc. Ikarus is one of the world's largest producers of transit buses and of large, integral construction buses in general. The company's annual production of buses is over 13,000, including some 1500 articulated transit buses. The phenomenal size of Ikarus as a bus producer is the result of planned specialization in motor vehicle production among the communist countries of Eastern Europe, wherein Hungary is permitted a virtual monoply in production of large buses.

M.A.N. Truck and Bus Corp., established in 1980, is a subsidiary of M.A.N. The headquarters are in Southfield, MI, and the manufacturing facilities, opened in October, 1981, are located in Cleveland, NC. In a joint venture with AM General, M.A.N. successfully bid on two major orders for articulated buses in 1976. The parent company is a deversified West German engineering firm whose business encompasses major civil engineering projects as well as truck and bus manufacturing. In motor vehicle manufacturing the company has concentrated on medium and heavy-duty vehicles and diesel engines.

Neoplan USA is a subsidiary of Gottlob Auwärter GmbH and Co. (otherwise known as Neoplan), a West German firm specializing in building intercity, transit and special purpose buses. The U.S. manufacturing plant is located in Lamar, CO. The plant was designed for the capability of small, standard articulated or doubledecker bus manufacture.

In 1976, Neoplan licensed the Gillig Corporation to build a medium-sized transit bus design. That venture was ended in 1978 when Gillig ceased production of the Neoplan buses. Neoplan built its first integral construction bus in 1953 and today builds only integral construction buses. The company produces about 1100 buses per year in Germany with about 60% of its German output exported and with licensed production in several countries.

4.2 Manufacturing Techniques

There are several articulated bus production practices which influence availability, purchasing policy and often design features or options. Some of the manufacturing terminology, such as "chassis builder" or "integral body", have appeared already in the text. This section identifies and describes the major production methods.

> Bus chassis builders, such as Volvo and Saab-Scania concentrate on the chassis construction and leave the superstructure work to specialized bus coach builders. Typically the chassis consists of a welded steel structure, generally made from box shaped frame members. The design of the chassis includes a complete propulsion system, and all axles suspension systems, steering units, brakes, and brake retarders, fuel tanks and electrical equipment. All that is needed to drive the chassis away would be a seat for the operator. Two examples of chassis design are provided in Figure 4. The top figure is a Volvo B10M chassis with the engine between the first and second axle. The second example is a Scania BR 112A chassis with the engine aft of the third axle.

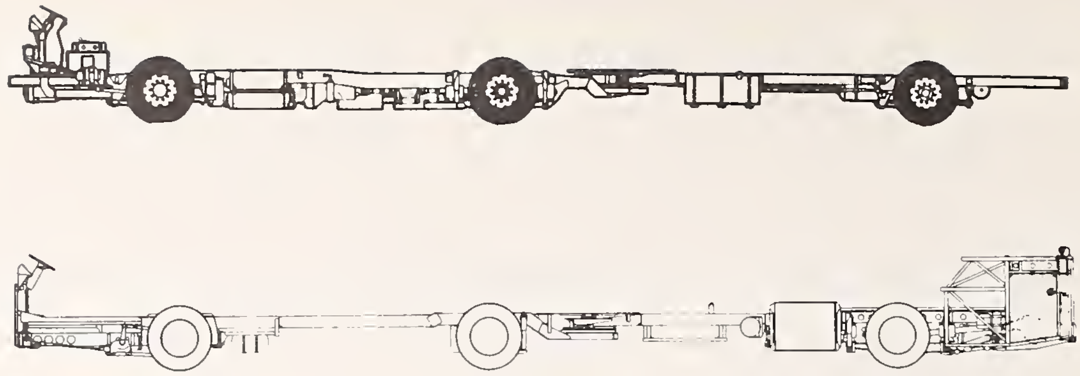

FIGURE 4 REPRESENTATIVE BUS CHASSIS

Coach builders, such as Lex, Hess and Van Hool, purchase the chassis from major chassis builders and fabricate the bus body to the buyer's specifications. One major benefit of the body-on-chassis construction method is that body fabrication has unusual design freedom to put in wide doors, extra doors, large windows, etc., since the chassis provides much of the rigidity and structural strength.

Major vehicle builders, such as Daimber-Benz, M.A.N. and Leland, construct the coachwork on their own proprietary chassis.

Integral-design coach builders, such as Neoplan, Ikarus and Vetter, produce the vehicle from the ground up and are likely to be able to supply "special vehicles or construct coachwork on any given chassis. In contrast to the body-on-chassis design bus the integral-design bus is usually designed so that structural stress is borne by the bus body itself and the chassis components are mounted to the body.

Regardless of the construction technique used the external size and contour of the articulated coach have been dictated by a combination of political/legal constraints, physical limitations, and human engineering.

Generally speaking, the overall length and width are governed by legal tolerances. Therefore, the vehicle always maximizes its floor plan or "footprint" to utilize the greatest available area. Lengths vary from 55 feet to 60 feet (61' for GMC). In general, these dimensions compare favorably with European practices. Standard width overseas is 98.4 inches while U.S. cities have progressively increased the allowable width from 96 inches to the currently popular width of 102 inches.

Inasmuch as the overall height is always well within allowable limits, it becomes a variable sensitive only to floor height and desired headroom.

4.3 Propulsion Configuration

Many different types of articulated buses have been developed over the years. The principal classes are illustrated below according to propulsion configuration.

Type	Unique Characteristics
1	Front-end, horizontal under floor axial engine with the second axle powered.
2	Vertical front engine with second axle powered.
3	Side mounted engine with second axle powered.
4	Transverse rear engine with third axle powered.
5	Transverse rear engine with second axle powered.
6	Transverse rear engine with second and third axle powered.

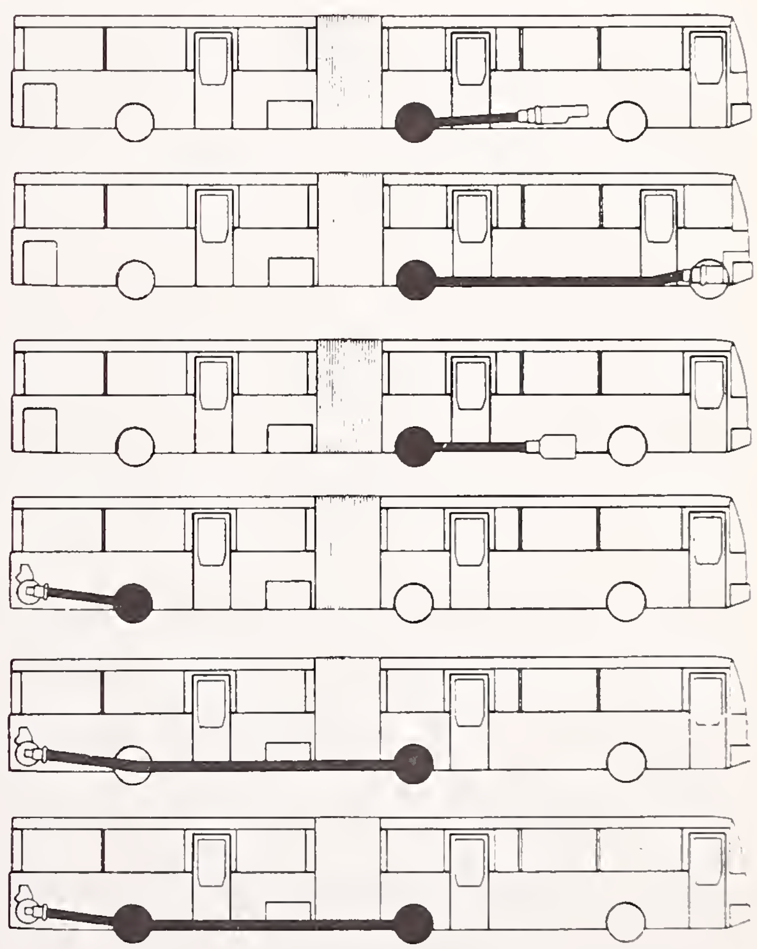

FIGURE 5 PROPULSION CONFIGURATIONS

Type 1, the front-end, horizontal, under-floor engine type,has been the most popular arrangement in articulated transit buses because:

a. The first articulated transit bus consisted simply of a trailer attached to a standard 35' transit bus; and

b. coachbuilders could build up from any standard chassis without major modifications.

Current users of this design using their own chassis include Ikarus, Leyland, M.A.N., Volvo, and Vetter. Current users on chassis purchased from another manufacturer include:

a. D.A.C., Graef & Stiff, and Portesi - each using a M.A.N. chassis;
b. Den Oudsten, Heuliez and Lex - each using a Daimler - Benz chassis; and
c. Hess and Haglund - each using a Volvo chassis.

Manufacturer-reported advantages are that the joint mechanism is simple, the dynamics during acceleration are better, there is less tendency to jackknife than with a rear-mounted engine, and the distributioon of weight is more even among the three axles.

Type 2, the vertical front engine type with second axle powered, is another configuration to convert a conventional bus to a compound chassis design. Currents users of this design are merely using the front-engine vehicle as a traction unit to tow a separate trailer section.

Type 3, side-mounted engine with second axle powered,is currently limited to one manufacturer, Van Hool. The advantages are similar to those associated with type 1 configuration but without the floor height constraints of an underfloor engine.

Type 4, the transverse rear engine with third axle powered, is a relatively new design configuration. Current users on proprietary chassis include Daimler-Benz, General Motors of Canada, GMC Truck and Coach, Neoplan, Saab-Scania, and Steyr-Daimler-Puch. Other users for coachbuilding on a purchased chassis are DeSimon on a Fiat chassis and Heuliez or Lex on a Daimler-Benz chassis. Reportedly, this design configuration provides greater traction, more effective braking (especially in slippery conditions), easier engine maintenance, isolated engine noise and pollution, low floor potential and more flexibility in body design. From a standpoint of familiarity, maintenance personnel in the transit industry have been working on rear engine, transverse-mounted propulsion systems for years.

Type 5, the transverse rear engine type with second axle powered, is currently used by Magirus Deutz and Graef & Stift. Manufacturers claim this configuration provides the dynamics of the type 1 design and with potential for low floor.

Type 6, the transverse rear engine type with second and third axle powered, is currently only used by Renault. Alleged advantages are a combination of those of type 1 and 4 configurations, particularly claims of superior traction in all driving conditions stability, engine accessibility, potential for low floor height and capability of accomodating up to 4 passenger doors.

4.4 Articulated Bus Capacity

Articulated buses have proven to be a practical way of increasing transportation capacity, without increasing the number of personnel and, reportedly, having almost the same operating costs as two-axle buses. The passenger carrying capacity can be increased over that of a conventional 40-foot bus by 50% to 75%.

For the purpose of this discussion the capacity of the articulated bus is the total number of seated and standing passengers at the point when additional boardings are denied. There are a number of factors, such as passenger "bunching" near the doors, seat widths, or amount of carry-on luggage, that can influence the apparent or actual capacity of the transit coach. Therefore, estimates of capacity, provided in Table 3, are provided as a range of values rather than one absolute number.

TABLE 3

Comparison of Passenger Capacities*

	Maximum No. of Seats**	Approximate No. of Standees***	Estimate of Total Capacity
60-foot Articulated	71-76	50-55	121-131
55-foot Articulated	65-68	45-48	110-116
40-foot Coach	46-53	33-38	79-91
35-foot Coach	38-41	22-25	60-66

* Data obtained from manufacturer's literature and brochures.

** Estimates exclude wheelchair provisions.

*** Crush loadings may result in higher capacities.

This table illustrates the general rule of thumb that passenger capacity is proportional to the length of the vehicle. A 60-foot articulated bus generally has one and one half times the capacity of a 40-foot conventional coach. Seated capacity (intuitively) is also proportional to vehicle length.

Other studies have compared capacities on the basis of allocating a certain amount of square feet for each standee. Table 4 is a recent example. As this table again demonstrates, the relative capacities are proportional to the vehicle length.

TABLE 4

Relative Capacities of Articulated and Conventional Buses At Equal Passenger Comfort Levels*

	@ 2.8 sq. ft. Per Standee		@ 3.4 sq. ft. Per Standee		@ 4.3 sq. ft. Per Standee	
	Seats	Standees	Seats	Standees	Seats	Standees
M.A.N. 60-foot Artic.	71	53	71	44	71	35
M.A.N. 55-foot Artic.	65	44	65	37	65	29
Conv'l 40-foot	50	30	50	25	50	20

*"Articulated Bus Evaluation", Transportation Systems Center, US/DOT, Staff Study #243-U. 3-209, Albright et al, Dec., 1981.

4.5 Manueverability/Handling

An articulated bus is, of course, longer (see Figure 6), so the driver has to take this into consideration. But other operating characteristics, such as instrumentation, fittings, controls, etc., may be more or less the same for an entire fleet.

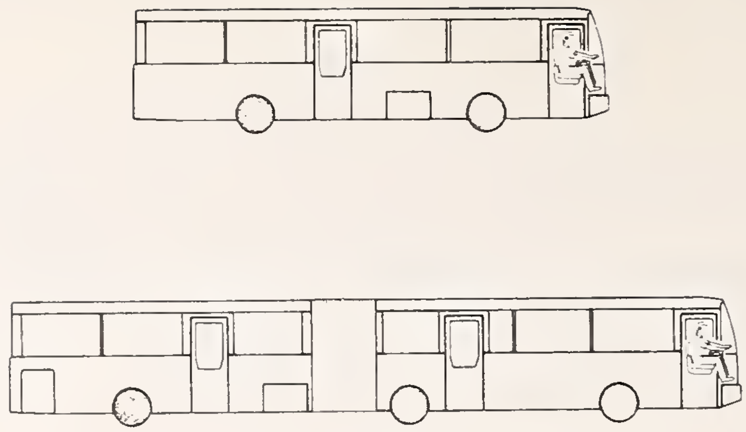

FIGURE 6 RELATIVE BUS SIZES

The geometry of the articulated bus requires special attention, i.e., extensive training of new personnel, to promote safe handling of the bus. Drivers, terminal and workshop personnel typically prefer a type of articulated bus that can be operated in the same places, and use the same stops, as two-axle buses. This should be feasible without any special supervision of bus movements. Safety wise, it is also important that the sweep area is the least possible when cornering, changing lanes, pulling in or out of bus stops, bearing in mind surrounding traffic, pedestrains, and obstacles.

In a geometrical sense, it is important to differentiate between articulated buses with a steered rear axle and those with a rigid rear axle. When utilizing a rear engine with the third axle powered, that axle must be rigid. Therefore, for that type of bus the geometry of turns is fixed. The sketch below shows two articulated buses in a full right turn. Bus A has a steerable axle (similar to M.A.N. vehicles). The turning envelope or sweep is the area inside the outer two circles. Bus B with a fixed rear axle requires a larger turning envelope to complete a turn.

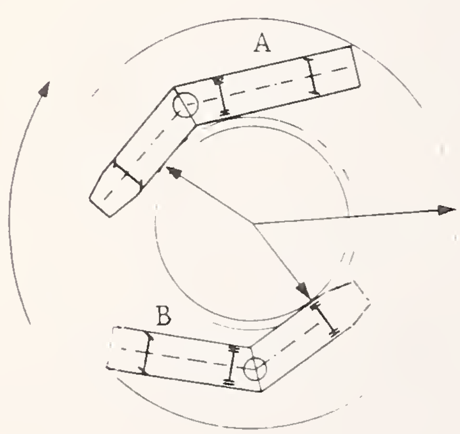

FIGURE 7 TURNING ENVELOPE

Clearly, the advantage offered by an articulated bus with a steered rear axle is a smaller sweep width. However, the difference may be less than 3 feet.

The turning envelope of an articulated bus shown in the previous sketch emphasized the "tracking" feature of the rear steerable axle, such that the wheel on the inside of the turn will not climb over the curb. However, the geometry of these vehicles affects the rear swing out of the bus, as well. An articulated bus with a steered rear axle has a drawback in that the rear section sweeps over the curb when the bus pulls sharply out from the bus stop. This oversweep, shown in Figure 8, generally does not exceed 4 feet (1.2M) and may be partially compensated for by tapering the rear coachwork corners or adjusting the steering system.

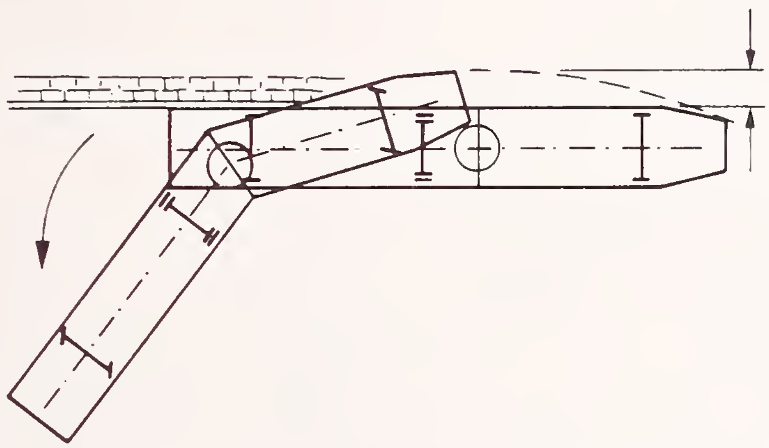

FIGURE 8 SWING-OUT WITH STEERED REAR AXLE

With a fixed rear axle, the oversweep is equivalent to that of a two axle bus.

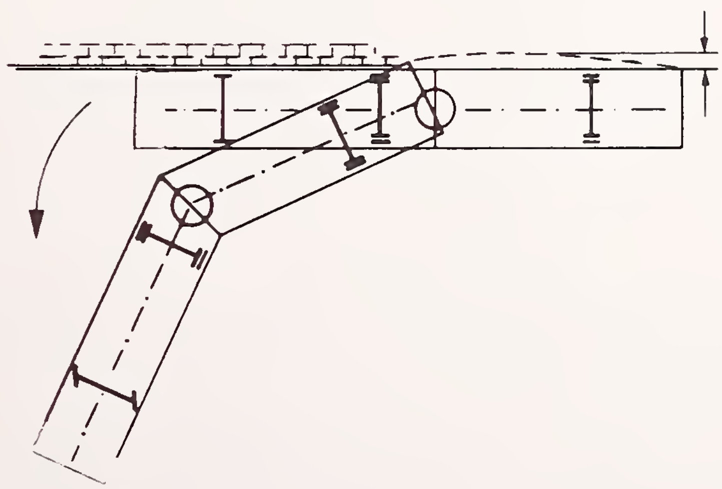

FIGURE 9 SWING-OUT WITH FIXED REAR AXLE

Another performance specification, that affects maneuverability, in addition to the sweep and the swing-out dimension, is the radius of the turning circle to the outside corner of the vehicle. Operation in narrow, congested streets in U.S. urban areas requires a relatively small turning radius.

Turning radii for a few articulated and standard size buses are shown below for comparison.

TABLE 5 REPRESENTATIVE TURNING RADII

Vehicle Designation	Turning Radius to Body Corner
Articulated	
Crown-Ikarus 286	40'
M.A.N. SG220-16.5	41'5"
AB Volvo B10M	39'4"
Standard-Size	
Gillig Phantom (35'LOA)	35'
Gen. Motors of Can. T6H5307N	42'3"
Flyer Ind. D901	42'
Flxible 870	43'.6"

Operating the articulated bus with a fixed rear axle in reverse is much like operating a tractor trailer truck. However, training in operating the steerable rear axle bus in reverse is required since the rear wheels turn the opposite way from the front axle.

In a similar way driver training is required for operating the vehicle at highway speeds. Although the problem may be worse with the steerable rear axle design, since, again, a right turn movement of steering wheel causes the rear section to swing to the left, special training at expessway speeds is required for all articulated buses to minimize or eliminate unnecessary sway of the rear section.

The articulated bus has the ability to negotiate hills, ramps and abrupt changes of grades. The bending of the vehicle in the vertical plane permits the articulated bus to perform as well as a shorter vehicle when operating on ramps. Approach and departure angles of the vehicle must be considered, similar to conventional buses, to prevent "bottoming out". A problem may occur when the vehicle must navigate successive ramps or grade changes in a short distance as shown in the examples in Figure 10. Operators should be instructed that these road profiles must be handled slowly and at non-90° crossing angles to minimize ground contact.

FIGURE 10 ARTICULATED BUS OPERATION ON RAMPS

4.6 Braking and Weight Distribution

The weight distribution on an articulated bus is arranged so that the drive wheels have sufficient tractive force for good distribution of the braking force. It must be possible to use the brake retarder without running the risk of jackknifing on slippery roads. For this reason many articulated bus designs provide a retarder on/off control for the driver.

When braking, it is advantageous to have the greatest axle load distribution at the rear. Furthermore, when the third axle is powered, there is an advantage in that the gearbox retarder works on the third axle. Each manufacturer uses different methods of controlling stability and reducing the chance of jackknifing.

4.7 Articulated Joint

The design of the joint mechanism or pivot apparatus is unique to the articulated bus. It is different from the design found in tractor-trailer rigs even though similar terminology may be used. Current designs of articulated joints permit relative movement in the horizontal plane of up to 48 degrees from either side of the vehicle centerline and as much as ± 16

degrees of vertical movement. Figure 11 illustrates the possible yaw and pitch movements of the trailer section relative to the forward section of the bus.

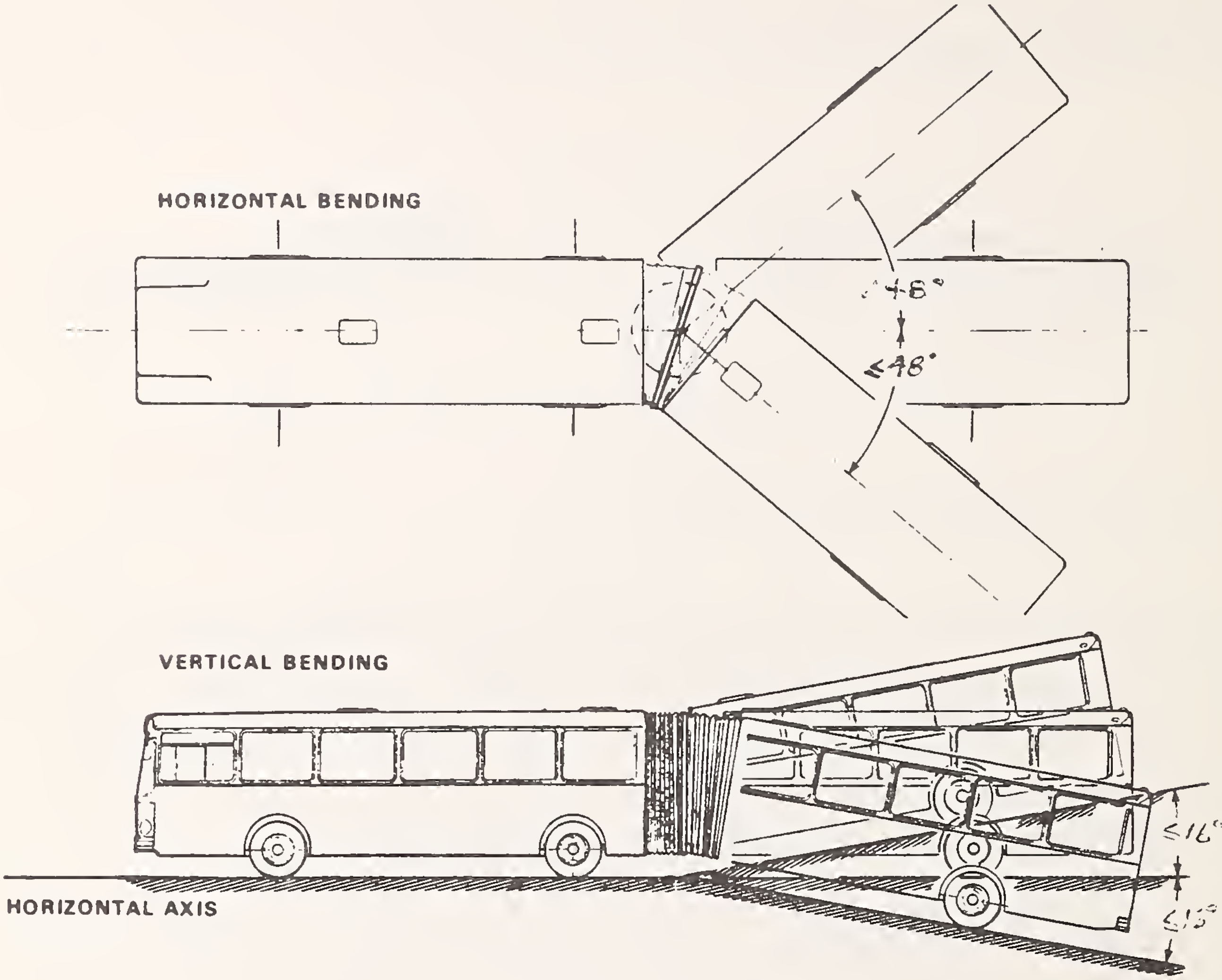

FIGURE 11 RELATIVE MOVEMENT OF ARTICULATED JOINT

Generally, motion about the third axis, or relative tortional movement of the trailer section is not permitted in the articulated joint. Instead, this motion is absorbed in the suspension system and the structure of the bus itself. In addition to forming a permanent, two-degree-of-freedom connection between the front and rear sections, the articulated joint must permit free interior movement, as well as fore-and-aft visibility.

Most manufacturers rely on a double universal joint to achieve the aforementioned tortional integrity. There are, of course, other mechanical links available to achieve similar results. For example, Volvo with its engine between the first and second axle (pulling the trailer section) uses a 33.5 inch diameter bearing or slew ring. Inasmuch as the universal joint or slew ring permits unobstructed lateral movement of the trailer in relation to the tractor, some supplementary means is often incorporated to prohibit uncontrolled, excessive motion, such as might occur during a skid, jackknifing, or over-rotation. Since these behavioral characteristics are directly related to the body type, location of the propulsion system and the axle being driven, the design and function of the articulation joint should be discussed in terms of the configuration types as previously listed.

Types 1, 2, and 3 buses are characterized by conventional tractor-trailer behavioral dynamics wherein the traction vehicle has its greatest weight over the driven axle while towing a trailing section having either a steerable or fixed axle. Since the trailer is the lightest body segment, the tendency is toward over-rotation of the trailer resulting in a whipping or pendulum action as opposed to jackknifing commonly found in the tractor-trailer relationship in trucking.

The M.A.N. concept is somewhat similar to the articulation manufactured by Robert Schenk GmbH wherein the tractor frame is dropped to accommodate a transverse pivot pin supporting a slew ring. Thus, the pivot pin permits pitching while the slew ring allows yawing and the combined stability of the three elements prohibits rolling of tractor relation to the trailer. In the situation where the rear axle is being "steered", adjustable connecting rods calibrate the steering angle in direct proportion to the turntable turning angle relative to the tractor.

In this type vehicle, anti-jackknifing controls are not considered necessary. However, vehicles, such as the Crown-Ikarus 286, do employ controls to lock brakes if the tractor-trailer angle exceeds a prescribed tolerance measured at the slew ring in the articulation. An articulation joint and steerable rear axle schematic are provided in figure 12.

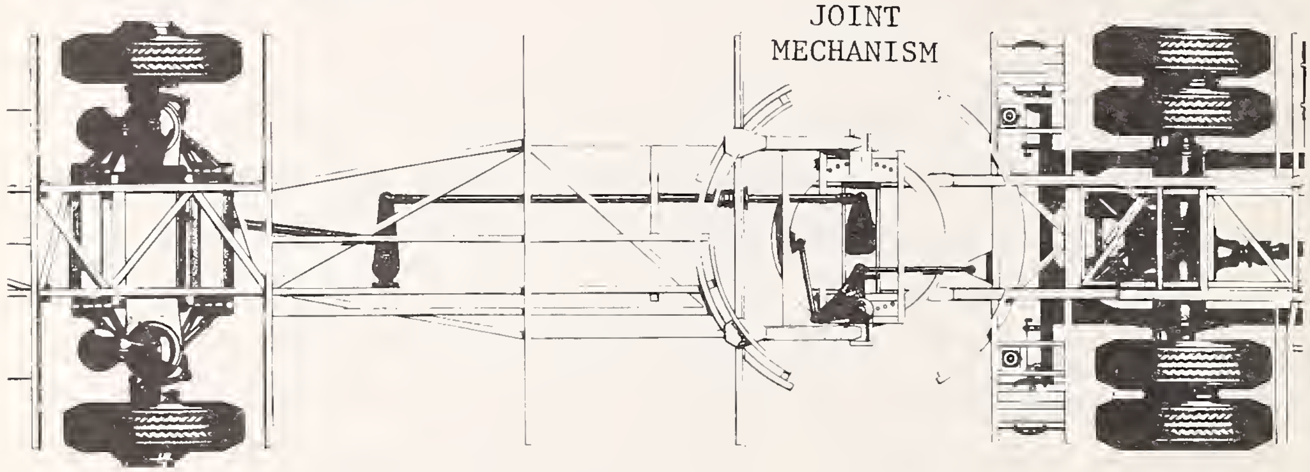

FIGURE 12 M.A.N. CHASSIS

<u>Type 4 buses</u>, rear engine with third axle powered, commonly called "pushers", introduce a new set of dynamics. Having the greatest concentration of mass behind the rear axle, jackknifing became a real threat. Confronted with this problem, each manufacturer either developed his own solution or acquired by purchase or license a suitable device having the proper capabilities. For example:

- Daimler-Benz developed an electronically controlled system of hydraulic dampers with dual functions: (1) to keep the vehicle "tracking"; and (2) on command of the electronic control, lock the joint to form a rigid unit of the tractor and trailer.

- Scania uses the Schenk design joint and depends upon electronic logic to monitor bending speeds, acceleration, and axle revolution, as well as to emit an impulse to instantaneously command the throttle, brakes, and fold absorbers to control jackknifing or fishtailing.

- General Motors, Truck and Coach Division, elected to strive for simplicity through the use of a totally mechanical coupling system and air bellows to provide controlled articulation and directional stability with automatic wheel lock controls.

- General Motors of Canada Limited uses a Schultz design articulated joint with automatic, anti-jackknife protective controls.

- Neoplan uses the Schenk design for the articulated joint. The Schenk is basically a turntable having brake-stabilizing shock absorbers dampen rear axle motion. On cornering, the angle between tractor and trailer is stiffened and controlled by airbrakes operated through four sensors. If the bus tends toward jackknifing a high volume dampening cylinder is pneumatically locked to resist further deformation until the vehicle's linear movement is restored.

Type 5 buses are compromised of the rear engine with forward traction. Concerned about the jackknifing tendency of the rear engine driving the rear axle, builders such as Magirus-Deutz or Graef and Stift extended the drive shaft through the articulation by means of universal joints and used state-of-the-art skid or fold control devices.

Type 6 buses, such as the Renault PR180, are designed to enjoy the best features of all the aforementioned types. That is, the rear engine eliminates the body design constraints imposed by the underfloor engine, while the power supply to both axles is intended to assure the most favorable dynamic characteristics of the vehicle from the standpoints of inertial forces, traction, anti-skid, and control of jackknifing or fishtailing. Figure 13 shows the Renault chassis with both the second and rear axles being driven.

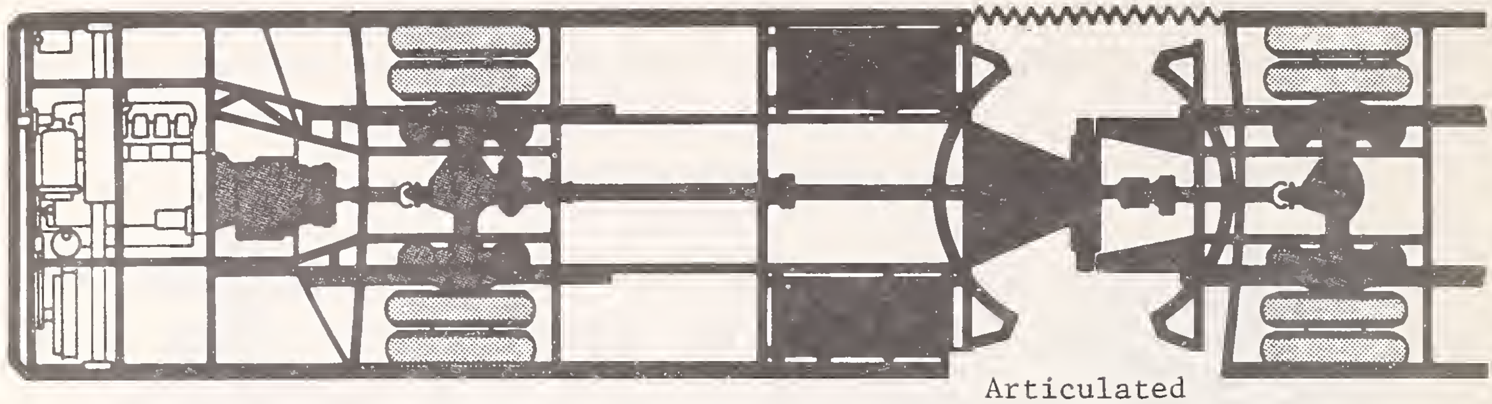

FIGURE 13 RENAULT CHASSIS

Two other elements are associated with the joint itself. They are the turntable and the bellows.

The turntable is a flat disc employed in the floor over the joint. It is generally hinged across the center to permit compliance with the floor of each section of the bus.

The bellows generally are fabricated from abrasion and tear-resistent, flame-retardant, Hypalon-coated, laminated, polyester fabric having a high degree of dimensional stability to impart rigidity and self-supporting characteristics. Interior appearance of the bellows resembles the exterior appearance with exceptions created by functional or cosmetic treatment such as handrails, seats, modesty panels, acoustical or insulating curtain, seals and ducts.

4.8 Miscellaneous Design Characteristics

Except for the design characteristics discussed in the previous sections of this report, the majority of technology found in the articulated transit bus also appears in standard coaches. Items, such as suspension, gearbox, axles, brakes, engines, transmissions and front steering gear, are generally not unique to articulated buses. However, a few design characteristics that potentially could differ from the conventional 40-foot coach, remain to be discussed.

4.8.1 Door Width

The principal advantage of the articulated bus relates to its ability to accommodate large numbers of passengers. To assure rapid access and egress, a door should be wide enough to permit passage two abreast. Most manufacturers offer optional widths up to 50 inches. Some vehicles, such as the GMC coach, have front door size limitations due to the reduced front overhang or styling constraints. To realize the full benefits of wide doors on articulated buses an appropriate fare collection policy and procedure must be determined.

4.8.2 Step Heights

Step height standards show only minor variations. The first step at the front of the vehicle varies according to manufacturer from 13 inches to 15 inches. Bus "Kneeling" systems could lower this even more. The first step at rear doors is generally lower where it is not necessary to contend with the approach angle necessary at the front of the vehicle. Succeeding steps vary from 5.5 to 14 inches.

4.8.3 Kneeling Capability

Inasmuch as the kneeling capability has only been a choice of American cities, it is only found on American articulated buses influenced by the American market. Here, the greatest height differential is found on the GMC articulated bus where the first step height can be reduced from 13 inches to 8 inches, utilizing controls of the front side air suspension system.

4.8.4 Interior Headroom

The articulated bus is not subjected to overall height constraints so the interior headroom becomes an option of the buyer or builder. Headroom in the buses studied varies from 79 inches to 91.5 inches. However, actual experience demonstrates interior fixtures generally produce clearances below those stated.

4.8.5 Floor Height

Floor height in the Type 1 vehicle (engine between first and second axle) is established by the height of the under-floor engine -- normally in excess of 36 inches. The other types have been developed to permit a lower floor height. However, it is interesting to note that the height difference may only be one step-riser or approximately 8 inches.

5.0 OPERATIONAL AND MAINTENANCE CHARACTERISTICS

In general, operational and maintenance experiences with articulated transit buses in this country is not extensive. As discussed in Section 3.0 only fourteen transit agencies collectively deploy about 511 articulated buses, many for only a relatively short time. To date, only two manufacturers, M.A.N. and Crown-Ikarus, have delivered buses, so the diversity of experiences is limited in vehicle design, as well. Therefore, it is important that caution be used in arriving at any conclusions based on this sample of data. However, eleven of these fourteen properties have had the vehicles for at least two years and the cumulative revenue mileage of all articulated buses is estimated at 40 million miles. Much can (and has) been stated about the operation and maintenance of articulated buses. It is worthwhile to accumulate and document this information for the benefit of others as long as those interested remain receptive to changes (hopefully improvements) that may occur in the future. Finally, summarizing this information can become difficult because of comments or data that varies or, in some instances, is contradictory. Such variation comes about because of differing maintenance philosphies, climate, topography or relationships with manufacturers. Given these cautions and qualifications the following sections address pertinent aspects of the operational and maintenance experiences of U.S. articulated transit buses.

5.1 Operational Characteristics

This section summarizes certain aspects of the operation of articulated buses in transit service that appear to be of interest to transportation departments and/or that offer some unique characteristic compared to conventional transit coach operation. The section first discusses the operational characteristics, such as fuel economy, stability, scheduling concerns, etc., and then presents in tabular format in Table 6 the specific comments of transit personnel at each property.

5.1.1 Fuel Economy

The fuel economy of articulated transit coaches appears to be relatively good, especially when the extra capacity is considered. The fuel economy data provided in the comments of Table 6 ranges from about 2.4 to 3.7 mpg for air conditioned, articulated vehicles. The variation in actual fuel economy is a function of a number of factors, including topography, ridership, and bus duty cycle. For the sake of comparison, if 3.0 mpg was a representative value for articulated buses and 3.5 mpg was a reasonable value for conventional buses, both air conditioned, the articulated bus would be about 20% more fuel efficient on a per seat-mile basis.

5.1.2 Bus Scheduling Concerns

Four major concerns appear to affect the scheduling of articulated buses in transit service. They are longer run times than conventional 40-foot buses, hill climbing ability, manueverability on narrow streets, and poor handling in slippery road conditions.

A few transit properties report approximately a 10% increase in required time for an articulated bus to complete its run over the time needed by a 40-foot coach.* Those properties using the bus on express or highway runs without many stops, however, feel the bus performs in equal or less time. The concensus of opinion appears to be that the delay occurs during the dwell time only; the bus accelerates well and easily keeps up with normal traffic. The time for which the passenger door remains open is determined by passenger loading charactersitics. The time for the door mechanics to operate is usually determined by specification, although it can be easily changed by adjusting air pressure. No property sampled seemed that alarmed by the slightly longer run time in light of other operational benefits.

Cities, such as Pittsburgh and Seattle, were concerned that the bus had some difficulty in handling steep grades under heavy loading conditions. However,

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*More analysis on this subject can be found in "Articulated Bus Evaluation," Albright et al, U.S. DOT, Transportation Systems Center, Report #SS-243-U.S.-209, 12/81.

this is not unique to articulated buses. Accomodations where possible had to be made in the vehicle scheduling and routing. In addition, some modifications have been made on the new M.A.N. buses now being delivered to Seattle to address this problem. These changes include:

- o an intercooled engine (as well as being turbocharged);
- o increasing the torque (and, therefore, horsepower) of the engine at relatively low rpm;
- o properly matching the rear axle ratio with engine/transmission shift points.

At least one city, Pittsburgh, felt there were some narrow routes (though not many) on which an articulated bus could not safely operate. Accordingly, some scheduling adjustments had to be made. This concern was initially shared by other cities, as well. Intuitively, the size of the vehicle made transportation staff feel the routing should be constrained to only wide straight routes. However, with experience this concern was tempered appreciably. Articulated buses maneuver well in city traffic and are used on a wide variety of routes and in a wide variety of operating environments.

Generally, northern cities, such as Seattle, Pittsburgh and Chicago, were concerned with "jackknifing" on slippery road conditions. Seattle, for one, would reschedule the articulated buses to operate on sanded roads only and use 40-foot buses as shuttles to bring riders to the pick-up points. Operator training and familiarity with the vehicle would also help ease this problem, the magnitude of which appears no greater than with conventional buses.

5.1.3 Stability in High Speed Operation

Some early reports claimed a certain amount of movement or "fish-tailing" in the rear section of an articulated bus during higher speed operations. This apparently was more evident in vehicles with steerable rear axles, since a turn of the steering wheel to the right causes the rear axle to move to the left. Virtually all properties reported no current problem with instability and except for isolated cases, this has been eliminated by operator training.

5.1.4 Rear-Side "Swing-Out"

Without exception every property has experienced some initial problems due to the rear side swinging out during turns. The amount of swing-out beyond the side plane of the bus varies. Articulated buses with steerable axles will sweep out further than vehicles with "fixed" rear axles (see section 4.5). Transit properties are successfully overcoming this problem to where it is now no greater than with conventional 40-foot buses. They are accomplishing this in the following manner:

- o Unanimously, all transit properties recognize and implement special operator training programs;
- o All current orders of articulated buses (listed in Table 2) are specifying a tapered rear section. The tapered section is a standard design in Europe. This substantially reduces the swing-out and the resulting potential of contact;
- o Some properties are considering adjusting the steerable rear axle to lessen the extent of swing-out;
- o About half of the properties use a sign at the rear exterior of the bus to warn motorists and pedestrians that "Caution This Bus Swings Out On Turns";
- o At least one property, Seattle, is ordering rear bumpers extending on both sides around to the wheel well.

Seattle is the one property that has the most experience in operating articulated transit buses. Their fleet safety department recently completed a comparison study of accidents between their articulated and standard 40-foot coaches for the time period from approximately October, 1981, to February, 1982. The 151 articulated buses were involved in 92 accidents or 33.08 accidents per million miles compared to 51.70 accidents per million miles for the 885 40-foot fleet. Only three of the 92 accidents involving the articulated coaches were accidents in which the tail swing was a factor.

5.1.5 Passenger Acceptance

Some measure of passenger acceptance is demonstrated by the fact that six of the original fourteen transit properties have ordered more articulated buses. Beyond that, according to comments by transit personnel, riders frequently will call and complain when the articulated bus is not assigned to their route. In Los Angeles, the business community recognized the popularity of the articulated bus and attempts were made to get and keep these buses on a certain highly commerical route. It appears safe to say that passenger acceptance has been very good.

5.1.6 Fare Collection

Fare collection policies and procedures have limited and constrained the potential benefit of articulated buses to U.S. transit operations. Except for express runs and park-and-ride services, most operations require either entrance or exit out the front door past the fare box; the full value of the wide doors and extra capacity, therefore, is not realized. At least two transit properties, TRI-MET in Portland, OR, and San Deigo, CA, will be experimenting with a self-service fare collection system starting in September, 1982. This fare collection policy relies, to a large extent, on the "honor" of the patron and thereby should permit use of all doors at each stop. Portland and San Diego offers an excellent opportunity to evaluate the full operational benefits of articulated buses in domestic service.

5.1.7 Institutional Concerns

Institutional concerns in the context of this report generally are regulatory in nature, either at a local state or even Federal level. Such regulations or ordinances may inhibit the operation of the vehicle in certain areas. Experiences to date suggest that with appropriate planning these constraints can be avoided by legislative action or waivers on an administrative level. Areas to be concerned with include:

- Restrictions on vehicle length, multiple units, width and maximum axle weight, both locally and on interstate highways;
- Operator licensing;
- Bridge or tunnel restrictions;
- Insurance coverages;
- Emergency evacuation procedures.

TABLE 6. SUMMARY OF OPERATIONAL EXPERIENCES OF ARTICULATED BUSES IN U.S.

(AS REPORTED BY TRANSIT PERSONNEL)

TRANSIT PROPERTY	TYPE OF SERVICE FOR WHICH ARTICULATED BUSES ARE USED	NUMBER OF ARTIC'D BUSES	APPROX. PERCENTAGE OF FLEET	EARLY PERFORMANCE PROBLEMS	OPERATIONAL BENEFITS
Seattle Metro-Seattle, WA	o Replace peak-hour double-headers. o Suburban park-and-ride to downtown. o Now operating at all times-peak and off-peak.	151 plus 202 being delivered (M.A.N.)	30	o 10% longer run time due primarily to increased dwell time. o Some difficulty on hills with heavy loading o Excessive "swing-out" of rear of bus during turns on some artics; steering system adjustments reduced "swing-out" and virtually eliminated associated accidents. o Handling is difficult in snow/ice.	o Eliminated need for double-heading 40' buses on crowded runs. o 98% availability. o Fuel economy reported to be very good-only 8-9% less than 40-foot coaches in their fleet.
MARTA-Atlanta, GA	o Originally on express routes. o More recently on long, heavily travelled routes with frequent stops.	10 plus 46 on order (M.A.N.s with [illegible] on order)	6	o Backing up often caused "jack-knifing" prior to improved driver training and more audible warning. o Some accident damage due to rear-end swing out; considering going to different steering unit offered by manufacturer.	o Fuel economy is relatively good-comparable to conventional bus and much better than GFC 870 o Replaced two 40-foot buses with one articulated. o Stable at normal road speeds.
Metropolitan Transit Comm.-Minneapolis/ St. Paul	o All types of routes-primarily during peak-hours.	20 plus 62 on order (M.A.N.)	7	o Unusual propensity for rear side damage due to "swing-out" on turns. o 10% longer run times than conventional vehicles in peak-hour, local service. o Insufficient power to operate heavy loads on hilly routes.	o Fuel economy comparable to GFC 870 - range of 3.5 to 3.7 mpg. o Very reliable vehicle averaging 19,000 miles between road service calls (compared to 3,000 miles for rest of fleet). o Better able to maintain schedule on express runs than conventional transit coaches. o Substitution of 1 for 2 for 100% productivity improvement.
San Diego Transit San Diego, CA	o All types of service-peak and off-peak, over 20 hours/day.	45 (M.A.N.)	13	o Performance on hilly routes not as good as conventional 40-foot bus.	o Availablity steadily improving 38 of 45 available daily for service.

TABLE 6A. SUMMARY OF OPERATIONAL EXPERIENCES OF ARTICULATED BUSES IN U.S. (Continued)

(AS REPORTED BY TRANSIT PERSONNEL)

TRANSIT PROPERTY	TYPE OF SERVICE FOR WHICH ARTICULATED BUSES ARE USED	NUMBER OF ARTIC'D BUSES	APPROX. PERFORMANCE OF FLEET	EARLY PERFORMANCE PROBLEMS	OPERATIONAL BENEFITS
TRI-MET-Portland, OR	o First artic scheduled in service 2/1/82 o One-for-one substitution without schedule change on local heavy passenger demand routes o Planning 1 for 1 1/2 substitution in late spring. o Peak-hour and off-peak deployment.	55 or 87 Delivered (Crown-Ikarus)	13	o Not in service long enough to identify performance problems. o Deployment of wheelchair lift equipment causes excessive delays (up to 8 min. per cycle).	o Demonstrating early indications of attracting significant ridership increases. o Seated capacity is 67 seats. o Three doors for faster passenger boarding/exiting on certain routes. o With the deployment of self-service fare collection system in the fall of 1982 significant operational benefits are expected with these high capacity vehicles featuring 3 wide doors.
San Trans-San Mateo, Mateo, CA	o Commuter shuttle to San Francisco. o Various other routes.	10 (since July '81) (Crown-Ikarus)	3	o Propensity for rear side accidents due to "swing-out". o Some routes are felt to be too narrow for artic use.	o More than adequate propulsion with Cummins 350 HP engine. o Good fuel economy (3.5-4.0 mpg) o Very good passenger acceptance.
So. Cal.RTD-Los Angeles, CA	o Primarily on Wilshire and Hollywood Blvd. with heavy passenger loading and congested traffic conditions. Used with 40' buses during peak-hrs. and only artics during off-peak.	30 [illegible]	1	o Propensity to rear side damage due to accidents on turns. o Fuel economy is approximately 40% less than GMC (mod. 5307A) o Availability decreases from 82% to 51% during summer periods.	o Vehicle is capable of moving large numbers of people-maximum passenger count during 3-day period was 116.

TABLE 6B. SUMMARY OF OPERATIONAL EXPERIENCES OF ARTICULATED BUSES IN U.S. (Continued)

(AS REPORTED BY TRANSIT PERSONNEL)

TRANSIT PROPERTY	TYPE OF SERVICE FOR WHICH ARTICULATED BUSES ARE USED	NUMBER OF ARTIC'D BUSES	APPROX. PERFORMANCE OF FLEET	EARLY PERFORMANCE PROBLEMS	OPERATIONAL BENEFITS
PA Transit-Pittsburgh, PA	o Heavy loads - longer routes. o Special events. o Suburban to downtown express (low headway). o Additional buses planned for dedicated busways.	20 plus 30 on order (M.A.N.)	5	o Insufficient power to operate heavy loads on hilly routes. o 10% longer run times than conventional transit coaches. o Fuel economy is about 25% less than conventional 40-foot bus.	o Eliminated need for "double-heading" 40 ft. buses.
AC Transit-Oakland, CA	o Variety of local routes. o Express routes over Bay Bridge. o Longest, slowest, local route with heavy ridership and high passenger turnover. o Transbay service due to temporary closing of BART.	30 (M.A.N.)	4	—	o Very stable mover of large masses of people. o Power steering is very good. o 85-93% availability. o Good passenger acceptance.
WMATA-Washington, D.C.	o Dedicated crosstown routes frequent stops, heavy traffic. o Operated all day up to 18 hours/day.	43 plus 32 on order (M.A.N.)	4	o Vehicle performed well, in general.	o Sufficient power to handle all loads on assigned routes. o For the size of the vehicles the fuel economy is good. WMATA tests show up to 5 mpg on express runs at curb weight. Average fuel economy is 2.4 mpg in service
CTA-Chicago, Ill.	o Initially operated on all types of routes. o Recently operated on three main arterial corridors comprised of local service and some boulevard sections. o Service for special events.	20 plus 125 on order (M.A.N.)	6	o Reportedly up to 10% increase in run times. o Rear side damage due to turning accidents comparable to conventional buses. Improving with driver familiarity.	o CTA has not yet experimented to measure operational/cost benefits. Well satisfied, however that the artic can be operated successfully in American transit environment. o Fuel economy has been good at about 2.6 mpg - slightly less than conventional 40-foot coaches. o Availability of artic fleet averages 18 or 19 per day out of 20 for peak-hour service.

TABLE 6C. SUMMARY OF OPERATIONAL EXPERIENCES OF ARTICULATED BUSES IN U.S. (Continued)

(AS REPORTED BY TRANSIT PERSONNEL)

TRANSIT PROPERTY	TYPE OF SERVICE FOR WHICH ARTICULATED BUSES ARE USED	NUMBER OF ARTIC'D BUSES	APPROX. PERFORMANCE OF FLEET	EARLY PERFORMANCE PROBLEMS	OPERATIONAL BENEFITS
PTA- Phoenix, AR	o Artics are split between express runs and local service, primarily used only in peak-hour.	20	9	o Early vehicle instability complaints have been corrected through driver familiarity and training.	o Fuel economy is good - for Jan. '82. The artic fleet averaged 3.3 mpg while the RTS fleet averaged 3.4-3.8 mpg and FLX new look averaged 3.9 mpg. o Very popular with riders. o Availability is very good now (90-100%).
TARC- Louisville, KY	o Operated on both express routes and local service out of two garages. o Peak-hour service mainly although there is some use in off-peak.	15	5	o Greater propensity for rear side damage due to "swing-out" problem than on conventional 40-foot bus.	o On express routes substitutions made using artics to keep number of seats/peak-hour constant; 4-5 vehicles saved during peak-hour operation on express service. o Fuel economy has been good. Average for Feb., '82 was 3.3 mpg for artics vs. 3.7 for fleet of GFC 870's. o Seventy-three seats/vehicle.
GGBHTD- San Rafael, CA	o Long suburban routes-city and highway conditions; high patronage routes	10	4	o Rear side collision damage exists but is minimized with driver training. o Some hilly routes require additional run time.	o Very good schedule compliance (98%). o Very good passenger acceptance. o Fuel economy is good averaging 3.6 mpg vs. 4.9 mpg for 40-foot new looks.

5.2 Maintenance Characteristics

This section addresses the maintenance experiences on various subsystems and components of articulated buses. In many instances, the initial frequency or severity of the particular maintenance problem was reduced appreciably as a result of increased transit staff familiarity with the technology of the bus, consistent technical assistance by the vehicle or component manufacturer and by innovative modifications or training suggestions by transit maintenance personnel. In general, it is fair to say that, although skeptical at first, maintenance supervisors and staff are now pleased with the reliability and maintainability of the current articulated transit bus. Table 7 provides specific comments on maintenance experiences among the 14 properties now operating articulated buses. The following sections reinforce this finding and note any exceptions.

5.2.1 Servicing, Inspection and Storage

The current fleet of articulated buses apparently offered no unusual problems in servicing, inspecting or parking. Care should be taken to ensure that servicing doors for fuel, water, fluid level checks are on the most convenient side of the vehicle. The fuel fill on some early M.A.N. vehicles was on the left (driver's side), causing some difficulty in the fueling lane.

Bus washing equipment in most areas has not caused concern, although if the pressure of the side brushes is not adjusted properly, some damage could occur to the bellows. Special considerations should be taken with gantry-type bus washing systems.

Generally, vacuum cleaning systems, especially the type where the vacuum covers the passenger door, may not be powerful enough to clean the full length of the articulated bus. Sweepers or hand-held vacuums are being used.

Periodic inspections do not appear to raise any particular problems. Certain inspections automatically fall into the practices established by the maintenance department. Typically, this is the case for brake inspections even though all articulated transit buses currently have automatic slack adjusters.

Other more thorough inspections, for example at 6, 12 and 18 thousand miles, do take longer, however. Transit experience indicates that these inspections take from one and one half to three times longer. The reasons offered for this fact are:

1) The total vehicle is new to maintenance staff; the design and equipment tends to be more sophisticated often requiring dedicated staff or, as a minimum, attention by the foreman to assign "better" mechanics; vehicle familiarity could moderate this inspection time somewhat;

2) The vehicle is longer, with longer hydraulic lines, an extra axle, a joint mechanism, more tires, etc. Therefore, the feeling is that it is reasonable for periodic inspections to take more time.

Parking and storage associated with maintenance facilities do not appear to be that much of a problem, particularly where the space exists or where a new facility design incorporated these concerns.

5.2.2 Transmission Reliability and Maintenance

Maintenance experience with articulated bus transmissions has only been associated with the Renk automatic, 4-speed (type DOROMAT 874-A) used in the M.A.N. buses and the Detroit Diesel Allison automatic, 4 speed (Type HT-740) used in the Crown-Ikarus vehicle. Both transmissions have an integrated hydraulic brake retarder.

In general, after some early problems, diagnosed as a design problem with the vibration damper, the Renk transmission has performed and continues to perform satisfactorily. All transmissions experiencing such a defect were retrofitted under a warranty program conducted by Renk. The reaction of those maintenance personnel dealing with Renk transmissions is that it has performed far better than the V730 transmission supplied during the same timeframe. More than one property expressed the opinion that the transmission, however, is "not forgiving"; that is, the procedures for maintenance or inspection must be closely followed or problems will occur.

During 1981 Detroit Diesel Allison (DDA), together with Los Angeles (SCRTD), Chicago (CTA) and Pittsburgh (PA Transit) began installing the HT-740 transmission in one test vehicle at each property. Documentation of this modification, entitled "HT-740 Regear Manual for M.A.N. Articulated Buses," has been published by DDA. Apparently, the reason for the study is to pursue alternate cost-effective options for transmission replacement.

The DDA HT-740D is in all Crown-Ikarus buses in use in this country. Since the bus deliveries were relatively recent the revenue service operation of this transmission is limited. So far the problems appear to be minor with transmission modulation adjustments required in Portland, some seal failures in Louisville and one or two transmission failures in San Mateo. These last problems reportedly are due more to vehicle fabrication problems than the transmission itself. The HT-740 has a long history of reliable, heavy-duty use in trucking applications. The popularity of this transmission is growing with U.S. manufacturers, such as Neoplan and Gillig.
standard equipment.

The General Motors Corp., Truck and Coach Division is planning on using a DDA V735 transmission in its articulated transit coach. This transmission is used in a transverse engine-transmission configuration and is currently described as having higher load capacity and offering electronic controls and a hydrau-

5.2.3 Air Conditioning Reliability and Maintenance

Problems with bus air conditioning is not unique to articulated buses. The greatest experience to date is with M.A.N. vehicles using a separate Perkins diesel engine and an air conditioning system manufactured by Trane. The compressor, generator, batteries, and condenser are installed in the rear of the bus. As reported by many of the transit properties and reinforced by M.A.N. representatives, the initial problems were the result of vehicle specifications that were too design-oriented and over-protective. The modification offered under warranty and accepted by most all the properties (excluding those, such as San Diego, that earlier worked out the problems together with

M.A.N. and Trane) involved a simplification of the design. Excessive shutdown possibilities were eliminated without sacrificing adequate electrical protection. The auxiliary alternator, additional batteries and associated wiring and controls were deleted. In general, the design simplification program greatly improved the reliability of the air conditioning system as demonstrated by its improved performance during the summer of 1981. A few properties such as AC Transit and Pittsburgh, feel the system can do better and that the air conditioning system remains "tempermental".

Little comparative information is available on other articulated buses. Crown-Ikarus uses a Carrier, Model CI-286, with a 10.3 ton capacity. Neoplan is planning to use a Suetrak, roof-top, air conditioning system. GMC Truck and Coach reportedly will use a design similar to that provided in the RTS-04 series except with increased capacity.

5.2.4 Accesory Belt Drives

Accessory belt drives on the initial M.A.N. articulated buses apparently reminded transit maintenance personnel of the earlier days when many major accessories were belt driven. Problems resulted in keeping proper tension on the relatively high number of belts and having to frequently replace more than one belt at a time. With the air conditioning modifications and the availability of a retrofit kit for a new two cylinder gear driven air compressor, many of the belt drives have been eliminated. Together with improvements in belt material and drive designs and increasing familiarity by maintenance personnel, the problems should be minimized.

5.2.5 Parts Cost and Delivery

The cost of replacement parts, particularly those parts of foreign manufacture, are reportedly high. During the first few years of M.A.N. bus operation all parts orders were handled by AM General. Apparently the costs were high and deliveries lengthly as compared to parts for buses of American manufacture. This appears to be another problem that is being resolved in a number of ways.

1) M.A.N. Truck and Bus Corp., as of January, 1982, has assumed control of all parts supply for their vehicles. Properties can and do rely on their M.A.N. service representative to forward and monitor parts orders. M.A.N. has initiated a computerized parts supply system to help detect potential fleet-wide problems earlier and help them more efficiently control their (M.A.N.'s) inventory. This efficiency, they claim, allows them to save money on their financing charges and those savings help maintain or lower parts prices.

2) M.A.N. claims that additional components of the new articulated buses will be "Americanized". This means that more components, such as roof hatches and brake systems, will be of American manufacture, thereby, reducing replacement costs and delivery time.

3) Numerous U.S. manufacturers of small components are becoming "second-source" manufacturers in the articulated parts market. In addition, some properties have successfully located local suppliers for overhauling or rebuilding components.

4) Most properties have established a "history" of their frequent parts orders. This experience permits them to more effectively and efficiently order parts.

There is little experience to date with parts supply for Crown-Ikarus buses. Crown has an advantage of having the driveline components (engine, transmission, axles, and brakes) supplied by U.S. manufacturers. Also, there should be little problem with parts availability with the Neoplan or GMC articulated bus parts. Neoplan's foreign parts share is only between 10-15 percent. GMC will use the RTS design and only special components unique to the articulated design, such as the joint, could pose any problem.

5.2.6 Body Repair

A majority of the properties deploying articulated buses have not performed extensive body repair. There may be an abundance of scrapes, particularly at the rear sides due to the swing-out action on turns, but few have been damaged enough to require body work. The side panels on the M.A.N. articulated bus are heated during manufacture so the skin is "stretched" at ambient temperatures. Transit properties do not have the capability to reproduce this process. Instead, they merely weld a steel plate over the tear or puncture, body-filled and paint. The general opinion is that difficulty and cost of body work on articulated buses is comparable to conventional vehicles in the domestic fleet.

5.2.7 Brake and Tire Life

All articulated buses in service today are equipped with hydraulic brake retarders. The conventional bus fleet, except for a few scattered tests, does not use either electronic or hydraulic brake retarders, although some interest is growing among certain properties (e.g., MARTA, San Diego, SEMTA). Manufacturers feel that, if used properly, brake retarders lengthen the brake lining life.

As reported by transit maintenance personnel, the brake lining life on articulated buses has been good, for the most part. The general opinions expressed were that the M.A.N. articulated buses provide better brake lining life than current ADB's, but still less than "Newlook" design, 40-foot buses. Although the figures vary widely, brake linings typically last 35-40,000 miles on the front and rear axle and more than that on the drive axle. AC Transit and Minneapolis - St. Paul appear to be experiencing much better brake performance, reportedly in the area of 60,000 miles between relining. A second feature of the articulated buses other than the retarder that may increase brake life is the automatic slack adjuster. Experiences with the M.A.N. brake slack adjusters are generally good. With the exception of one or two properties, who are experiencing initial problems with the slack adjusters on the Crown-Ikarus vehicles, the general opinion is that they work well.

Tire wear, universally, appears worse than conventional 40-footers. In general, the opinions expressed indicate that tire life is only half as good as with the rest of the fleet. This is one maintenance area that has not shown improvement with time. M.A.N. has stressed the need to inspect wheel alignment and use good quality bias ply or radial tires. The alignment equipment is expensive (approx. $4,000) and properties with only a few articulated buses are reluctant to spend the money. It is worth noting that M.A.N. service representatives may possibly make the equipment available on loan to individual properties for them to evaluate how tire mileage might improve with the use of this equipment.

Experience with tire wear on Crown-Ikarus articulated bus is minimal. Early indications from San Mateo suggest poor tire wear with regrooving being required on steel belted radial tires in less than 15,000 miles. Information from Louisville, however, indicates that with about 20,000 miles on the tires they are expecting no tire wear problems.

Virtually all transit properties lease bus tires. Due to the excessive tire wear experienced to date leasing rates are higher in many cases for the tires used on articulated buses. Also some properties experienced early problems with leasing companies that were unable to supply the proper size.

5.2.8 Articulated Joint

The articulated mechanism is one piece of equipment that is unique and, therefore, different than anything maintenance personnel have worked on before. Some articulated joint designs employ sophisticated technology, especially in the electronic controls, to prevent jackknifing and alert the operator. To date, no property deploying articulated buses thought reliability and maintenance of the joint mechanism or controls were a problem.

TABLE 7 SUMMARY OF SERVICING AND MAINTENANCE EXPERIENCES

TRANSIT PROPERTY	GENERAL MAINTENANCE ADVANTAGES	EARLY MAINTENANCE PROBLEMS
MARTA-ATLANTA (10 M.A.N.)	o Improved brake lining life over many "new-looks" and their GFC 870's. o Transmission (Renk) reliability has proven to be very good compared to existing V730 transmission. o Body repair easier, less expensive than GFC 870 and comparable to repair costs for "new look".	o Tire wear not as good as lighter, conventional bus. o Air conditioning problems; corrected with manufacturer's suggested modification. o Parts costs continue to be higher than parts for conventional buses; some American producers are lowering costs for selected components.
SEATTLE METRO (151 M.A.N.)	o Transmission (Renk) performance and reliability currently is very good compared to transmission in other new 40-foot buses. o Automated slack adjuster work well.	o Eight replacement vehicles had incorrect steering mechanisms increasing swing-out to 50-53". Corrected later to reduce swing-out. Result was rear side accidents almost eliminated.
MTC-MINN/ST. PAUL (20 M.A.N.)	o Brake lining life averaging 58-63,000 miles-60% improvement over 40 foot coaches in their fleet.	o Excessive tire wear on drive axle. o Parts costs are still high. o Early air conditioning problems resolved.
SAN DIEGO TRANSIT (45 M.A.N.)		o Air conditioning problems were corrected in cooperative action with M.A.N. and Trane. o Brake lining life is comparable to remainder of fleet (18-24,00 between re-line). o Tire wear on the artics is poor but the rest of the fleet is not as good as expected either. o Renk transmissions on all 45 vehicles were retrofitted under warrenty - appear reliable now.

TABLE 7A SUMMARY OF SERVICING AND MAINTENANCE EXPERIENCES

TRANSIT PROPERTY	GENERAL MAINTENANCE ADVANTAGES	EARLY MAINTENANCE PROBLEMS
SAN DIEGO TRANSIT (CONTINUED)	—	o Unhappy with hydraulic transmission retarder on all artics. o Relatively poor fuel economy (approx. 2 mpg.).
TRI-MET, PORTLAND (55/87 Crown-Ikarus)	—	o With 55 of 87 delivered the Ikarus is demonstrating poor brake life (10,000 plus miles). o Slack adjuster problems. o Adjustments required in transmission modulator. o Vapor wheelchair lift on 3rd door has had problems.
SAMTRANS-SAN MATEO, CA (10 Crown-Ikarus)	o Transmission appears reliable.	o Poor brake lining life (10-13,000 mi.) despite hydraulic transmission retarder. o Poor tire wear-regrooving required at 13-15,000 miles. o Experiencing some structural problems - reinforcing required. o Wheelchair lift (Vapor) causing problems. o Some electrical problems - familiarity required with 24 V system.
SCRTD - LOS ANGELES, CA (30 M.A.N.)	—	o Early electrical problems corrected. o Parts cost relatively high: time for delivery improving. o Transmission-related problems - over 13% of all road calls for the artic were for transmission problems.

TABLE 7B SUMMARY OF SERVICING AND MAINTENANCE EXPERIENCES

TRANSIT PROPERTY	GENERAL MAINTENANCE ADVANTAGES	EARLY MAINTENANCE PROBLEMS
SCRTD - LOS ANGELES, CA (CONTINUED)	—	o Early air conditioning problems resolved somewhat by modifications, however, serious reliability problems still exist.
PA TRANSIT - PITTSBURGH, PA (20 M.A.N.)	—	o Transmission has been a problem with 17 different failures in 11 coaches. o Requires more attention than conventional coach; higher degree of sophistication in design; requires assigning best mechanics. o Brake lining life worse than conventional 40-foot "newlook" though comparable to ADBs. o Air conditioning modifications appear to correct early problems yet the air conditioning system is still "tempermental".
AC TRANSIT - OAKLAND, CA (30 M.A.N.)	o Brake lining life on front and rear axle approximately 35,000 mi.; drive axle in excess of 60,000 mi.	o Early Renk transmission problems appear to be corrected with manufacturer retrofits. o Tire wear is about twice as fast; therefore, tire leasing costs are higher. o Parts replacement costs remain higher than conventional 40-foot buses; delivery time has improved. o Requires more time for inspecting - up to three times more time for thorough inspection.
WMATA - WASHINGTON, DC (43 M.A.N.)	o Brake lining life is very good - approximately 40,000 miles on first two axles and far in excess of that for the rear. o Structure appears durable and extent of accident damage is less than conventional 40-foot bus.	o Transmission - retrofits complete and performance is good now. o Air conditioning - modifications complete and performance is much improved. o Electrical system, particularly independent charging system was revamped.

TABLE 7C SUMMARY OF SERVICING AND MAINTENANCE EXPERIENCES

TRANSIT PROPERTY	GENERAL MAINTENANCE ADVANTAGES	EARLY MAINTENANCE PROBLEMS
WMATA - WASHINGTON, DC (Continued)	o Parts supply process has improved recently using manufacturer's representative on the property.	o In general, air and electrical systems are more complex and often require well-trained and dedicated maintenance staff.
CTA - CHICAGO, ILL (20 M.A.N.)	o Renk transmission has proven very reliable.	o Tire wear in comparison to newlook buses has been poor. o Air conditioning - manufacturer recommended changes have improved reliability. Flexible copper lines eliminated nuisance breaks in sweated joints.
PTS - PHOENIX, AR (20 M.A.N.)	o Brake lining life reportedly better than GM RTS but not as good as newlook design buses; artics averaging 35-50,000 miles between lining changes for all axles.	o Tire wear continues to be about one half that of wear on newlook buses. o Air conditioning - all modifications performed - improvements were evident. o Parts supply problems no worse or better now than parts supply for conventional 40 foot buses; second sources are improving parts costs, as well. o Fair amount of jackknifing turntable damage, primarily nonfunctional railings under the platform. o Periodic inspections do take more time, though it is considered reasonable since the vehicle is longer, has an additional axle, etc. o Change to a single 2 cylinder air compressor per manufacturer's suggestion, should improve reliability further.

TABLE 7D SUMMARY OF SERVICING AND MAINTENANCE EXPERIENCES

TRANSIT PROPERTY	GENERAL MAINTENANCE ADVANTAGES	EARLY MAINTENANCE PROBLEMS
TARC - LOUISVILLE, KY	o To date, the vehicles have been in use about 8 months for an average of 18-20,000 miles/vehicle. Therefore, it is still too early to identify many definite maintenance improvements or problems.	o Brake lining life is about one half (8-10,000 miles on front axle) of that experienced with conventional 40-foot vehicles.
GGBHTD - SAN RAFAEL, CA	o Brake lining life is comparable to newlook design buses. o Bus has very few problems now that preliminary modifications are complete.	o Tire life continues to be bad. o Early transmission problems corrected by Renk retrofit actions. o Early air conditioning reliability problems corrected by property actions ("San Diego Fix"). o Replacement parts cost were excessive at the beginning: anticipate improvement by dealing directly with M.A.N.

6.0 MISCELLANEOUS TECHNICAL INFORMATION

This section identifies and briefly describes a number of hardware and procedural modifications or suggestions that appear to have a demonstrated benefit to the operation or maintenance of articulated transit coaches. The source of these ideas is primarily from discussions with transit properties around the country who currently deploy articulated coaches. In addition, some of the information was obtained through visits and discussions with the vehicle manufacturers. Some of these ideas may not be unique to articulated transit buses, nor may this information be totally novel or benefical to everyone. In general, the information appears to offer solutions to some of the early problems encountered in the use of articulated buses, could instigate further improvements by users of articulated buses or transit planners, and, clearly, should be communicated and shared by the transit community as much as possible.

- MARTA - Atlanta, Georgia was concerned about jackknifing when operating the articulated bus in reverse. Transit properties in general have emphasized training, both with operators and mechanics, as a way to minimize jackknifing and possible damage to the joint or turntable equipment. MARTA went two steps beyond that. First, they increased the volume of the manufacturer supplied buzzer ensuring that the driver is alerted that the bend angle of the bus is getting too great. Second, they have experimented with the installation of a microswitch sensor connected to the radio on board the bus to automatically signal the dispatcher that one of the fleet has exceeded a safe bend angle.

- MARTA has also specified "unlockable" windows to permit opening of the passenger windows by the driver using a square "key" when either the air conditioning fails or environmental conditions permit. The windows cannot be unlocked or opened by the passengers.

- San Mateo County Transit District attempted to "Americanize" their articulated buses they were to receive from Crown-Ikarus by specifying Bendix-Westinghouse brass fittings. Unfortunately, Ikarus utilized the Bendix Westinghous (Metric) suppliers in Europe and, therefore, defeated that property's attempt to standarize and replacement fittings. Apparently, the lesson here is to be more specific and be aware of potential ambiguities.

- San Mateo installed an audible alarm to alert the operator that someone or something is activating the sensitive edge on the rear doors. At certain times, the driver loses sight of the rear door and any passengers that may be boarding or alighting from the articulated bus.

- Seattle Metro is attempting to minimize rear side damage to the articulated bus and the "snagging" of obstacles during swing-out by installing bumper extensions all the way back to the wheelwells.

- San Diego Transit as well as other properties strongly recommends the purchase and use of the special wheel alignment tool. M.A.N. Truck and Bus feels this is a necessity to obtain proper tire life. However, some properties feel special equipment is not necessary (MARTA).

- Pittsburgh (PA Transit), Chicago Transit Authority (CTA) and Los Angeles (SCRTD) have experimented with retrofitting a Detroit Diesel Allison, Model HT-740 automatic transmission with brake retarder in place of the Renk automatic transmission which is original equipment and also has an integral retarder. The properties performed this experiment with cooperation and technical support from Detroit Diesel Allison Division of General Motors Corporation. As of mid-February, 1982, the buses at CTA had accumulated about 12 thousand miles. SCRTD had accumulated about 5 thousand miles and Pittsburgh had not yet placed the test vehicle in service.

- Oakland - AC Transit experienced costly damage to electronics associated with Renk transmission when the vehicle was jump-started. Disconnecting the electronics at the circiut breaker eliminated this problem.

- Oakland, together with a Renk service representative, modified the transmisison control electronics to govern the speed in reverse to 1.5 - 2.0 mph. This was beneficial in minimizing damage to the joint and turntable when mechanics operated the vehicle in reverse.

- Washington, DC - WMATA experienced problems with operators "reving" the engines in neutral to build up air pressure and then shifting to forward or reverse gear before the engine rpm was low enough to safely permit it. Modifications to the electronics associated with the Renk transmission eliminated this problem.

- Phoenix and San Diego and possibly other properties are adding additional fuel tank capacity. In the two cases mentioned the properties are doubling the capacity to 200 gallons.

- An engine tachometer on the operator's console apparently is a beneficial option in articulated transit buses having the engine in the rear. With engine compartment sound-proofing and high ambient noise it is possible for the bus operator to be unable to hear the engine.

- As startling as it might be to see a new (e.g., foreign) design articulated bus travel down your city street for the first time, it is even more so to see the familiar New Look design or RTS design in an articulated configuration. Fred Wagoner at Coach County Charter Company in Campbell, CA, has used this same philosphy of merging two "standard" design vehicles to fabricate his own articulated bus for his charter service. During approximately a three year period Mr. Wagoner performed body and fabrication work on two, eighteen to twenty year old Crown Interstate Coaches and created a 74 passenger articulated intercity bus using an articulation joint of his own design. He has started building his second articulated bus, again using old (15-18 yrs.) Crown coaches.

- For transit authorities wishing to review articulated bus specifications used by other properties in their bid solicitation, the American Public Transit Association (APTA) in Washington, DC has established a file of such specifications.

- A number of transit authorities have undertaken articulated bus demonstration and evaluation programs. Pittsburgh (PA Transit) is planning on demonstrating one or two Magirus-Deutz articulated buses beginning in April, 1982. Metropolitan Suburban Bus Authority, East Meadow, NY, is planning to demonstrate a DAC articulated bus. Plans at MSBA include modifications to "Americanize" the propulsion system. San Francisco MUNI is currently evaluating three articulated transit buses - M.A.N. SG220, Neoplan N421, and Crown-Ikarus 286 - to assess, among other things, the fuel economy, hill-climbing ability, and overall operating cost per seat mile. MUNI is scheduled to document the evaluation by late Spring, 1982.

- A "higher" capacity bus is being developed by at least two European bus manfuacturers - M.A.N. and Mercedes Benz. M.A.N. has unveiled a prototype of a <u>double</u> articulated bus that can carry 225 passengers, weighs about 32 tons and is about 70 feet long. The vehicle basically is constructed of three sections, "hinged" at two places. Similarly, Mercedes Benz three sectioned, articulated, O-Bahn bus reportedly can carry about 240 passengers and is 75 feet long. This vehicle is designed for automated guideway use and for bus-train formation on track-guided sections. Both prototype vehicles are undergoing testing in Germany.

- Neoplan in Germany has manufactured and sold a number of articulated double decker buses. One version is an articulated bus with a second deck on only one section of the bus. Another version, shown below, is a full double deck articulated bus. Although shown here is an intercity or charter-type of bus, it is possible to fabricate a transit-style vehicle with the same configuration.

FIGURE 14 NEOPLAN ARTICULATED DOUBLE DECKER BUS

- One area that is critical to the satisfactory deployment of articulated transit buses is the design and equipping of bus maintenance facilities. The vehicle manufacturers realize this and offer technical assistance to properties in the planning of new or rehabilitated structures and in identifying required equipment to most effectively and efficienty maintain the articulated bus. In addition, the following suggestions, as a minimum, should be considered.

- Garage bays must be sufficiently long to permit closing of overhead doors.

- Many maintenance personnel prefer a pit, preferably long enough (80-85 ft.) to allow space to get in and out or shaped like a cross with side access openings.

- Almost all the properties having articulated buses use and like the portable hoists, such as the one shown in Figure 15. They apparently work well and can be used on other size vehicles as well. They are almost a necessity for properties who are not planning a new facility. Portable hoists are useful near the steam cleaning area for use on mid-engine articulated buses.

- Special tool kits are offered by articulated bus manufacturers.

- Ensure that filling openings for fluids are on the correct side of the vehicle and/or lines (fuel, air, lubrication) are long enough in service lanes and bays.

- Garage bay opening or service lanes must be sufficiently wide and have no obstructions for at least 60 feet in front of the opening, since the rear of the coach will swing out when the bus turns.

- Locate oil and water drains to suit the engine or drain plug location on the articulated bus. M.A.N. and Crown-Ikarus are in the middle of the vehicle.

- Consideration should be given to 3 post hydraulic hoist capable of handling 30, 40, 55 and 60 foot vehicles.

- Generous turning radii should be allowed.

- Consider provisions for towing an articulated bus. One property (Seattle) uses a "dolly" type of device inserted under drive axle.

- Conventional vacuum systems may not be powerful enough for the volume in an articulated bus.

- In slippery conditions or in operating in reverse it is possible to cause the articulated joint to "lock-up". It is then necessary to actually lift the bus to reduce the bend angle. Such provisions must be planned for.

FIGURE 15 MAINTENANCE OF ARTICULATED BUS MECHANISM USING PORTABLE LIFT EQUIPMENT

7.0 FINDINGS AND CONSIDERATIONS

There are about 500 articulated buses operating in urban transit service throughout the U.S. About 80 percent of these vehicles were manufacturered by M.A.N. corporation; all have been in service at least two years. The remaining articulated buses are manufactured by a joint venture of Crown Coach Corp. and Ikarus; these articulated buses have operated less than one year in revenue service. Clearly, the information and perceptions available to date from transit properties have been dominated by M.A.N. technology.

Information on new orders demonstrates that M.A.N. continues to dominate the articulated bus market. Crown-Ikarus remains in the business and Neoplan has entered the market for the first time with a modest order from Atlanta. Therefore, operational and maintenance experiences with articulated buses will continue, at least through 1984, to be dominated by M.A.N.

Although on any given operational or maintenance issue there may be a divergence of experience and opinion, the consensus of opinion among the fourteen transit properties operating articulated buses is that the vehicles have performed well, increased ridership on their respective routes, and proven to be very reliable coaches.

This general opinion may result from the fact that most all of these properties had a manufacturer's representative on the premises, full time for the first year and longer if the size of the order warranted it. In addition, the warranty period of a new vehicle is often the "honeymoon" period where most everythiing that goes wrong with the bus is corrected or paid for by the manufacturer. In addition to the on-site attention and warranty back-up, the two manufacturers continue to offer comprehensive technical assistance to aid and advise the property in all aspects of operation, maintenance, training, facilities design, and accessory equipment. Strong and responsive customer support has helped "smooth-out" early performance and reliability rough spots. Finally, the reaction to the articulated bus from transportation and maintenance departments appears to reflect the capabilities of the vehicle and the quality of design and manufacture.

While many planners and transportation personnel initially considered the articulated bus suitable only for express service on wide streets with adequate turning areas, the experience of the last four years has shown that the articulated bus can safely and efficiently operate on virtually all routes and in all operating environments in the U.S.

The experiences with articulated transit coaches during the past few years are interesting and worth reviewing and understanding. It is true there were some early problems with air conditioning reliability, the abundance of belt drives for engine accessories, minor transmission problems and a propensity for rear side body damage due to swing-out on turns. However, the design and componentry of articulated buses has evolved and improved in the last four years. After much effort by maintenance departments and manufacturers the vehicle appears to be performing well. A snap-shot view today reveals:

- o High vehicle availability (greater than 90 percent)
- o High vehicle utilization (up to 18 hours of revenue service daily)
- o Good fuel economy on a per seat-mile basis;
- o Continually improving safety record, occassionally surpassing other segments of the fleet; and
- o Excellent passenger and operator acceptance.

Experiences worthy of highlighting for prospective buyers of articulated buses include:

- o Adequate facility planning for servicing and maintenance is essential;
- o Early and frequent training is required for operators - such expense should be allowed for;
- o Consideration of dedicated maintenance personnel is beneficial; and
- o Investigation of parts supply, both OEM and second sources, is worthwhile.

The capital cost of articulated buses is relatively high. Representative contract prices are currently range from $275-$300 thousand per unit. On a per seat basis the initial cost of articulated buses may be somewhat higher than conventional 40-foot coaches. However, it appears that the articulated bus could have a significant advantage over the conventional bus in meeting service requirements at a lower operating cost. Using passenger capacity alone as a guide for the comparison, two articulated buses could carry the same capacity as three standard vehicles, thereby saving the cost associated with one driver. To date, articulated transit coaches typically have been assigned to runs to meet existing high demands or to increase ridership. To better realize the full potential of articulated buses in U.S. transit service, it is generally agreed that special planning and scheduling efforts are needed for each location and route. In this way appropriate data could be obtained to quantitatively determine the service and cost benefits of this type of vehicle.

APPENDIX A

REPRESENTATIVE LIST

NORTH AMERICAN AND EUROPEAN

ARTICULATED BUS MANUFACTURERS

Crown Coach Corporation (Ikarus)
2428 East 12th Street
Los Angeles, CA 90021

William H. Coryell,
Transit Program Dir.

TWX 910-321-2368
Tel. (213) 627-4021
Ron Ingraham

Years experience producing buses: 55
Product line: Articulated city transit coaches; heavy-duty school coaches (35 and 40 foot); custom utility coaches; custom fire trucks
Productive capacity: buses per year: 150 articulated
600 school/utility

DAC (Autozel)
Str. Ostrov 3
Bucharest 5, Rumania

Tel. 23.93.20

Distr. by:
Auto Export Import
45 Republicii Str.
Brasov, Rumania
Dipl. Engr. Pompiliev Petrescu

Daimler - Benz A. G.
Hanns-Martin-Schleyer-Str. 1
6800 Mannheim 31
West Germany

Reinhold Kiel, Sales Mgr.

Telex 462 131
Tel. (0621) 3931

Years experience: 87
Product line: Standard city buses, articulated city buses, ACB trolley buses, cross-country and tourist coaches, bus chassis, CKD versions in addition to the commercial line of passengers, trucks, tractors, unimog
Productive capacity: 38 buses and 1600 chassis per year

Mercedes-Benz of North America, Inc.
One Mercedes Drive
Montvale, NJ 07645

Walter Bodack

Tel. (201) 573-0600

Carrosseriefabriek Den Oudsten & Zonen N.V.
(Utrechtsestratweg 112A)
P.O. Box 26
3440 AA Woerden
The Netherlands

Telex 47835
Tel. 03480-12345

Years experience: 50
Product line: Intercity buses with semi-integral steel frame and polyester panel sections constructed on chassis of various manufacturers
Productive capacity: 400-500 per year

De Simon S.P.A. (Inbus)
33010 Osoppo
Udine, Italy

Tel. 0432/986001-2-3
Tlx 460868

Ilvo De Simon, President

Years experience: 30
Product line: Complete range of city and intercity buses on various chassis.
Productive capacity: 1000 buses per year.

Enasa (Pegaso) Bus Div.
Jose Abascal 2
Madrid, Spain 3

Telex 27493 (Buska E)
Tel. 91 447 51 00

Jose M. Blasco, Sales Mgr.
Francisco Iglesias, Mktg. Mgr.

Product line: Full range of transit buses from 23 feet to 40 feet including articulated buses

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General Motors of Canada, Ltd.
P.O. Box 5160
Oxford Street E.
London, Ontario
Canada NGA 4N5

Telex 064 7231
Tel. (519) 452-5534

Don Kershaw, Coach Sales Mgr.

John Atchison
P. G. Brewer, Gen. Sales Mgr.

Years experience: 20
Product line: City transit coaches
Productive capacity: 225 per year

General Motors Corp.
Truck and Coach Division
660 South Blvd., E.
Pontiac, MI 48053 — Tel. (313) 857-5000

John Rosenkrands, Asst. Ch. Eng.

Ed Stokel, Dir. Public Trnsp.
M. A. Pullin, Coach Sales Mgr.

Years experience: 56
Product line: Advanced design specification 35 and 40 foot coaches and articulated coaches.
Productive capacity: approx. 5000 buses per year.

OAF-GRAEF & STIFT AG.
Brunnerstrasse 72
A-1211 Vienna
Austria

Telex 133329 (AFLIE A)
Tel. 86 96 11

Years experience: 75
Product line: City and intercity buses full range including articulated, double-deck, trolley, diesel, and LPG as well as special buses for airfield use and mobile X-ray clinics.
Productive capacity: 250 buses per year.

Carrosserie Hess A. G. (See Volvo)
CH-4512 Bellach S.O.
Switzerland

Telex (845) 34624
Tel. (065) 3.08.81

Heinrich Naef

Lars Sandberg, Volvo Resident

Years experience: 50
Product line: Heavy-duty city transit buses and trolley buses in aluminum construction on chassis of various manufacturers.
Productive capacity: 250 buses per year.

S. A. Louis Heuliez
B. P. 9 (7, Rue L. Heuliez)
79140 Cerizay, France

Telex 790 466
Tel. (49) 80.12.22

M. Louis Heuliez, Director

Jean-Pierre Derey, Mktg. Dept.
Patrice Roulois
R. Cesbron, Comm. Mgr.

Ikarus Body and Coach Works (see Crown Coach)
Margit U.2
Budapest, Hungary 1630
Telex 224766
Tel. 831-396

Dr. Sandor Szego, Dep. Mng. Dir.

Years experience: 60
Product line: Mid-size, standard and articulated buses in integral welded steel construction
Productive capacity: 4000 buses per year

Karl Kaessbohrer
Fahrzeugwerke GmbH
Postfach 2660 (Peter-Schmid-Strasse)
D 7900 Ulm (Donau)
West Germany
Telex 07-12766
Tel. (0731) 1811
Karl Kromer, Managing Director

Hans Schoeffler, Managing Sales Dir.

Years experience: 50
Product line: Full range of mid-size, standard, articulated, and double-deck city transit and intercity coaches in integral welded steel construction.
Productive capacity: 2000 buses per year.

Recent complete redesign of full product range will soon be completed with inclusion of the articulated transit bus.

Lex Vehicle Engineering Ltd.
Ringwood Road
Totton, Hants, England S04 3EA
Office: 17 Great Cumberland Place
London, W1H 8AD
Telex 477756 (Southampton)
Tel. (0703) 862137

A. F. Norman, Marketing Mgr.

Years experience: 25
Product line: Mid-size, standard, and articulated coachwork in steel construction on various chassis.
Productive capacity: 130 buses per year.

DAF Bus Div.
Geldropseweg 303
Eindhoven 5645 TK
The Netherlands
Telex 51085
Tel. (40) 143075
(40) 149111

Van De Pol, Mktg. Mgr.
C. Bohme, Manager

Leyland Vehicles
Lancaster House, Leyland
Preston, Lancashire PR5 1SN
England

Telex 67655
Tel. (07744) 21400

Michael B. Cornish, Mgr. Spec. Veh.

Chas. Bentley, Dir. Spec. Veh. Vent. London
Tel. (07744) 24241
Jay D. Hale, Export Sales
K. Lloyd

Years experience: 80
Product line: Mid-size, standard, double-deck, urban, inter-urban, and tour buses and/or chassis.
Productive capacity: 5000 buses per year.

Leyland Vehicles Overseas Div.
Guildcentre, Lords Walk
Preston, Lancs. PR1 1QY
England

Telex 677342
Tel. (07722) 22232

R. R. Morris, Overseas Ops. Dir.

C. H. Braithwaite, Overseas Oper. Mktng. Dir.

Magirus-Deutz A. G.
65 Hauptstr.
6500 Mainz 25
West Germany

Also: P.O.B. 2740, 7900 ULM

Tel. 06131 6961

Herbert Kusgens, Sales Mgr.

H. Brucki, Regional Mgr.

Years experience: 60
Product line: Full range of small, mid, standard, and articulated city and inter-city buses in welded steel construction on proprietary chassis.
Productive capacity: 2000 buses per year.

Mack Trucks Inc. (See Renault)
Box M
Allentown, PA 18105

(RVI Rep) Tel. (215) 439-3756

John Bowerman-Davies

M.A.N. Truck & Bus Corp.
3000 Town Center, Suite 111
Southfield, MI 48075

Telex 234249 (MAN SOFD)
Tel. (313) 352-7850

George Pickett, Sales Mgr.

Lutz M. Eggert, Exec. V.P.

Years experience: New U.S. plant opened in North Carolina November 1981
Product line: Articulated diesel transit coaches in 55 foot and 60 foot lengths in steel coachwork on proprietary chassis
Productive capacity: 390 buses per year.

Gottlob Auwaerter A. G. (Neoplan)
Vaihinger Str. 122
7 Stuttgart (Moehringen), West Germany

Ing. Bob Lee, General Manager

Ing. Albrecht Auwaerter, Managing Dir.

Neoplan USA/Rolf Ruppenthal & Assoc.
627 South Broadway, Suite B
Boulder, CO 80303

Telex 450838
Tel. (303) 499-4040

Rolf Ruppenthal

Factory - Neoplan
1 Gottlob Auwaerter Drive
Lamar, CO 81052
Tel. (303) 336-3256

Years experience: New factory in Lamar, Colorado opened October 1981
Product line: Full range of small, mid, standard articulated and double-deck city, intercity and tour buses in integral welded steel construction
Productive capacity: 500 buses per year

Renault Vehicules Industriels
Buses Div.
8 Quai Leon Blum
92156 Suresnes Cedex, France

Telex 620 567
Tel. 772 33 33

Jean-Pierre Friederich, North Am. V.P.

Years experience: 75
Product line: Full range of small, mid, standard, and articulated city transit and intercity buses in welded steel construction on proprietary chassis.

Saab-Scania, Scania Division
151 87 SODERTALJE, Sweden
Telex 10200 (SCANIA S)
Tel. (0755) 810 00

Rolf Lindstrom, Sales Mgr.

Years experience: 70
Product line: Chassis and buses for city transit, intercity, and tour operation.
Productive capacity: 2700 chassis and 220 buses per year.

Saab-Scania of America, Inc.
Saab Drive, P.O. Box 697
Orange, CT 06477
Tel. (203) 795-5671

John J. McKeon
Ralph P. Millet
John Schiavone

Steyr-Daimler-Puch A. G.
P.B. 100 (Haidequerstr, 3)
A-1110 Vienna 2, Austria
Telex 131810
Tel. (0222) 76 45 11

Years experience: 75
Product line: Mid-size, standard, and articulated transit buses in integral welded steel construction.
Productive capacity: 350 buses per year.

Trans Bus of America Corp. (Steyr)
P.O. Box 1199
299 Warren Avenue
Portland, Maine 04104
Tel. (207) 797-7837

Robert Brown, Sales Mgr.

Van Hool Bus & Commercial Vehicle Works
Bernard Van Hoolstraat 58
B-2578 Koningshooikt-Lier
Belgium
Telex 31709
Tel. (031) 821500 (Antwerp)

Leo Gijsels, Eng. Proj. Mgr.
Leon Van Hool, Managing Dir.

Years experience: 30
Product line: Small, mid-size, standard, articulated and double-deck city transit, intercity, luxury coach, tour coach, double-deckers and airport buses in integral welded steel or coachwork on proprietary as well as various chassis.
Productive capacity: 1400 buses per year.

Walter Vetter Co.
Ringstrasse 28 (Postfach 2080)
7012 Fellbach
West Germany

Telex 07-254496
Tel. (0711) 589041

Hans-Juergen Bachmann, Sales Mgr.
Siegbert Rosenkranz, Ch. Eng.

Years experience: 50
Product line: Small, mid-size, standard, articulated and double-deck city transit, intercity, tour and luxury coaches as well as low floor and airfield apron buses, bookmobiles, mobile clinics, in integral welded steel construction or coachwork on various chassis.

Transportation Equipment Development Co.
22 Monument Square
Portland, Maine 04101

Telex 944311
Tel. (207) 772-1973

H. T. Hawkes, President

AB Volvo, Bus Division
S-405 08 Gothenburg, Sweden

Telex 27000
Tel. (031) 59.00.00

Rolf Oberg, Project Mgr. 81500-HB1M
Rolf Soderhielm, President

Years experience: 49
Product line: Chassis for single articulated and double-deck buses
Productive capacity: 5500 units per year.

Volvo of America
20700 Greenfield Road
Oak Park, MI 48237

Tel. (313) 967-0555

Kirby Gingerich

Volvo of America
Building 8
Rockleigh, NJ 07647

Tel. (201) 768-7300

Con Kardash

APPENDIX B

ARTICULATED TRANSIT
BUSES:

DESIGN, DIMENSIONAL & PERFORMANCE CHARACTERISTICS

Companies Represented

Crown Coach Corp. (Ikarus)

NV Carrosseriefabriek Den Oudsten & Zonen

DAF Bus Division

Daimler-Benz A. G.

DeSimon-INBUS

Enasa (Pegaso) Bus Division

General Motors of Canada LTD, Diesel Division

GMC Truck & Coach Division

ÖAF - Gräef & Stift A. G.

S. A. Louis Heuliez

Lex Vehicle Engineering Ltd.

Leyland Vehicles Ltd.

Magirus - Deutz A. G. (Iveco)

M.A.N. Truck and Bus Corp.

Neoplan USA

Renault Vehicles Industries

Scania Division of Saab-Scania

Steyr-Daimler-Puch A. G.

Van Hool Bus and Commercial Vehicle Works

Watter Vetter Company

AB Volvo, Bus Division

Table B-1. SUMMARY DESIGN, DIMENSIONAL & PERFORMANCE CHARACTERISTICS (1 of 3)

MANUFACTURER	MODEL	COUNTRY OF MFR.	U.S. AFFILIATE OR (JOINT VENTURE)	COMPLIANCE CALIF. EMISS.	COMPLIANCE FED. NOISE	COMPLIANCE FMVSS	VEHICLE TYPE (PER ILLUST.)	OVER-ALL LENGTH METERS (FT.IN.)	OVER-ALL WIDTH METERS (FT.IN.)	OVER-ALL HEIGHT METERS (FT.IN.)	ARTICULATION ANGLES HOR.	ARTICULATION ANGLES VER.
DAC (Autobuzel)		Rumania		Y	Y	Y	1 T	16.565 (54'4")	2.500 (98.4")	3.040 (10'0")	32°	10°
Daimler-Benz A.G.	O 305 C	W. Germany	M-B No. Am.	U	U	U	4 TA	17.260 (56'8")	2.500 (98.4")	2.941 (9'8")	47°	10°
Carr. Den Oudsten N.V.	Merc-B 0317	Netherlands		U	U	U	1	17.960 (58'11")	2.500 (98.4")	3.150 (10'4")		
ENASA (Pegaso)	6031 A/2	Spain		U	U	U	1 T	16.500 (54'2")	2.450 (96.5")			
De Simon S.P.A. (Inbus)	Inbus AS 250	Italy		U	U	U	4 TA	17.440 (57'3")	2.500 (98.4")	3.040 (10'0")	47°	10°
General Motors Canada Ltd.	TA60102N	Canada	GMC	Y	Y	Y	4	18.288 (60')	2.590 (102")	3.029 (9'11")	45°	10°
GMC Truck and Coach	R10-204 R20-204	USA		Y	Y	Y	4	17.068 (56') 18.592 (61')	2.590 (102") 2.590 (102")	3.124 (10'3") 3.124 (10'3")	47°	16°
Graef & Stift A.G.	GS CU 280M18	Austria		Y	Y	U	1 & 5 TA	18.000 (59'1")	2.500 (98.4")	3.010 (9'10")	47°	8°
Louis Heuliez S.A.	O 305 C	France		U	U	U	4 TA	17.335 (56'10")	2.500 (98.4")	2.984 (9'9")	45°	10°
Ikarus	IK 286	Hungary	(Crown Coach)	Y	Y	Y	1 TA	18.210 (59'9")	2.590 (102")	3.150 (10'4")	39°	15°
Lex Vehicle Eng. Ltd.	O 305 C	England		U	U	U	1 & 4 T	17.335 (56'10")	2.500 (98.4")	3.048 (10'0")	47°	10°
Leyland Vehicles Ltd.	OAB	England		U	U	U	1	17.335 (56'10")	2.500 (98.4")	3.200 (10'6")	45°	10°
Magirus-Deutz A.G.	SH170	W. Germany		U	U	U	5	16.700 (54'9")	2.500 (98.4")	3.200 (10'6")	43°	13°
M.A.N. Truck & Bus Corp.	SG220-16.5	USA		Y	Y	Y	1 T	18.251 (59'10")	2.578 (101.5")	3.175 (10'5")	32°	10°
Neoplan USA	N421	USA		Y	Y	Y	4	18.374 (60'3")	2.500 (98.4")	3.038 (10'0")		
Renault Vehicles Ind.	PR180	France	Mack Trucks	Y	U	U	6 TA	17.335 (56'10")	2.500 (98.4")	2.890 (9'10")	51°	7°
Saab-Scania	112A	Sweden	Saab America	Y	Y	Y	4	17.434 (57'2")	2.590 (102")	3.139 (10'3")		
Steyr-Daimler-Puch A.G.	SG 18 HUA 250	Austria	Trans Bus of Am.	U	U	U	4 T	18.135 (59'5")	2.500 (98.4")	3.111 (10'3")	43°	12°
Van Hool Bus Works	AG 280	Belgium		Y	Y	Y	3 TA	17.340 (56'10")	2.490 (98")	3.150 (10'4")	36°	8°
Walter Vetter GmbH	18R	W. Germany	Trans. Eqpt. Dev.	Y	Y	Y	1 TA	18.000 (59'1")	2.500 (98.4")	3.300 (10'10")	45°	5°
AB Volvo (Hess Coach)	B10M	Sweden	Volvo Amer.	Y	Y	Y	1 TA	18.288 (60'1") 16.800 (55')	2.590 (102") 2.438 (96")	3.175 (10'5") 3.150 (10'4")	48°	10°

T = Electric Trolleybus version available

TA = Auxiliary thermal power unit available with trolleybus

Table B-2. SUMMARY DESIGN, DIMENSIONAL & PERFORMANCE CHARACTERISTICS (2 of 3)

MANUFACTURER	MODEL	DOOR WIDTH M. IN.	FIRST STEP HEIGHT MM. IN.	FIRST STEP HT. KNEELING MM. IN.	INTERIOR HEADROOM M. IN.	FLOOR HEIGHT MM. IN.	OUTSIDE TURNING RADIUS M. FT.IN.	MAX. SEATING CAPACITY (STANDEES)	CURB WEIGHT KG. (LBS.) AT GVWR	WHEELCHAIR LIFT AVAIL.
DAC (Autobuzel)		1.200 (47.2")	360 (14.2")		2.010 (79.1")	955 (37.6")	11.500 (37'9")	52	13,000 (28,600)	U
Daimler-Benz A.G.	O 305 G	1.250 (49.2")	328 (12.9")		2.100 (82.7")	718 (28.3")	11.250 (36'10")	66 (101)	13,000 (28,600)	U
Carr. Den Oudsten N.V.	Merc-B 0317	1.13 (44.4")	345 (13.5")		2.000 (78.7")	930 (36.6")	12.000 (39'4")	60	14,150 (31,130)	N
ENASA (Pegaso)	6031 A/2						12.000 (39'4")	73		N
De Simon S.P.A. (Inbus)	Inbus AS 250	1.160 (45.6")	350 (13.7")		2.100 (82.7")	750 (29.5")	12.000 (39'4")	73 (97)	15,525 (34,155)	Y
General Motors Canada Ltd.	TA60102N	1.074 (42.3")	343 (13.5")	244 (9.6")	1.994 (78.5")	850 (33.5")	13.280 (43'6")	76	15,086 (33,260)	Y
GMC Truck and Coach	R10-204 R20-204	0.710 (28")FR. 1.170 (46")RR.	330 (13")	200 (8")	2.032 (80")	864 (34")	N/A	73 65		Y
Graef & Stift A.G.	GS GU 280M18	1.250 (49.2")	304 (12")		2.045 (80.5")	860 (33.8")	11.000 (36'1")	36 (123)	13,900 (30,580)	Y
Louis Heuliez S.A.	O 305 G	1.290 (50.7")	339 (13.3")		2.140 (84.2")	729 (28.7")	11.250 (36'10")	64 (136)	12,900 (28,380)	N
Ikarus	IK 286	1.220 (48")	370 (14.5")	290 (11.5")	1.980 (78")	940 (37")	12.190 (40'0")	74	16,477 (36,250)	Y
Lex Vehicle Eng. Ltd.	O 305 G	1.200 (47.2")	339 (13.3")		2.172 (85.5")	729 (28.7")	11.250 (36'10")	67 (113)	25,729* (56,672)	Y
Leyland Vehicles Ltd.	DA8	1.200 (47.2")	383 (15.1")		2.100 (82.7")	914 (36")	11.300 (37'1")	To Suit	24,000 (52,910)	N
Magirus-Deutz A.G.	SH170	1.220 (48")	325 (12.8")		2.100 (82.7")	740 (29.1")	10.900 (35'9")	63 (107)	24,700* (54,340)	Y
M.A.N. Truck & Bus Corp.	SG220-16.5	1.240 (49.2")	367 (14.4")	325 (12.8")	1.981 (78")	909 (35.8")	12.620 (41'5")	65	17,181 (37,800)	Y
Neoplan USA	N421	1.000 (39.3")	350 (13.8")		2.150 (84.6")	750 (29.5")	12.649 (41'7")	71		Y
Renault Vehicles Ind.	PR180	1.200 (47.2")	363 (14.3")		2.190 (86.2")	619 (24.4")	11.640 (38'3")	68	26,200* (57,640)	Y
Saab-Scania	112A	1.200 (47.2")	350 (13.7")	250 (9.8")	2.100 (82.7")	670- (26.3")- 930 (36.6")	12.000 (39'4")	56-68 *	16,030 (35,266)	Y
Steyr-Daimler-Puch A.G.	SG 18 HUA 250	1.25 (49.2")	328 (12.9")		2.190 (86.2")	680 (26.7")	11.000 (36'1")	48 (132)	14,360 (31,592)	Y
Van Hool Bus Works	AG 280	1.150 (45.3")	350 (13.8")		2.325 (91.5")	680 (26.8")	10.765 (35'4")	51	24,000* (52,800)	Y
Walter Vetter GmbH	18R	1.200 (47.2")	380 (14.9")	320 (12.5")	2.000 (78.7")	920 (30.2")	12.000 (. ")	To Suit	25,000* (55,000)	Y
AB Volvo (Hess Coach)	810M	1.200 (47.2")	355 (14")		2.150 (84.6")	787 (31")	12.000 (39'4")	68	23,732* (52,210)	Y

*Number of seats varies with seat pitch and no. of doors

Table B-3. SUMMARY DESIGN, DIMENSIONAL & PERFORMANCE CHARACTERISTICS (3 of 3)

MANUFACTURER	MODEL	MAIN ENGINE MAKE	ENGINE MODEL	MAX. SPEED KPH	MAX. SPEED MPH	TRANSMISSION MAKE	TRANSMISSION MODEL	RETARDER MAKE	RETARDER TYPE	AXLE MFR.	SUSPENSION TYPE	BRAKE MFR.	BRAKE TYPE	AIR COND. MAKE	AIR COND. CAPACITY TONS
DAC (Autobuzel)		DAF	DKTL 1160	88	55	Voith	D851	Voith	Hydraulic	Baba	A		Dual Circ. Air		
Daimler-Benz A.G.	O 305 G	Daimler-Benz	OM407NA	88	55	D-B	W4 A 110R	D-B	Hydraulic	O-B	A	D-B	Dual Circ. Air	NO	
Carr. Den Oudsten N.V.	Merc-B 0317	Daimler-Benz	OM 355	90	55	D-B	W3D 080R			Mercedes-Benz	A	Mercedes-Benz	Pneumatic	KONI	16 KW
ENASA (Pegaso)	6031 A/2	Pegaso	9107.00	85	53	Wilson	RV-38				A	MCM	Dual Circ. Air		
De Simon S.P.A. (Inbus)	Inbus AS 250	Fiat	6-250CV	85	53	Voith	Di Wa 854	Voith	Hydraulic	Sicca/Padova	A	Perrot	Dual Circ. Air	Optional	
General Motors Canada Ltd.	TA60102N	Detroit D	8V-71N	90	55	Allison	V735	Telma	El. Mag.	Rockwell	A	Bendix-West.	Air		
GMC Truck and Coach	R10-204 R20-204	Detroit D	6V92TA	85	53	Allison	V735D	Allison	Hydraulic	GMC & Rockwell	A	Rockwell	Air (Wedge)	GMC	13 Ton
Graef & Stift A.G.	CS CU 280M18	M.A.N.	D 2566 MTUM	70	44	Voith	0851	Voith	Hydraulic	M.A.N.	A	Westinghouse	Air		
Louis Heuliez S.A.	O 305 C	Daimler-Benz	OM 407H	70	44	O-B	W 3D 080K	O-B	O-B	D-B	A	D-B	Air		
Ikarus	IK 286	Cummins 6	NNHTC-290	88	55	Allison	HT-740D	Allison	Hydraulic	Rockwell	A	Rockwell	S-Cam	Carrier	10.3 Ton
Lex Vehicle Eng. Ltd.	O 305 G	Daimler-Benz	OM 407H	70	44	O-B	W 30 08/R	O-B	Hydraulic		A				
Leyland Vehicles Ltd.	DAB	Leyland	TL 11 H	86	54	Leyland	Hydracyclic	Leyland	Hydraulic	Leyland	A	Leyland	Air S-Cam	Optional	
Magirus-Deutz A.G.	SH170	Kloeckner-Deutz	BF 8 L 413F	88	55	Voith	DIWA 854	Voith	Hydraulic	Magirus	A & T	Rockwell	Air	Konvekta	10 Ton
M.A.N. Truck & Bus Corp.	SG220-16.5	M.A.N. AC	D2566 MLUM/US	88	55	Renk	0874A	Renk	Hydraulic	M.A.N.	A	M.A.N.		Tran	
Neoplan USA	N421	Detroit D	8V92	88	55	Allison	HT740	Optional	Hydraulic	M.A.N.	A	M.A.N.	Air	Optional	
Renault Vehicles Ind.	PR180	Renault	MIPS 062030	88	55	Voith	D854	Voith	Hydraulic	Renault	A & S		Air		
Saab-Scania	112A	Scania	DS 1104	107	66	Scania	CAV 762	Scania	Automatic	Scania	A	Scania	Air		
Steyr-Daimler-Puch A.G.	SG 18 HUA 250	Str-Daim-Puch		75	47	ZV or Voith	854	Voith	Hydraulic	Steyr	A	Westinghouse			
Van Hool Bus Works	AG 280	M.A.N.	D2566	76	47	Voith	D854	Voith	Hydraulic	M.A.N.	A		Air	Optional	
Walter Vetter GmbH	18R	Daimler-Benz		100	62	Optional	Optional	Telma	El. Mag.	Mercedes-Benz	A	Westinghouse	Air	Optional	
AB Volvo (Hess Coach)	B10M	Volvo	THD100DC	90	56	ZF or Allison	Automatic	Telma	El. Mag.	Volvo	A/T		Air	Optional	

A - Air
S - Steel Springs
T - Torsion Bar

MANUFACTURER'S PROFILE

A. FIRM CROWN COACH CORPORATION

B. ADDRESS 2500 E. 12th St.
Los Angeles
California 90021

C. TELEPHONE (213) 627-4021

D. TELEX 1-910-321-2368 E. CABLE ____

F. OTHER MANUFACTURING SITES ____

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 55

H. BRIEF DESCRIPTION OF PRODUCT LINE ARTICULATED CITY TRANSIT COACHES; INTEGRAL, HEAVY-DUTY SCHOOL COACHES (35 and 40 foot); CUSTOM UTILITY COACHES; CUSTOM FIRETRUCKS

I. PRODUCTIVE CAPACITY 150 Articulated 600 school/utility BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES x NO ____ UNKNOWN ____

K. COMPLIANCE WITH NOISE STANDARDS

YES x NO ____ UNKNOWN ____

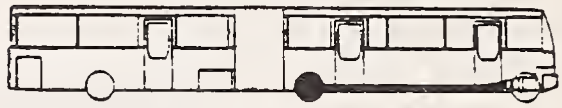
L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

YES x NO ____ UNKNOWN ____

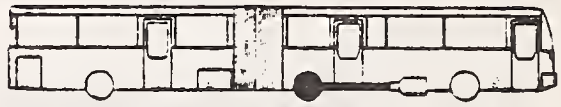
M. VEHICLE TYPE

X *Front end horizontal under floor axial engine with the second axle powered.*

Vertical front engine with second axle powered.

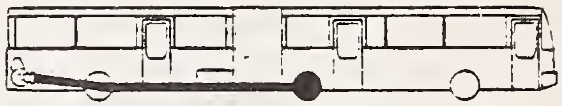


Side mounted engine with second axle powered.



Rear engine with third axle powered.

Rear engine with second axle powered.



Engine immaterial, with hydrostatic or electric transmission.

APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer CROWN COACH CORPORATION

B. Bus Model Number CROWN-IKARUS 286

C. Dimensions

1.	Overall Length	____ M.	59 Ft.	9 In.
2.	Overall Width	____ M.	8 Ft.	6 In.
3.	a. Overall Height (maximum)		____ M.	124 In.
	b. Height (main roof line)		____ M.	118 In.
4.	Angle of Approach			8 Deg.
5.	a. Breakover Angle Tractor			8 Deg.
	b. Breakover Angle Trailer			8 Deg.
6.	Angle of Departure			8 Deg.
7.	Articulation Angles			
	a. Horizontal			39 Deg.
	b. Vertical			15 Deg.

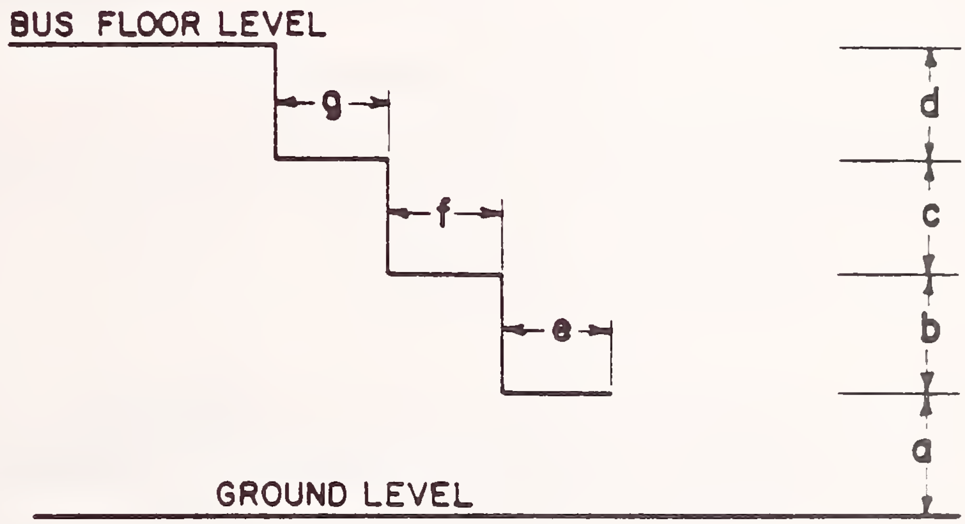
CROWN COACH CORP. (WITH IKARUS) - MODEL 286

USA & HUNGARY

8. Doorway Clear Opening (Including grab handles)

a.	Front	Width	______ M.	48 In.
		Height	______ M.	86 In.
b.	Center (if provided)	Width	______ M.	48 In.
		Height	______ M.	86 In.
c.	Rear	Width	______ M.	48 In.
		Height	______ M.	86 In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	____ mm.	14½ in.	____ mm.	14½ in.	____ mm.	14½ in.
Kneeling bus	____ mm.	11½ in.	____ mm.	14 in.	____ mm.	14-5/8 in.
b.	____ mm.	7½ in.	____ mm.	7½ in.	____ mm.	7½ in.
c.	____ mm.	7½ in.	____ mm.	7½ in.	____ mm.	7½ in.
d.	____ mm.	7½ in.	____ mm.	7½ in.	____ mm.	7½ in.
e.	____ mm.	10 in.	____ mm.	10 in.	____ mm.	10 in.
f.	____ mm.	10 in.	____ mm.	10 in.	____ mm.	10 in.
g.	____ mm.	10 in.	____ mm.	10 in.	____ mm.	10 in.

10. Interior Head Room (center of aisle)

a. Front Axle Location ________mm. 78 in.

b. Drive Axle Location ________mm. 78 in.

c. Trailer Axle Location ________mm. 78 in.

11. Aisle Width

Between Transverse Seats (minimum) ______mm. 22 in.
(using 36" wide, forward facing seats)

12. Floor Height Above Ground (at each door)

a. Front Door ________mm. 37 in.

b. Center Door (if provided) ________mm. 37 in.

c. Rear Door ________mm. 37 in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

________M. 40 Ft. 0 In.

b. Inside Turning Radius

________M. 20 Ft. 6 In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

________M. 2 Ft. 4 In.

14. Wheel Bases

a. Tractor ________M. 18 Ft. 8¼ In.

b. Trailer ________M. 23 Ft. 4¼ In.

c. Total ________M. 53 Ft. 1/2 In.

15. Seats

a. Total Number of Seats 74 (Maximum density)

b. Minimum Knee to Hip Room 27 (Using hard transit seats)

c. Minimum Foot Room ________

D. Weight of Bus

	Full Complement of Fuel, Oil, Water	At GVWR
1. On Front Axle	____ Kg. 13,000 Lbs.	____ Kg. 16,000 Lbs.
2. On Center Axle	____ Kg. 13,850 Lbs.	____ Kg. 22,000 Lbs.
3. On Rear Axle	____ Kg. 9,400 Lbs.	____ Kg. 16,000 Lbs.
4. TOTAL	____ Kg. 36,250 Lbs.	____ Kg. 54,000 Lbs.

E. Main Engine

1. Manufacturer CUMMINS DIESEL
2. Type 6 cylinder, in-line 3. Model NHHTC-290 (Standard) NHHTC-350 (Optional)
4. Net S.A.E. (S8166)/Horsepower 290 (Std) 350 (Opt) HP

at 2100 RPM

5. Turbo Charge, Make & Type CUMMINS
6. Maximum Vehicle Speed (@ Max. GVW) / ____ KPH 55 MPH (w/Std 4.63 Axle 62 MPH (w/Opt 4.11 Axle

F. Transmission

1. Manufacturer ALLISON
2. Type Automatic, with locking torque converter 3. Model HT-740D 4. Speeds 4
5. Retarder, Make, Type, and Size Allison, hydraulic, 365 horsepower

G. Axle, Front

1. Manufacturer ROCKWELL
2. Type I-Beam, steered 3. Model FL-931 4. GAWR ____ Kg. 18,000 Lbs.

H. Axle, Center Drive

1. Manufacturer ROCKWELL
2. Type Drive, hypoid, single reduction 3. Model 59000 4. GAWR ____ Kg. 23,000 Lbs.

J. Axle, Rear

1. Manufacturer ROCKWELL
2. Type I-Beam, steered 3. Model FL-931 4. GAWR ____ Kg. 18,000 Lbs.

K. Suspension

Air All Axles Steel Spring ________ Torsion Bar ________

L. Brakes

1. Make ROCKWELL Type S-CAM

M. Interior Lighting

1. Type Luminator flourescent, individual ballast

2. Number of Fixtures 16 (6 foot, single tube)

N. Tires

1. Manufacturer Michelin or Goodyear

2. Size 13/80R22.5 tubeless, 18PR

3. Type Radial ply, tubeless, low profile

O. Air Conditioning

1. Make Carrier-Transicold 2. Model CI-286 3. Capacity 10.3 ton

P. Kneeling Feature Available Yes X No ____

Q. Wheelchair Lift Available Yes X No ____

R. Vehicle available as Electric Trolley Bus? Yes X No ____

1. Model 286-T

2. Auxiliary Thermal Power Plant? Yes X No ____ KW ____

MANUFACTURER'S PROFILE

A. FIRM NV Carrosseriefabriek Den Oudsten & Zonen

B. ADDRESS Utrechtsestraatweg 112A
WOERDEN
HOLLAND

C. TELEPHONE 03480 - 1 2 3 4 5

D. TELEX 47835 E. CABLE OUDSTEN-WOERDEN

F. OTHER MANUFACTURING SITES

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 50

H. BRIEF DESCRIPTION OF PRODUCT LINE intercity buses
semi-integral steel frame with polyester panel sections,on every chassis-type

I. PRODUCTIVE CAPACITY 400/500 BUSES PER YEAR

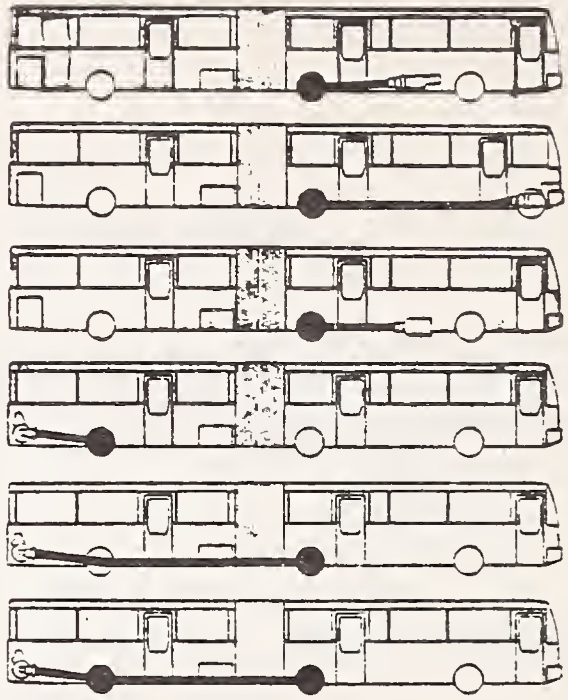
J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS
~~YES~~ ______ ~~NO~~ ______ UNKNOWN ______

K. COMPLIANCE WITH NOISE STANDARDS
~~YES~~ ______ ~~NO~~ ______ ~~UNKNOWN~~ ______

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS
~~YES~~ ______ ~~NO~~ ______ UNKNOWN ______

M. VEHICLE TYPE

rear Door 2 Center Door
Rear Door 1
Front Door



Front end horizontal under floor axial engine with the second axle powered. ___ 13

Vertical front engine with second axle powered.

Side mounted engine with second axle powered.

Rear engine with third axle powered.

Rear engine with second axle powered.

Engine immaterial, with hydrostatic or electric transmission.

APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer NV Carrosseriefabriek Den Oudsten & Zonen

B. Bus Model Number Mercedes Benz 0317 and Schenk GOB2 8000/1KU

C. Dimensions

1. Overall Length 17,96 M. - Ft. - In.

2. Overall Width 2,5 M. - Ft. - In.

3. a. Overall Height (maximum) 3,15 M. - In.

   b. Height (main roof line) 2,98 M. - In.

4. Angle of Approach - Deg.

5. a. Breakover Angle Tractor - Deg.

   b. Breakover Angle Trailer - Deg.

6. Angle of Departure - Deg.

7. Articulation Angles

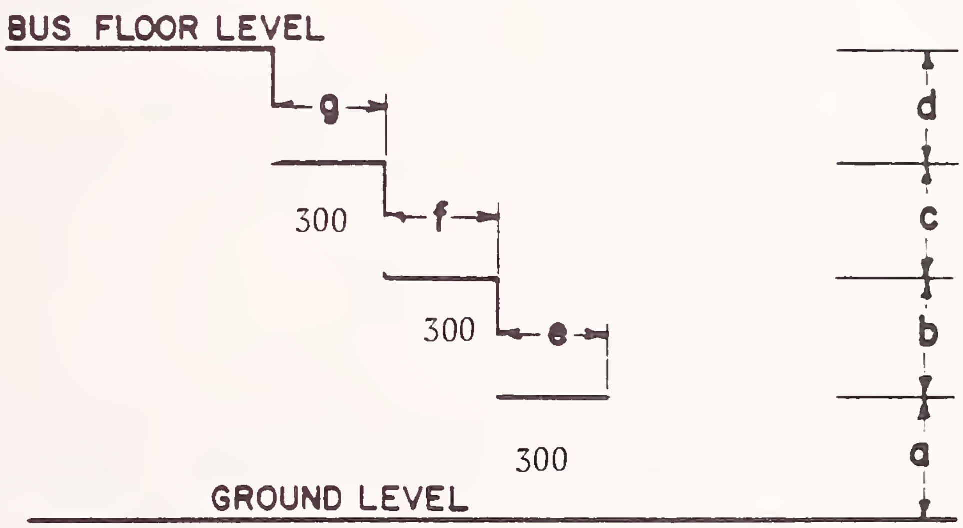
   a. Horizontal - Deg.

   b. Vertical - Deg.

8. Doorway Clear Opening (Including grab handles)

a. Front	Width	1,13	M.	-	In.
	Height	2,29	M.	-	In.
b. Center (if provided)	Width	1,13	M.	-	In.
	Height	2,29	M.	-	In.
c. Rear (Door 1 and 2)	Width	0,67	M.	-	In.
	Height	2,29	M.	-	In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door 1	Rear Door 2
a. Empty Bus	345 mm.	- in.	345 mm.	- in.	345 mm.	345 ~~XX~~ mm
Kneeling bus	- mm.	- in.	- mm.	- in.	- mm.	- ~~XX~~ mm
b.	195 mm.	- in.	195 mm.	- in.	195 mm.	195 ~~XX~~ mm
c.	195 mm.	- in.	195 mm.	- in.	195 mm.	195 ~~XX~~ mm
d.	195 mm.	- in.	195 mm.	- in.	195 mm.	195 ~~XX~~ mm
e.	205 mm.	- in.	205 mm.	- in.	205 mm.	205 ~~XX~~ mm
f.	205 mm.	- in.	205 mm.	- in.	205 mm.	205 ~~XX~~ mm
g.	205 mm.	- in.	205 mm.	- in.	205 mm.	205 ~~XX~~ mm

10. Interior Head Room (center of aisle)

a. Front Axle Location 2000 mm. - in.

b. Drive Axle Location 2000 mm. - in.

c. Trailer Axle Location 2000 mm. - in.

11. Aisle Width

Between Transverse Seats (minimum) 400 mm. - in.

12. Floor Height Above Ground (at each door)

a. Front Door 930 mm. - in.

b. Center Door (if provided) 930 mm. - in.

c. Rear Door 1 930 mm. - in.

d. Rear Door 2 950 mm. -

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

12 M. - Ft. - In.

b. Inside Turning Radius

6,5 M. - Ft. - In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

9,5 M. - Ft. - In.

14. Wheel Bases

a. Tractor 5,25 M. - Ft. - In.

b. Trailer 7,15 M. - - Ft. - In.

c. Total 12 M. - Ft. - In.

15. Seats

a. Total Number of Seats 60

b. Minimum Knee to Hip Room 280 mm

c. Minimum Foot Room 300 mm

D. Weight of Bus

Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	5340 Kg.	- Lbs.	6500 Kg.	- Lbs.
2. On Center Axle	4760 Kg.	- Lbs.	10000 Kg.	- Lbs.
3. On Rear Axle	4050 Kg.	- Lbs.	6500 Kg.	- Lbs.
4. TOTAL	14150 Kg.	- Lbs.	23000 Kg.	Lbs.

E. Main Engine

1. Manufacturer Mercedes Benz
2. Type OM 355 3. Model horizontal
4. Net S.A.E. Horsepower 240 HP
   at 2200 RPM
5. Turbo Charge, Make & Type no
6. Maximum Vehicle Speed 90 KPH - MPH

F. Transmission

1. Manufacturer Mercedes Benz
2. Type W3D 080 R 3. Model ____ 4. Speeds 3
5. Retarder, ~~Make, Type, and Size~~ Yes

G. Axle, Front

1. Manufacturer Mercedes Benz
2. Type ____ 3. Model - 4. GAWR - Kg. - Lbs. -

H. Axle, Center Drive

1. Manufacturer Mercedes Benz
2. Type -- 3. Model - 4. GAWR - Kg. - Lbs. -

J. Axle, Rear

1. Manufacturer Mercedes Benz
2. Type - 3. Model - 4. GAWR - Kg. - Lbs. -

K. <u>Suspension</u>

Air ___Yes___ Steel Spring ___-___ Torsion Bar ___No___

L. <u>Brakes</u>

1. Make ___Mercedes-Benz Bosch/Westinghouse___ Type ___pneumatic___

M. <u>Interior Lighting</u>

1. Type ___Fluorescence tubes___
2. Number of Fixtures ___14 x 40W___

N. <u>Tires</u>

	Tractor	Trailer
1. Manufacturer	Michelin	Michelin
2. Size	12-22,5	13/70-22,5
3. Type	-	-

O. <u>Air Conditioning</u>

1. Make ___KONI___ 2. Model ___-___ 3. Capacity ___16 kW___

P. Kneeling Feature Available ~~Yes~~ ____ No ____

Q. Wheelchair Lift Available ~~Yes~~ ____ No ____

R. Vehicle available as Electric Trolley Bus? ~~Yes~~ ____ No ____

1. Model ___-___
2. Auxiliary Thermal Power Plant? Yes _-_ No _-_ KW _-_

DAF TRUCKS B.V.
DAF BUS DIVISION

MANUFACTURERS PROFILE

A. FIRM DAF Bus division, DAF Trucks b.v.

B. ADDRESS Geldropseweg 303

5645 TK Eindhoven

C. TELEPHONE 040 - 143075

D. TELEX 51085 DAF NL E. CABLE DAF Trucks

F. OTHER MANUFACTURING SITES Oevel in Belgium

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 35

H. BRIEF DESCRIPTION OF PRODUCT LINE DAF Bus produces bus- and coachchassis, mid- and rear engined, including articulated buses in a dieselengine range from 156 hp to 260 hp

I. PRODUCTIVE CAPACITY 1500 BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES ____ NO ____ UNKNOWN x according to EEC regulations

K. COMPLIANCE WITH NOISE STANDARDS

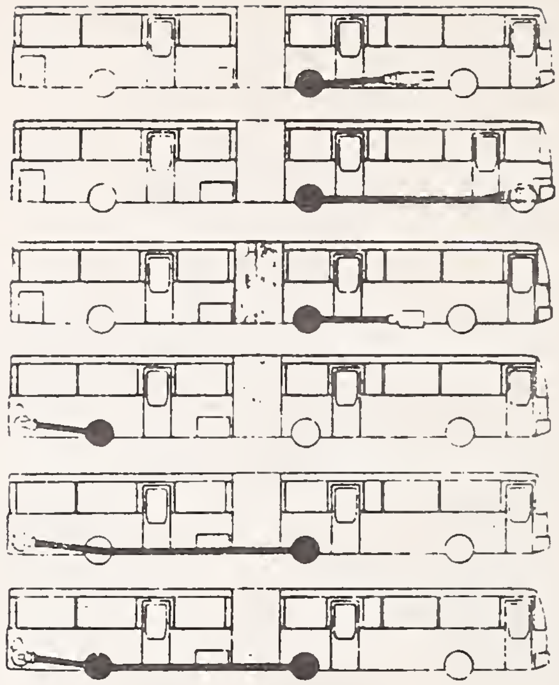
YES ____ NO ____ UNKNOWN x according to EEC regulations

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

YES ____ NO ____ UNKNOWN x

M. VEHICLE TYPE

NO



Front end horizontal under floor axial engine with the second axle powered — 1

Vertical front engine with second axle powered — 2

Side mounted engine with second axle powered — 3

Rear engine with third axle powered — 4

Rear engine with second axle powered — 5

Engine immaterial, with hydrostatic or electric transmission — 6

APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer DAF (buschassis manufacturer)

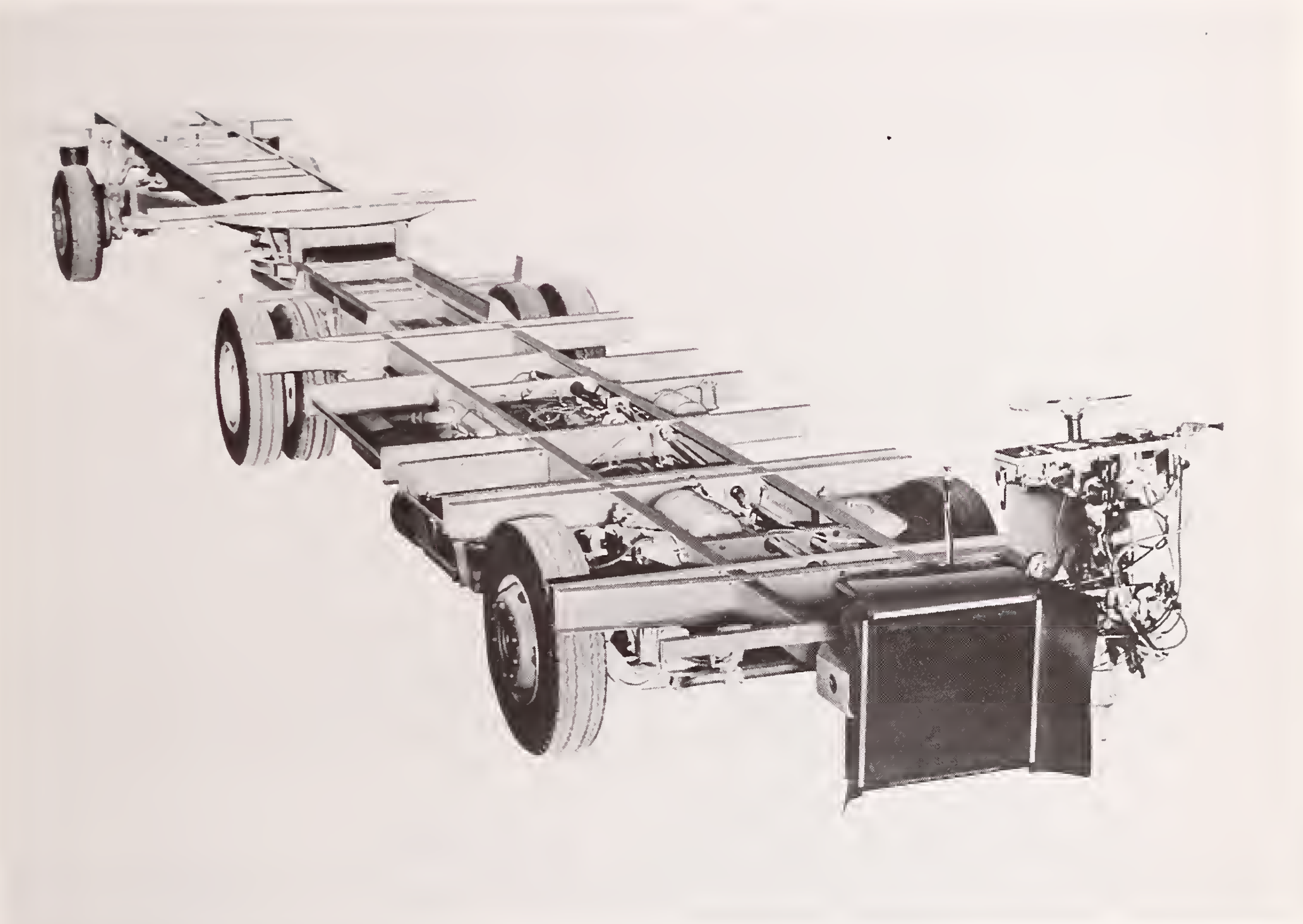
B. Bus Model Number 1

C. Dimensions

1. Overall Length 17.880 M. ______ Ft. ______ In.
2. Overall Width 2.400 M. ______ Ft. ______ In.
3. a. Overall Height (maximum) 0,91 M. ______ In.
   ~~b~~. Height (main roof line) ______ M. 7,1 In. (1 : 8)
4. Angle of Approach ______ Deg.
5. a. Breakover Angle Tractor ______ Deg.
   b. Breakover Angle Trailer ______ Deg.
6. Angle of Departure 7° Deg.
7. Articulation Angles
   a. Horizontal 22,5 Deg.
   b. Vertical ______ Deg.

DAF TRUCKS B.V. (BUS DIVISION)
BUS CHASSIS MANUFACTURER

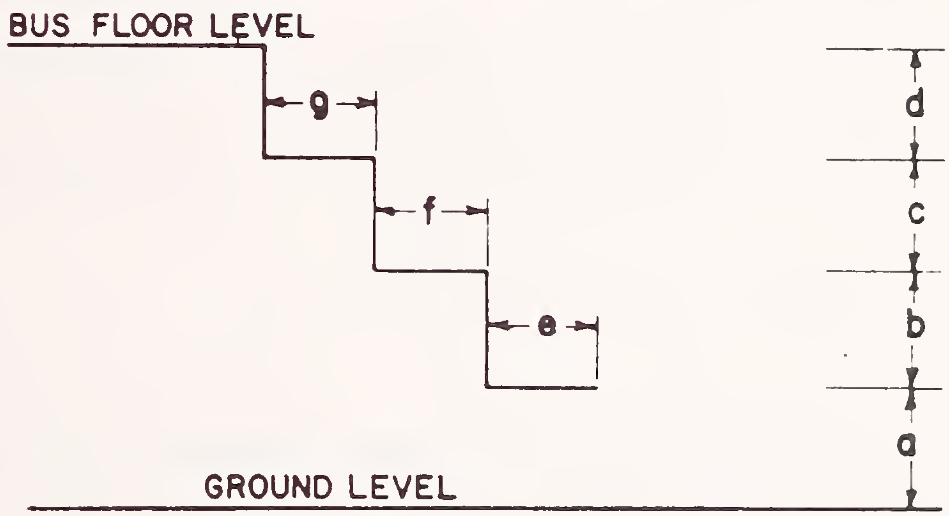
HOLLAND



8. Doorway Clear Opening (Including grab handles)

a.	Front	Width	______ M.	______ In.
		Height	______ M.	______ In.
b.	Center (if provided)	Width	______ M.	______ In.
		Height	______ M.	______ In.
c.	Rear	Width	______ M.	______ In.
		Height	______ M.	______ In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	____mm.	____in.	____mm.	____in.	____mm.	____in.
Kneeling bus	____mm.	____in.	____mm.	____in.	____mm.	____in.
b.	____mm.	____in.	____mm.	____in.	____mm.	____in.
c.	____mm.	____in.	____mm.	____in.	____mm.	____in.
d.	____mm.	____in.	____mm.	____in.	____mm.	____in.
e.	____mm.	____in.	____mm.	____in.	____mm.	____in.
f.	____mm.	____in.	____mm.	____in.	____mm.	____in.
g.	____mm.	____in.	____mm.	____in.	____mm.	____in.

10. Interior Head Room (center of aisle)

a. Front Axle Location ________mm. ________in.

b. Drive Axle Location ________mm. ________in.

c. Trailer Axle Location ________mm. ________in.

11. Aisle Width

Between Transverse Seats (minimum) ______mm. ______in.

12. Floor Height Above Ground (at each door)

a. Front Door ________mm. ________in.

b. Center Door (if provided) ________mm. ________in.

c. Rear Door ________mm. ________in.

* floor height above 1) front axle 9.10 mm 3) trailer axle : 920 mm
2) driven axle 9.40 mm

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

________M. ________Ft. ________In.

b. Inside Turning Radius

________M. ________Ft. ________In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

________M. ________Ft. ________In.

14. Wheel Bases

a. Tractor ________M. ________Ft. ________In.

b. Trailer ________M. ________Ft. ________In.

c. Total ________M. ________Ft. ________In.

15. Seats

a. Total Number of Seats ________

b. Minimum Knee to Hip Room ________

c. Minimum Foot Room ________

D. Weight of ~~Bus~~ chassis

	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	2750 Kg.	____ Lbs.	6500 Kg.	____ Lbs.
2. On Center Axle	4270 Kg.	____ Lbs.	11600 Kg.	____ Lbs.
3. On Rear Axle	1560 Kg.	____ Lbs.	7100 Kg.	____ Lbs.
4. TOTAL	8580 Kg.	____ Lbs.	25200 Kg.	____ Lbs.

E. Main Engine

1. Manufacturer DAF
2. Type DKTL 1160 3. Model hor. 11,6 ltr 6 cyl. in line between le-2e axle turbo charged with piston cooling
4. Net S.A.E. Horsepower 252 HP at 2200 RPM
5. Turbo Charge, Make & Type K.K.K. 4 LG 252 D 32.22
6. Maximum Vehicle Speed ± 106 KPH ____ MPH

F. Transmission

with tyres 12 x 22,5 and rear axle reduction 4,11 : 1

1. Manufacturer ZF
2. Type 5 HP 500 automatic 3. Model horizontal 4. Speeds 5
5. Retarder, Make, Type, and Size integrated ZF W 360

G. Axle, Front

1. Manufacturer DAF
2. Type N 140 3. Model 'I' 4. GAWR 6500 Kg. ____ Lbs.

H. Axle, Center Drive

1. Manufacturer ____
2. Type 2255 3. Model ____ 4. GAWR 11000 Kg. ____ Lbs.

J. Axle, Rear

1. Manufacturer DAF
2. Type N 142 3. Model ____ 4. GAWR 7100 Kg. ____ Lbs.

front suspension : 4 air bags type : Firestone
rear suspension : 2 air bags per axle. type:continen-tal

K. Suspension

Air * ______ Steel Spring ______ Torsion Bar ______

L. Brakes

1. Make DAF Type mechanic pneumatic (2 independant systems)

M. Interior Lighting

1. Type ______

2. Number of Fixtures ______

N. Tires

1. Manufacturer Michelin

2. Size tractor D 22,5 trailor : E 22,5

3. Type Pilote X

Ø. Air Conditioning

1. Make ______ 2. Model ______ 3. Capacity ______

P. Kneeling Feature Available Yes ____ No x

Q. Wheelchair Lift Available Yes from body builder No ____

R. Vehicle available as Electric Trolley Bus? Yes ____ No x

1. Model ______

2. Auxiliary Thermal Power Plant? Yes ____ No x KW ____

nb:
for completeness sake, the DAF Bus division of DAF Trucks B.V. produces only bus- and coach chassis.
DAF as a company is not in the integral- or complete bus business. We depend on the specialised bodybuilders in a number of countries for bodies on DAF chassis.

MANUFACTURER'S PROFILE

A. FIRM Daimler-Benz AG

B. ADDRESS Daimler-Benz AG
Hanns-Martin-Schleyer-Str. 1
6800 Mannheim 31 W.-Germany

C. TELEPHONE 0621 393 1

D. TELEX 462 131 dbm d E. CABLE

F. OTHER MANUFACTURING SITES DB-AG, 7000 Stuttgart, W.-Germany (Passenger cars, Trucks, Tractors, Unimog)

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES since 1894

H. BRIEF DESCRIPTION OF PRODUCT LINE Standard-City-Buses Articulated-City-Buses, ACB-Trolley, Cross-County-Buses, Tourist-Coaches, Chassis, CKD-Versions

I. PRODUCTIVE CAPACITY 3800 u. 1600 chassis BUSES PER YEAR for all typ

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES ____ NO ____ UNKNOWN X

K. COMPLIANCE WITH NOISE STANDARDS

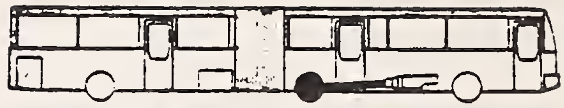
YES ____ NO ____ UNKNOWN X

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

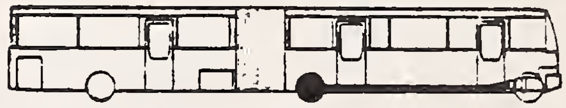
YES ____ NO ____ UNKNOWN X

M. VEHICLE TYPE

Front end horizontal under floor axial engine with the second axle powered.



Vertical front engine with second axle powered.

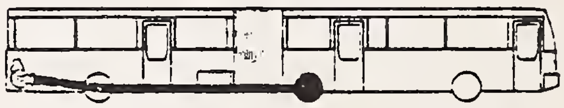


Side mounted engine with second axle powered.

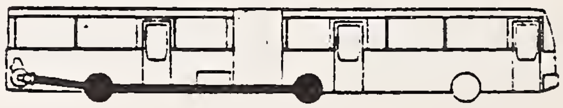
X
X
X
Rear engine with third axle powered.

X
X
X

Rear engine with second axle powered.



Engine immaterial, with hydrostatic or electric transmission.



APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer Daimler-Benz AG

B. Bus Model Number O 305 G

C. Dimensions

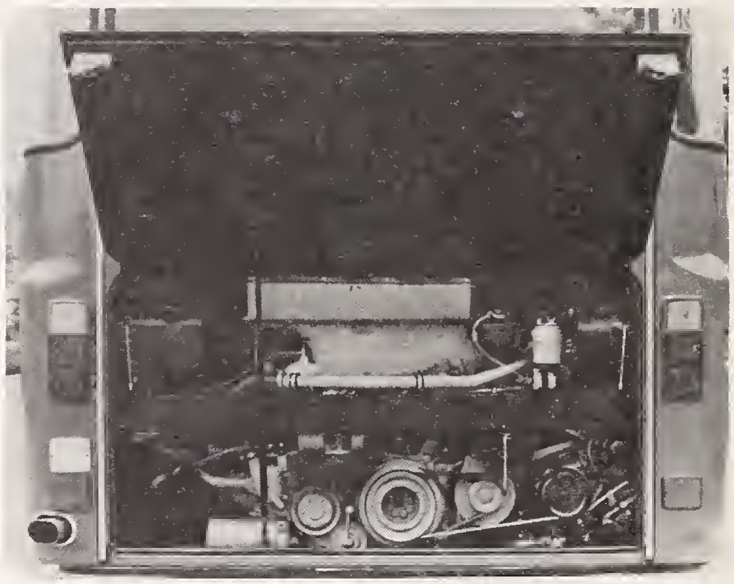
1. Overall Length 17.260 M. 56.63 Ft. 679.5 In.
2. Overall Width 2.500 M. 8.20 Ft. 98.4 In.
3. a. Overall Height (maximum) 2.941 M. 115.8 In.
   b. Height (main roof line) 2.903 M. 114.3 In.
4. Angle of Approach 8^{o} 15' Deg.
5. a. Breakover Angle Tractor) Anti-jackknifing device Deg.
   b. Breakover Angle Trailer) see brochure! Deg.
6. Angle of Departure 8^{o} 10' Deg.
7. Articulation Angles
   a. Horizontal approx. 10^{o} Deg.
   b. Vertical 47^{o} Deg.

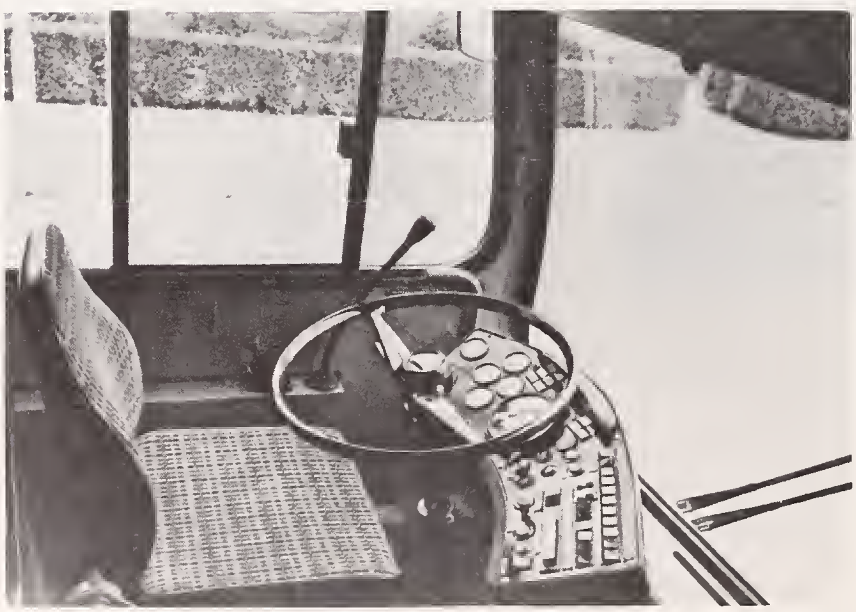
DAIMLER-BENZ A.G. (MERCEDES-BENZ) - MODEL O 305 G

W. GERMANY

DAIMLER-BENZ - MODEL O 305 G

W. GERMANY

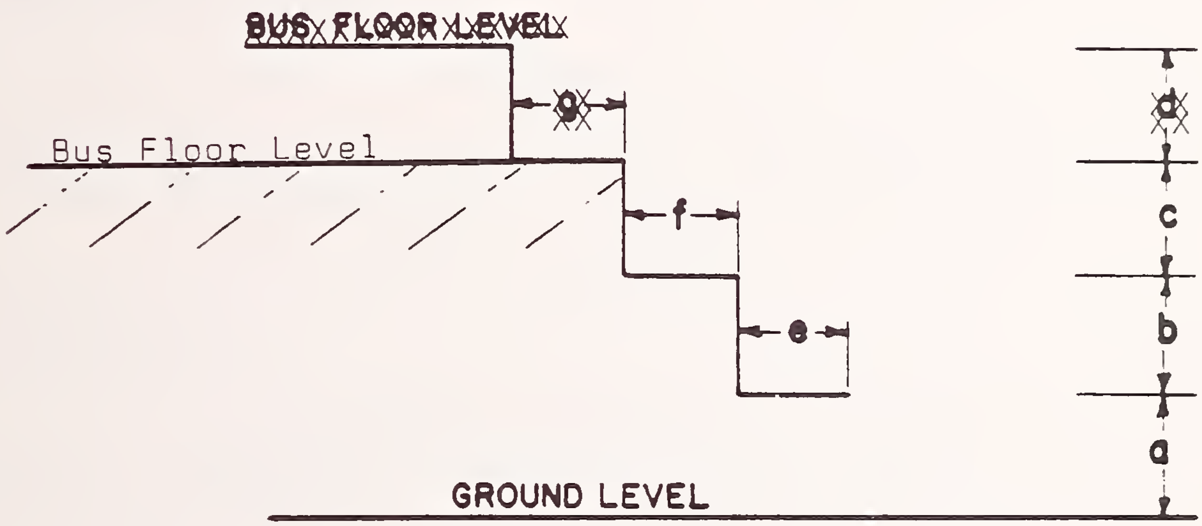




8. Doorway Clear Opening (Including grab handles)

a. Front	Width	1.250 M.	49.2 In.
	Height	2.020 M.	79.5 In.
b. Center (if provided)	Width	1.250 M.	49.2 In.
	Height	2.020 M.	79.5 In.
c. Rear	Width	1.250 M.	49.2 In.
	Height	2.020 M.	79.5 In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	328 mm.	12.9 in.	328 mm.	12.9 in.	328 mm.	12.9 in.
Kneeling bus	328 mm.	12.9 in.	328 mm.	12.9 in.	328 mm.	12.9 in.
b.	195 mm.	7.67 in.	195 mm.	7.67 in.	195 mm.	7.67 in.
c.	195 mm.	7.67 in.	195 mm.	7.67 in.	195 mm.	7.67 in.
~~d.~~ X X X X X X	X mm.	X in.	X mm.	X in.	X mm.	X in.
e.	410 mm.	16.1 in.	305 mm.	12.0 in.	305 mm.	12.0 in.
f.	410 mm.	16.1 in.	305 mm.	12.0 in.	305 mm.	12.0 in.
~~g.~~ X X X X X X	X mm.	X in.	X mm.	X in.	X mm.	X in.

10. Interior Head Room (center of aisle)

a. Front Axle Location 2100 mm. 82.7 in.

b. Center ~~Drive~~ Axle Location 2100 mm. 82.7 in.

c. Drive ~~Trailer~~ Axle Location 2000 mm. 78.7 in.

11. Aisle Width

Between Transverse Seats (minimum) 550 front 370 rear mm. 21.7 front 14.6 rear in.

12. Floor Height Above Ground (at each door)

a. Front Door 718 mm. 28.3 in.

b. Center Door (if provided) 718 mm. 28.3 in.

c. Rear Door 718 mm. 28.3 in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

11.250 M. 36.91 Ft. 442.9 In.

b. Inside Turning Radius

4.700 M. 15.42 Ft. 185.0 In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

0.160 M. 0.52 Ft. 6.3 In.

14. Wheel Bases

a. Front/Center ~~Tractor~~ 5.600 M. 18.27 Ft. 220.5 In.

b. Center/Rear ~~Trailer~~ 6.150 M. 20.18 Ft. 242.1 In.

c. Total 11.750 M. 38.55 Ft. 462.6 In.

15. Seats

a. Total Number of Seats 1/58 or 1/66 or 1/48

b. Minimum Knee to Hip Room 650 mm

c. Minimum Foot Room 255 mm

D. **Weight of Bus**

Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	3300 Kg.	7275 Lbs.	6200 Kg.	13670 Lbs.
2. On Center Axle	3300 Kg.	7275 Lbs.	9500 Kg.	20945 Lbs.
3. On Rear Axle	6400 Kg.	14110 Lbs.	10000 Kg.	22045 Lbs.
4. TOTAL	13000 Kg.	28660 Lbs.	25300 Kg.	55775 Lbs.

E. **Main Engine**

1. Manufacturer Daimler-Benz AG
2. Type Diesel, 6-cylinder 3. Model OM 407 h / OM 407 hA
4. ~~Net S.A.E.~~ Horsepower DIN HP 240 / 280 (Turbo)
   at ______ RPM 2200 / 2200
5. Turbo Charge, Make & Type KKK, exhaust gas turbo charger
6. Maximum Vehicle Speed 72/88 KPH 44,7/54,7 MPH

F. **Transmission**

W 3D 080/R; W4 A 080 R
W 3 D 110/R; W4 A 110 R

1. Manufacturer DB-AG
2. Type Automatic 3. Model ______ 4. Speeds 3 option 4
5. Retarder, Make, Type, and Size DB-AG hydraulic integrated in automatic transmission

G. **Axle, Front**

1. Manufacturer DB-AG
2. Type rigid 3. Model VO4/11DL7 4. GAWR 400 Kg. 882 Lbs.

H. **Axle, Center ~~Drive~~**

1. Manufacturer DB-AG
2. Type Tubular 3. Model NR7/4DL10 4. GAWR 480 Kg. 1058 Lbs.

J. **Axle, Rear** Drive

1. Manufacturer DB-AG
2. Type Hub reducted 3. Model HO7/8DL10 4. GAWR 570 Kg. 1257 Lbs.

K. Suspension

Air __x__ Steel Spring ____ Torsion Bar ____

L. Brakes

Dual circ. Air

1. Make DB Type Dual circuit compressed-air brake load sensitive brake at central axle

M. Interior Lighting

1. Type Swing lights

2. Number of Fixtures 13

N. Tires

1. Manufacturer Michelin, Dunlop, Goodyear, Continental etc.

2. Size 11 R - 22,5

3. Type Radial

O. Air Conditioning not provided ex works

1. Make ____ 2. Model ____ 3. Capacity ____

P. Kneeling Feature Available Yes ____ No __x__

Q. Wheelchair Lift Available Yes ____ No __x__

R. Vehicle available as Electric Trolley Bus? Yes __x__ No ____

1. Model O 305 GT

2. Auxiliary Thermal Power Plant? Yes __x__ No ____ KW150

MANUFACTURERS PROFILE

A. FIRM INBUS - INDUSTRIE AUTOBUS

B. ADDRESS MILANO - CORSO VENEZIA, 12

C. TELEPHONE ______

D. TELEX ______ E. CABLE ______

F. OTHER MANUFACTURING SITES DE SIMON Factory: OSOPPO (Udine) Tlx.460868
SICCA Factory: Vittorio Veneto(TV) Tlx. 410541;BREDA Factory:Pistoia Tlx.570186

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 30

H. BRIEF DESCRIPTION OF PRODUCT LINE
CITY - INTERCITY BUSES
INBUS U 210 (12 m.-200 HP)/INBUS S 210/INBUS I 210/INBUS U 150 (8.5 m. 150 HP)

I. PRODUCTIVE CAPACITY 1000 BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES ______ NO ______ UNKNOWN X

K. COMPLIANCE WITH NOISE STANDARDS

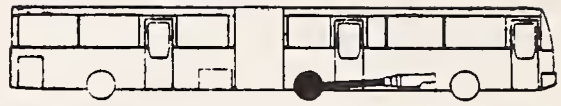
YES ______ NO ______ UNKNOWN X

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

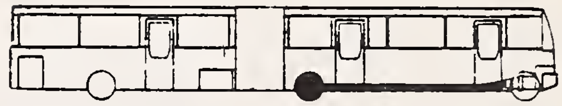
YES ______ NO ______ UNKNOWN X

M. VEHICLE TYPE

Front end horizontal under floor axial engine with the second axle powered.



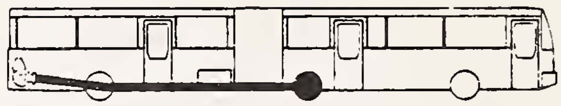
Vertical front engine with second axle powered.



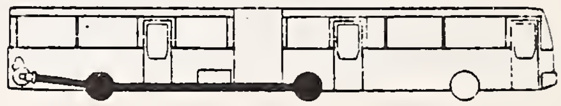
Side mounted engine with second axle powered.

* *Rear engine with third axle powered.*

Rear engine with second axle powered.



Engine immaterial, with hydrostatic or electric transmission.



APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer INBUS

B. Bus Model Number AS 250

C. Dimensions

1. Overall Length 17.44 M. ______ Ft. ______ In.
2. Overall Width 2.50 M. ______ Ft. ______ In.
3. a. Overall Height (maximum) 3.05 M. ______ In.

   b. Height (main roof line) 3.05 M. ______ In.
4. Angle of Approach 8 Deg.
5. a. Breakover Angle Tractor 7 Deg.

   b. Breakover Angle Trailer 7 Deg.
6. Angle of Departure 7 Deg.
7. Articulation Angles

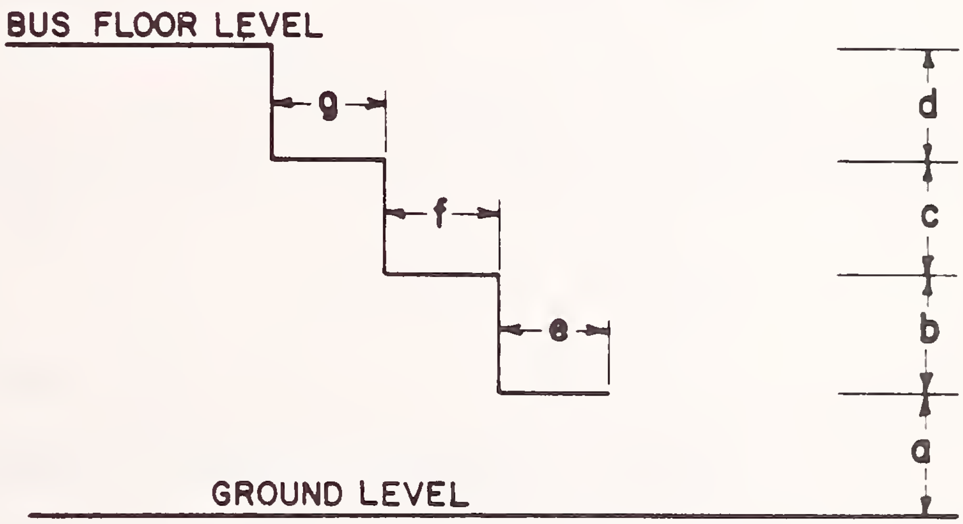
   a. Horizontal 47 Deg.

   b. Vertical 10 Deg.

8. Doorway Clear Opening (Including grab handles)

a. Front	Width	.800	M.	____ In.
	Height	2,000	M.	____ In.
b. Center (if provided)	Width	1,160	M.	____ In.
	Height	2,000	M.	____ In.
c. Rear	Width	1,160	M.	____ In.
	Height	2,000	M.	____ In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	350 mm.	____ in.	350 mm.	____ in.	350 mm.	____ in.
Kneeling bus	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.
b.	200 mm.	____ in.	200 mm.	____ in.	200 mm.	____ in.
c.	200 mm.	____ in.	200 mm.	____ in.	200 mm.	____ in.
d.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.
e.	300 mm.	____ in.	300 mm.	____ in.	300 mm.	____ in.
f.	300 mm.	____ in.	300 mm.	____ in.	300 mm.	____ in.
g.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.

10. Interior Head Room (center of aisle)

a. Front Axle Location 2100 mm. ________ in.

b. Drive Axle Location 2100 mm. ________ in.

c. Trailer Axle Location 1950 mm. ________ in.

11. Aisle Width

Between Transverse Seats (minimum) 450 mm. ________ in.

12. Floor Height Above Ground (at each door)

a. Front Door 750 mm. ________ in.

b. Center Door (if provided) 750 mm. ________ in.

c. Rear Door 750 mm. ________ in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bump..

12 M. ________ Ft. ________ In.

b. Inside Turning Radius

5.30 M. ________ Ft. ________ In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

________ M. ________ Ft. ________ In.

14. Wheel Bases

a. Tractor 5450 M. ________ Ft. ________ In.

b. Trailer 6290 M. ________ Ft. ________ In.

c. Total 11740 M. ________ Ft. ________ In.

15. Seats

a. Total Number of Seats 73

b. Minimum Knee to Hip Room 710 mm.

c. Minimum Foot Room ________

D. Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	4025 Kg.	Lbs.	6250 Kg.	Lbs.
2. On Center Axle	3855 Kg.	Lbs.	6750 Kg.	Lbs.
3. On Rear Axle	7645 Kg.	Lbs.	10930 Kg.	Lbs.
4. TOTAL	15525 Kg.	Lbs.	23930 Kg.	Lbs.

E. Main Engine

1. Manufacturer FIAT (or MAN)

2. Type 6 cyl- 4 str. - Diesel 3. Model

4. Net S.A.E. Horsepower 250 (or 280) HP

at 2200 RPM

5. Turbo Charge, Make & Type Turbo

6. Maximum Vehicle Speed 85 KPH ______ MPH

F. Transmission

1. Manufacturer VOITH

2. Type automatic 3. Model Diwa 4. Speeds 4

5. Retarder, Make, Type, and Size Hydraulic retarder included

G. Axle, Front

1. Manufacturer SICCA

2. Type integral 3. Model I shaped 4. GAWR 6500 Kg. ______ Lbs.

H. Axle, Center Drive

1. Manufacturer SICCA

2. Type integral 3. Model Box shaped 4. GAWR 10000 Kg. ______ Lbs.

J. Axle, Rear

1. Manufacturer MPM PADOVA

2. Type double reduction 3. Model ______ 4. GAWR 12000 Kg. ______ Lbs.

K. Suspension

Air X Steel Spring ____ Torsion Bar X

L. Brakes

1. Make PERROT Type Front disc brake
Rear and trailer drumm brake

M. Interior Lighting

1. Type Fluorescent

2. Number of Fixtures 10

N. Tires

1. Manufacturer MICHELIN - PIRELLI (or other)

2. Size 11-22.5

3. Type 315/70 TUBELESS

O. Air Conditioning

1. Make Optional 2. Model ____ 3. Capacity ____

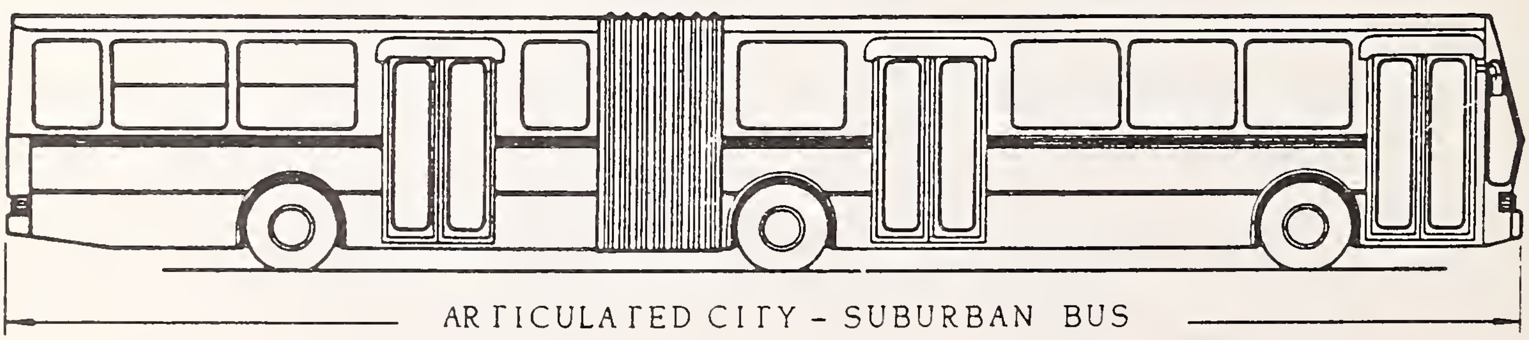
P. Kneeling Feature Available Yes ____ No X

Q. Wheelchair Lift Available Yes X No ____

R. Vehicle available as Electric Trolley Bus? Yes X No ____

1. Model ____

2. Auxiliary Thermal Power Plant? Yes X No ____ KW ____



ARTICULATED CITY - SUBURBAN BUS

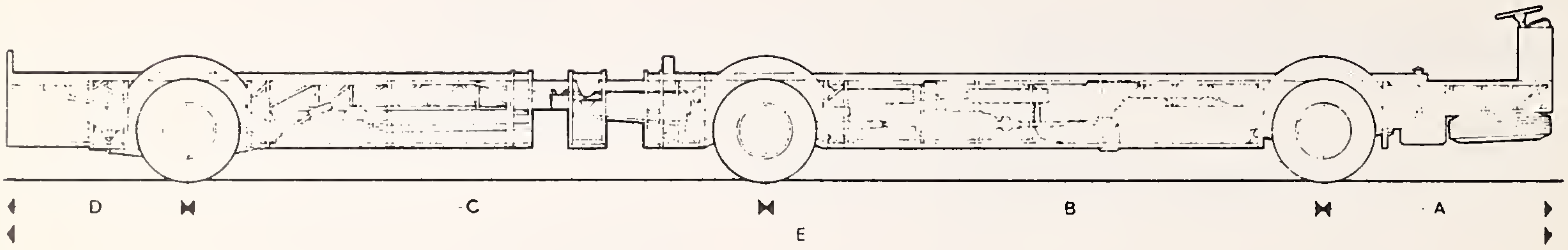
NO PHOTOGRAPHS WERE PROVIDED BY THE MANUFACTURER.

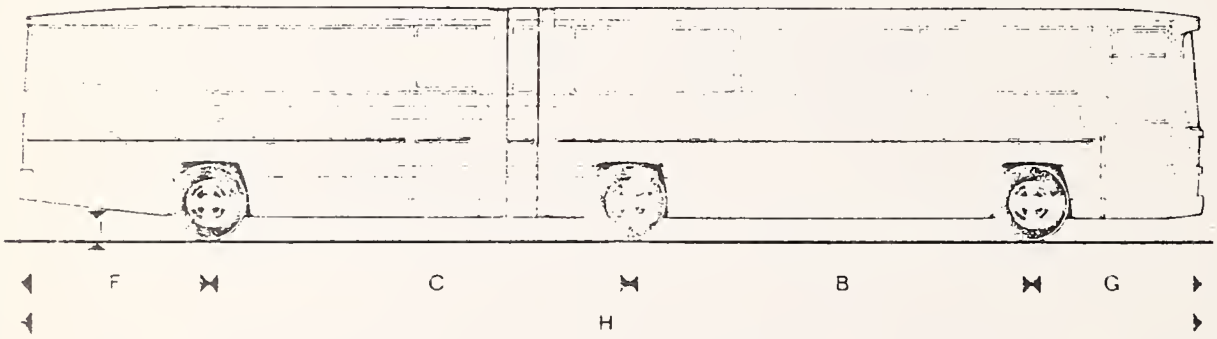
PEGASO

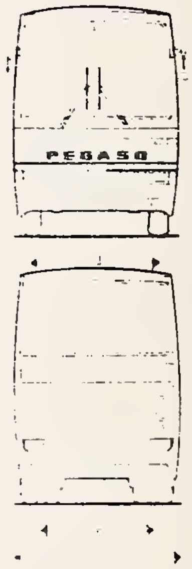
MANUFACTURER'S PROFILE DATA SHEETS WERE NOT RETURNED; ONLY THE FOLLOWING SPECIFICATION SHEET WAS PROVIDED.

PEGASO 6031 A/2

76 pasajeros + conductor







Dimensiones (mm)

A	B	C	D	E	F	G	H	I	J	K	L
2320	5600	5815	1885	15620	2625	2460	16500	250	2002	1830	2450

Motor

Marca	PEGASO Aspirado Diesel, 4 tiempos Inyeccion directa
Modelo	**9107.00**
Cilindros	6
Diametro	120 mm
Carrera	155 mm
Cilindrada	10 518 cm³
Potencia maxima	**200 cv** (147,1 kW) a **2000** r min.
Par maximo	79 mkg (77 5 daN m) a **1250** r min.
Relac. de compresion	16 1
Capacidad de aceite	24 litros
Consumo especifico	[illegible] 175 gr [illegible] a 1500 r p m
Peso	920 kg

Embrague

Modelo	8704 00
Tipo	Hidraulico con blocaje centrifugo
Diametro	

Caja de cambios

Marca	WILSON 5 velocidades (RV-38)
Capacidad de aceite	14 litros
Peso	
Relaciones	

5ª	1,00 1
4ª	1,59 1
3ª	2,43 1
2ª	4,28 1
1ª	7,25 1
M A	7,25 1

PEG-2

Eje delantero

Modelo	4499 23
Tipo	Rigido en seccion doble T

Puente posterior

Tipo	4995 06
Caoacidad de aceite	16 litros
Reduccion normal	4,69.1 (27 19 x 3,3)

Ruedas

Tipo	DISCO
Llanta	8 00 x 20"
Neumaticos	11.00 x 20"

Dirección

Modelo	0522 03
Tipo	HIDRAULICA-VIREX
Diametro del volante	550 mm
Relac desmultiplicacion	19 1
Radio minimo de giro	11 500 mm aprox
Capacidad de aceite	4 8 litros

Frenos

Tipo — Neumaticos de doble circuito

	Primer Eje	Puente	Semi-remolque
Diametro tambor (mm)	410	410	410
Ancho zapata	140	160	140
Camara freno	24 Nor	24 MGM	30" MGM
Superficie frenado (cm)	1970	2250	1970

Superficie total	6190 cm
Freno de estacionamiento	Camaras MGM y valvula manual

Suspensión

Anterior	Ballestas amortiguadores, neumatica
Posterior	Ballestas amortiguadores, neumatica

Estructura

Tipo	Autoportante

Compresor

Caudal	221 litros
Depositos de aire	1-12, 1-20 3-36 1-40
Capacidad total	177 litros

Instalación eléctrica

Tension	24 V
Generador	80 A (1500 W)
Baterias	2, de 12 V y 160 Amp h
Motor de arranque	6 cv

Cargas

	Eje	Puente	Eje Remolque	Total
Autobastidor y carroceria	4 900	5 600	3 900	14 400
Pasaje + equipaje	1600	4 400	2 600	8 600
Pesos nominales	6 500	10 000	6 500	23 000

Velocidades máximas y pendientes superables

Velocidad	Reduccion normal	
	Km	%
5 '	85	1 2
4 '	53	2,8
3 '	35	5,2
2 '	20	10,3
1 '	12	18,7

Dotación de serie

Deposito de combustible de 175 litros
Rueda de repuesto
Tablero de instrumentos Velocimetro y cuentakilometros Cuenta revoluciones Manometro de aire Aparato combinado

Nota importante: Estas especificaciones tienen mero caracter orientativo y pueden ser modificadas sin previo aviso — Abril 1981

CONCESIONARIO:

ENASA (Empresa Nacional de Autocamiones, S.A.)
José Abascal, 2 - Teléf. 447 50 00 - Télex 27493 BUSKA E - 42803 DIEX E - MADRID-3

MANUFACTURERS PROFILE

A. FIRM Diesel Division, General Motors of Canada Limited

B. ADDRESS Box 5160
London, Ontario N6A 4N5
Canada

C. TELEPHONE 519-452-5153

D. TELEX 064-7231 E. CABLE ______

F. OTHER MANUFACTURING SITES St. Eustache, Quebec, Canada

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 20

H. BRIEF DESCRIPTION OF PRODUCT LINE Transit coaches

I. PRODUCTIVE CAPACITY 225 BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES x NO ______ UNKNOWN ______

K. COMPLIANCE WITH NOISE STANDARDS

YES x NO ______ UNKNOWN ______

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

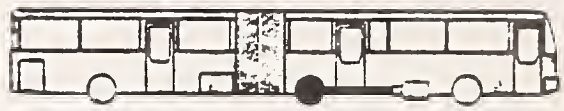
YES x NO ______ UNKNOWN ______

M. VEHICLE TYPE

Front end horizontal under floor axial engine with the second axle powered.

Vertical front engine with second axle powered.

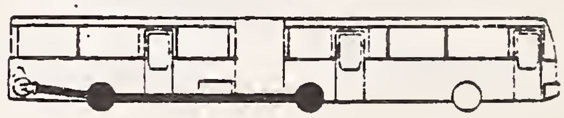
Side mounted engine with second axle powered.



XX *Rear engine with third axle powered.*

Rear engine with second axle powered.

Engine immaterial, with hydrostatic or electric transmission.



APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer: Diesel Division, General Motors of Canada Limited

B. Bus Model Number: TA60102N

C. Dimensions

1. Overall Length: 18,288 M. 60 Ft. ____ In.
2. Overall Width: 2,590 M. ____ Ft. 102 In.
3. a. Overall Height (maximum): 3029 M. 119.25 In.

   b. Height (main roof line): 2959 M. 116.5 In.
4. Angle of Approach: 10° 46' Deg.
5. a. Breakover Angle Tractor: -- Deg.

   b. Breakover Angle Trailer: -- Deg.
6. Angle of Departure: 8° 16' Deg.
7. Articulation Angles

   a. Horizontal: 10 Deg.

   b. Vertical: 10 Deg.

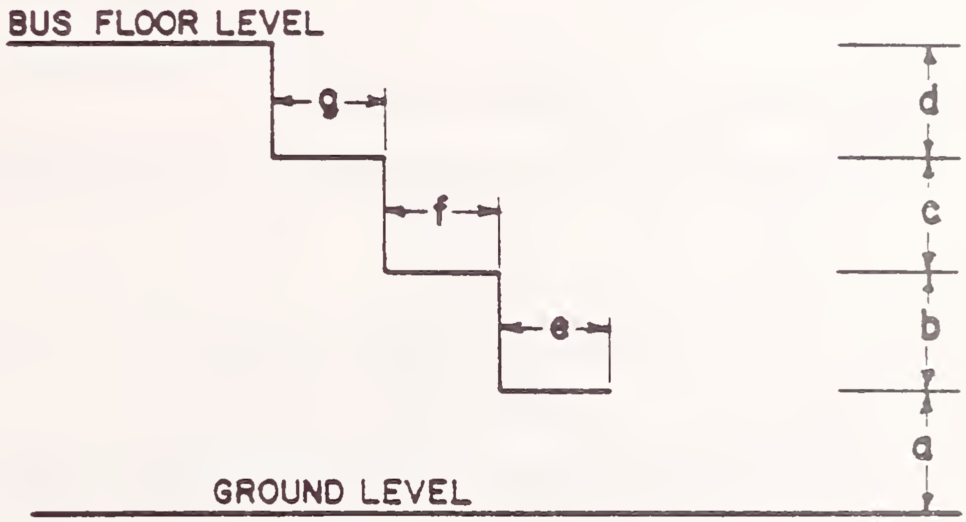
GENERAL MOTORS OF CANADA, LTD. - MODEL TA60102N

CANADA

8. Doorway Clear Opening (Including grab handles)

a.	Front	Width	1074	M.	42.3	In.
		Height	2029	M.	79-7/8	In.
b.	Center (if provided)	Width	1145	M.	45.1	In.
		Height	1955	M.	77	In.
c.	Rear	Width	1145	M.	45.1	In.
		Height	1955	M.	77	In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	343 mm.	13.5 in.	350 mm.	13.8 in.	376 mm.	14.8 in.
Kneeling bus	244 mm.	9.6 in.	-- mm.	-- in.	-- mm.	-- in.
b.	254 mm.	10 in.	243 mm.	9.6 in.	266.7 mm.	10.5 in.
c.	254 mm.	10 in.	243 mm.	9.6 in.	266.7 mm.	10.5 in.
d.	NA mm.	in.	NA mm.	in.	NA mm.	in.
e.	304.8 mm.	12 in.	304.8 mm.	12 in.	304.8 mm.	12 in.
f.	304.8 mm.	12 in.	304.8 mm.	12 in.	304.8 mm.	12 in.
g.	NA mm.	in.	NA mm.	in.	NA mm.	in.

10. Interior Head Room (center of aisle)

a. Front Axle Location 1994 mm. 78.5 in.

b. Drive Axle Location 1943 mm. 76.5 in.

c. Trailer Axle Location 1994 mm. 78.5 in.

11. Aisle Width

Between Transverse Seats (minimum) 660.4 mm. 26 in.

12. Floor Height Above Ground (at each door)

a. Front Door 850 mm. 33.5 in.

b. Center Door (if provided) 863 mm. 34 in.

c. Rear Door 889 mm. 35 in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

1328 M. 43.5 Ft. 523 In.

b. Inside Turning Radius

6502.4 M. 21.3 Ft. 256 In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

NIL M. NIL Ft. NIL In. (No swing out due to pusher style rear engine

14. Wheel Bases

a. Tractor	5969	M.	19.58	Ft.	235	In.
b. Trailer	7156	M.	23.47	Ft.	281.73	In.
c. Total	13124	M.	43.05	Ft.	516.73	In.

15. Seats

a. Total Number of Seats 76

b. Minimum Knee to Hip Room 27"

c. Minimum Foot Room ______

D. Weight of Bus

Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	3020 Kg.	6660 Lbs.	3760 Kg.	8290 Lbs.
2. On Center Axle	4282 Kg.	9440 Lbs.	1006 Kg.	22180 Lbs.
3. On Rear Axle	7784 Kg.	17160 Lbs.	9186 Kg.	20252 Lbs.
4. TOTAL	15086 Kg.	33260 Lbs.	23132 Kg.	50995 Lbs.

E. Main Engine

1. Manufacturer G.M. Detroit Diesel Allison
2. Type Diesel 3. Model 8V-71N
4. Net S.A.E. Horsepower 255 HP at 2000 RPM
5. Turbo Charge, Make & Type ---------
6. Maximum Vehicle Speed 90 KPH 55 MPH

F. Transmission

1. Manufacturer Detroit Diesel Allison
2. Type ________ 3. Model V735 4. Speeds 3F/1R
5. Retarder, Make, Type, and Size Telma Eddy-Current Focal 155

G. Axle, Front

1. Manufacturer Rockwell
2. Type Reverse Elliott 3. Model ________ 4. GAWR 4990 Kg. 11,000 Lbs.

H. Axle, Center Drive

1. Manufacturer Rockwell
2. Type Full Floating 3. Model ________ 4. GAWR 10433 Kg. 23,000 Lbs.

J. Axle, Rear

1. Manufacturer Rockwell
2. Type Full Floating 3. Model ________ 4. GAWR 10433 Kg. 23,000 Lbs.

K. Suspension

Air __XX__ Steel Spring ______ Torsion Bar ______

L. Brakes

1. Make Bendix-Westinghouse Type Air

M. Interior Lighting

1. Type Fluorescent - centre strip

2. Number of Fixtures 7

N. Tires

1. Manufacturer Customer choice

2. Size 12.00 x 22.5

3. Type Tube or tubeless

O. Air Conditioning

1. Make -- 2. Model --- 3. Capacity --

P. Kneeling Feature Available Yes __X__ No ____

Q. Wheelchair Lift Available Yes __X__ No ____

R. Vehicle available as Electric Trolley Bus? Yes ____ No __X__

1. Model ----

2. Auxiliary Thermal Power Plant? Yes ____ No __X__ KW ____

MANUFACTURERS PROFILE

A. FIRM GMC TRUCK & COACH DIVISION GENERAL MOTORS CORPORATION

B. ADDRESS 660 SOUTH BOULEVARD EAST
PONTIAC, MICHIGAN 48053

C. TELEPHONE (313) 857-4005

D. TELEX TWX-810-232-5217 E. CABLE ______

F. OTHER MANUFACTURING SITES NONE

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 56

H. BRIEF DESCRIPTION OF PRODUCT LINE ADVANCED DESIGN SPECIFICATION 35 AND 40 FOOT TRANSIT COACHES, AND ARTICULATED COACHES.

I. PRODUCTIVE CAPACITY APPROX. 5,000 BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS
YES X NO ______ UNKNOWN ______

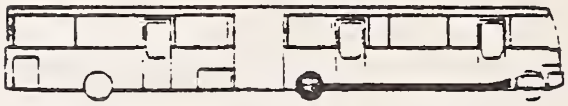
K. COMPLIANCE WITH NOISE STANDARDS
YES X NO ______ UNKNOWN ______

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS
YES X NO ______ UNKNOWN ______

M. VEHICLE TYPE

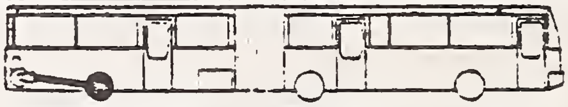
Front end horizontal under floor axial engine with the second axle powered.

Vertical front engine with second axle powered.



Side mounted engine with second axle powered.

Rear engine with third axle powered.



Rear engine with second axle powered.

Engine immaterial, with hydrostatic or electric transmission.

APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer GMC TRUCK & COACH

B. Bus Model Number R10-204 (56 FT.) R20-204 (61 FT.)

C. Dimensions

1. Overall Length ______ M. -61- -56- Ft. ______ In.
2. Overall Width ______ M. ______ Ft. 102 In.
3. a. Overall Height (maximum) ______ M. 123 In.
   b. Height (main roof line) ______ M. 119 In.
4. Angle of Approach 10 Deg.
5. a. Breakover Angle Tractor 10 Deg.
   b. Breakover Angle Trailer 13 Deg.
6. Angle of Departure 9 Deg.
7. Articulation Angles
   a. Horizontal ± 47 Deg.
   b. Vertical ± 16 Deg.

GMC TRUCK AND COACH DIVISION

PONTIAC, MI

GMC Truck & Coach Division of General Motors is developing an articulated bus with nearly 60 percent greater seating capacity than its conventional RTS transit buses. The new design utilizes two basic RTS body structures joined by a flexible hinge and revolving turntable to pivot the vehicle for turning corners. Robert W. Truxell, a GM vice president and division general manager, said, "After further development and testing, articulated bus production could start in about 2-1/2 years at GMC facilities in Pontiac."

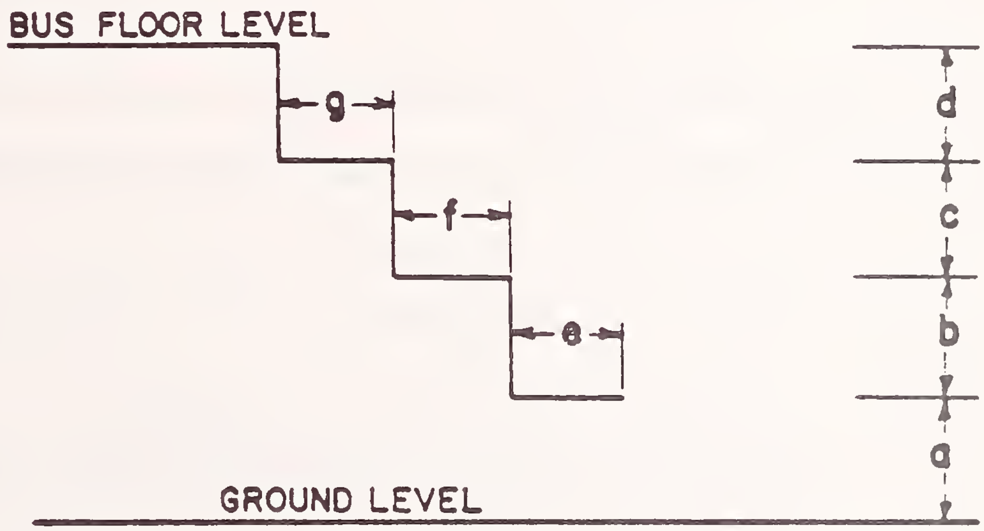
MODEL R10 - 204 (56')
MODEL R20 - 204 (61')

FROM: GMC TRUCK & COACH PUBLIC RELATIONS, PONTIAC, MI 48053 313-857-2911

8. Doorway Clear Opening (Including grab handles)

a.	Front	Width	____ M.	28 In.
		Height	____ M.	71 In.
b.	Center (if provided)	Width	____ M.	46 In.
		Height	____ M.	70 In.
c.	Rear	Width	____ M.	46 In.
		Height	____ M.	70 In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	____ mm.	13 in.	____ mm.	15 in.	____ mm.	16 in.
Kneeling bus	____ mm.	8 in.	____ mm.	- in.	____ mm.	- in.
b.	____ mm.	10 in.	____ mm.	10 in.	____ mm.	10 in.
c.	____ mm.	10 in.	____ mm.	10 in.	____ mm.	10 in.
d.	____ mm.	0 in.	____ mm.	0 in.	____ mm.	0 in.
e.	____ mm.	11 in.	____ mm.	11 in.	____ mm.	11 in.
f.	____ mm.	11 in.	____ mm.	11 in.	____ mm.	11 in.
g.	____ mm.	0 in.	____ mm.	0 in.	____ mm.	0 in.

10. Interior Head Room (center of aisle)

a. Front Axle Location ________ mm. ___80___ in.

b. Drive Axle Location ________ mm. ___80___ in.

c. Trailer Axle Location ________ mm. ___80___ in.

11. Aisle Width

Between Transverse Seats (minimum) ______ mm. __22__ in.

12. Floor Height Above Ground (at each door)

a. Front Door ________ mm. ___32___ in.

b. Center Door (if provided) ________ mm. ___34___ in.

c. Rear Door ________ mm. ___35___ in.

JT AVAILABLE AT THIS TIME

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

________ M. ________ Ft. ________ In.

b. Inside Turning Radius

________ M. ________ Ft. ________ In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

________ M. ________ Ft. ________ In.

14. Wheel Bases

	M.	Ft.	T10-204 56 ft. In.	T20-204 61 ft.
a. Tractor	________	________	239	299"
b. Trailer	________	________	246	246"
c. Total	________	________	485	545"

15. Seats

	T10-204 56 ft.	T20-204 61 ft.
a. Total Number of Seats	65	73
b. Minimum Knee to Hip Room	________	
c. Minimum Foot Room	________	

'OT AVAILABLE AT THIS E

D. Weight of Bus

Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	_____ Kg.	_____ Lbs.	_____ Kg.	_____ Lbs.
2. On Center Axle	_____ Kg.	_____ Lbs.	_____ Kg.	_____ Lbs.
3. On Rear Axle	_____ Kg.	_____ Lbs.	_____ Kg.	_____ Lbs.
4. TOTAL	_____ Kg.	_____ Lbs.	_____ Kg.	_____ Lbs.

E. Main Engine

1. Manufacturer DETROIT DIESEL ALLISON DIV. GM (DDAD)

2. Type SIX CYL. V. 3. Model 6V92TA

4. Net S.A.E. Horsepower 294 HP STD 315 HP OPT.

at 2100 RPM

5. Turbo Charge, Make & Type FURNISHED DDAD

6. Maximum Vehicle Speed _____ KPH 52.8 MPH

F. Transmission

1. Manufacturer DDAD

2. Type V-DRIVE 3. Model V735D 4. Speeds 3

5. Retarder, Make, Type, and Size _____

G. Axle, Front

1. Manufacturer GMC, INDEPENDENT FRONT SUSPENSION

2. Type _____ 3. Model _____ 4. GAWR _____ Kg. 13,400 Lbs.

H. Axle, Center ~~Drive~~

1. Manufacturer ROCKWELL (WITHOUT CARRIER)

2. Type _____ 3. Model 59733 RDL 4. GAWR _____ Kg. 23,500 Lbs

J. Axle, Rear DRIVE

1. Manufacturer ROCKWELL

2. Type - 3. Model 59733 RDC 4. GAWR - Kg. 23,500 Lbs

K. Suspension

Air X Steel Spring ________ Torsion Bar ________

L. Brakes

1. Make ROCKWELL Type WEDGE

M. Interior Lighting

1. Type FRONT LIGHTED ADVERTISING SIGNS

2. Number of Fixtures NOT DEFINED

N. Tires

1. Manufacturer VARIOUS

2. Size 12.5 x 22.5 G RANGE

3. Type CITY - SUBURBAN

O. Air Conditioning

1. Make GMC 2. Model - 3. Capacity 13 TON NOMINAL

P. Kneeling Feature Available Yes X No ____

Q. Wheelchair Lift Available Yes X No ____

R. Vehicle available as Electric Trolley Bus? Yes ____ No X

1. Model N/A

2. Auxiliary Thermal Power Plant? Yes ____ No X KW ____

MANUFACTURERS PROFILE

A. FIRM ÖAF - Gräf & Stift AG

B. ADDRESS Brünnerstraße 72
A-1211 Vienna
Austria /Europe

C. TELEPHONE 86 96 11

D. TELEX 133329 aflie a E. CABLE ______

F. OTHER MANUFACTURING SITES Carlbergergasse 4o-42
A-123o Vienna (bus production)

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 75

H. BRIEF DESCRIPTION OF PRODUCT LINE city and intercity buses - two axled, articulated, double deck versions, trolley, diesel and lpg buses; special buses like airfield buses, X-ray buses etc.

I. PRODUCTIVE CAPACITY 25o BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES x NO ______ UNKNOWN ______

K. COMPLIANCE WITH NOISE STANDARDS

YES x NO ______ UNKNOWN ______

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

YES ______ NO ______ UNKNOWN x

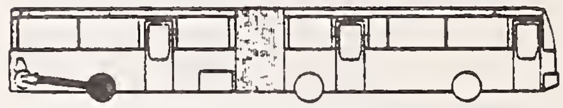
M. VEHICLE TYPE

X *Front end horizontal under floor axial engine with the second axle powered.*

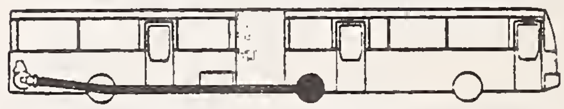
Vertical front engine with second axle powered.

Side mounted engine with second axle powered.

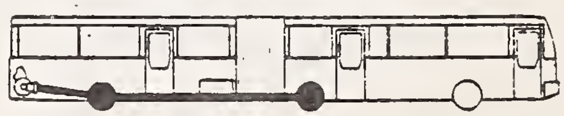
Rear engine with third axle powered.



Rear engine with second axle powered.



Engine immaterial, with hydrostatic or electric transmission.



APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer ÖAF Gräf & Stift AG

B. Bus Model Number GS GU 28o M18

C. Dimensions

1. Overall Length 18,o M. ______ Ft. ______ In.
2. Overall Width 2,48 M. ______ Ft. ______ In.
3. a. Overall Height (maximum) 3,o1 M. ______ In.
   b. Height (main roof line) 2,94 M. ______ In.
4. Angle of Approach 9 Deg.
5. a. Breakover Angle Tractor 13 Deg.
   b. Breakover Angle Trailer 11 Deg.
6. Angle of Departure 8 Deg.
7. Articulation Angles
   a. Horizontal ± 47 Deg.
   b. Vertical ± 8 Deg.

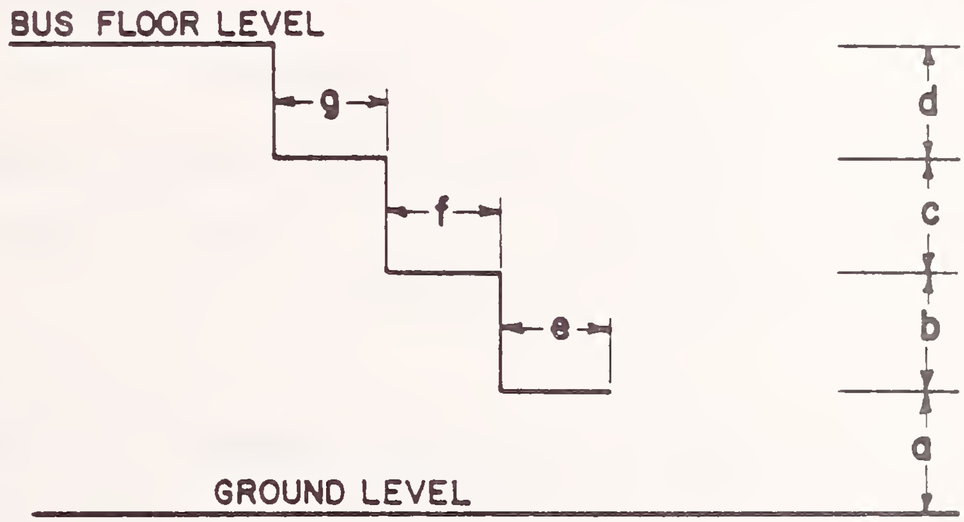
GRAEF & STIFT A.G. - MODEL GS GU 280M18

AUSTRIA

8. Doorway Clear Opening (Including grab handles)

a.	Front	Width	1,25	M.		In.
		Height	2,03	M.		In.
b.	Center (if provided)	Width	1,25	M.		In.
		Height	2,03	M.		In.
c.	Rear (two rear doors provided)	Width	1,25	M.		In.
		Height	2,03	M.		In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door				Center Door				Rear Door			
a. Empty Bus	340	mm.		in.	340	mm.		in.	340	mm.		in.
Kneeling bus	340	mm.		in.	340	mm.		in.	340	mm.		in.
b.	170	mm.		in.	170	mm.		in.	170	mm.		in.
c.	170	mm.		in.	170	mm.		in.	170	mm.		in.
d.	180	mm.		in.	180	mm.		in.	180	mm.		in.
e.	300	mm.		in.	300	mm.		in.	300	mm.		in.
f.	300	mm.		in.	250	mm.		in.	250	mm.		in.
g.	approx. 500	mm.		in.	250	mm.		in.	250	mm.		in.

10. Interior Head Room (center of aisle)

a. Front Axle Location 2045 mm. ________ in.

b. Drive Axle Location 2045 mm. ________ in.

c. Trailer Axle Location 2045 mm. ________ in.

11. Aisle Width

Between Transverse Seats (minimum) 910 mm. ________ in.

12. Floor Height Above Ground (at each door)

a. Front Door 860 mm. ________ in.

b. Center Door (if provided) 860 mm. ________ in.

c. Rear Door 860 mm. ________ in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

11,0 M. ________ Ft. ________ In.

b. Inside Turning Radius

4,5 M. ________ Ft. ________ In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

1,2 M. ________ Ft. ________ In.

14. Wheel Bases

a. Tractor 5,6 M. ________ Ft. ________ In.

b. Trailer 7,05 M. ________ Ft. ________ In.

c. Total 12,65 M. ________ Ft. ________ In.

15. Seats

a. Total Number of Seats 36 seats/123 standing passengers

b. Minimum Knee to Hip Room 700 mm

c. Minimum Foot Room 400 mm

D. **Weight of Bus**

Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	4600 Kg.	Lbs.	7500 Kg.	Lbs.
2. On Center Axle	5900 Kg.	Lbs.	10000 Kg.	Lbs.
3. On Rear Axle	3400 Kg.	Lbs.	7500 Kg.	Lbs.
4. TOTAL	13900 Kg.	Lbs.	25000 Kg.	Lbs.

E. **Main Engine**

1. Manufacturer M.A.N.
2. Type Diesel 3. Model D 2566 MTUM
4. Net ~~SAE~~ DIN. Horsepower 280 HP
   at 2200 RPM
5. Turbo Charge, Make & Type M.A.N.
6. Maximum Vehicle Speed 70 KPH ____ MPH

F. **Transmission**

1. Manufacturer Voith
2. Type DIWA (automatic) 3. Model D 851 4. Speeds 3
5. Retarder, Make, Type, and Size hydraulic retarder, Voith

G. **Axle, Front**

1. Manufacturer M.A.N.
2. Type independent suspension 3. Model ~~V7-70~~ 4. GAWR 7500 Kg. ____ Lbs.

H. **Axle, Center Drive**

1. Manufacturer ÖAF Gräf & Stift
2. Type countershaft gear axle 3. Model ____ 4. GAWR 13000 Kg. ____ Lbs.

J. **Axle, Rear**

1. Manufacturer MAN
2. Type independent suspension 3. Model V7-70 4. GAWR 7500 Kg. ____ Lbs.

K. Suspension

Air __x__ Steel Spring ______ Torsion Bar ______

L. Brakes

1. Make Westinghouse Type air operated

M. Interior Lighting

1. Type Fluorescent

2. Number of Fixtures 7

N. Tires

1. Manufacturer Semperit

2. Size 11R 22,5/12R22,5

3. Type steel belted radial

O. Air Conditioning

1. Make ______ 2. Model ______ 3. Capacity ______

P. Kneeling Feature Available Yes ____ No x

Q. Wheelchair Lift Available Yes x No ____

R. Vehicle available as Electric Trolley Bus? Yes x No ____

1. Model see attached literature

2. Auxiliary Thermal Power Plant? Yes x No ____ KW 40

MANUFACTURERS PROFILE

A. FIRM S.A. HEULIEZ BUS

B. ADDRESS 7 rue Louis Heuliez
79140 CERIZAY - FRANCE

C. TELEPHONE (49) 80.11.11 - 80.12.22

D. TELEX ________ E. CABLE ________

F. OTHER MANUFACTURING SITES
RORTHAIS - CERIZAY - BOURG-EN-BRESSE - BROU

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 35 years

H. BRIEF DESCRIPTION OF PRODUCT LINE MINIBUS - MEDIUMBUS - STANDARD and ARTICULATED BUSES - COACHES

I. PRODUCTIVE CAPACITY 600 BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS
YES ____ NO ____ UNKNOWN X

K. COMPLIANCE WITH NOISE STANDARDS
YES ____ NO ____ UNKNOWN X

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS
YES ____ NO ____ UNKNOWN X

M. VEHICLE TYPE

~~*Front end horizontal under floor axial engine with the second axle powered.*~~

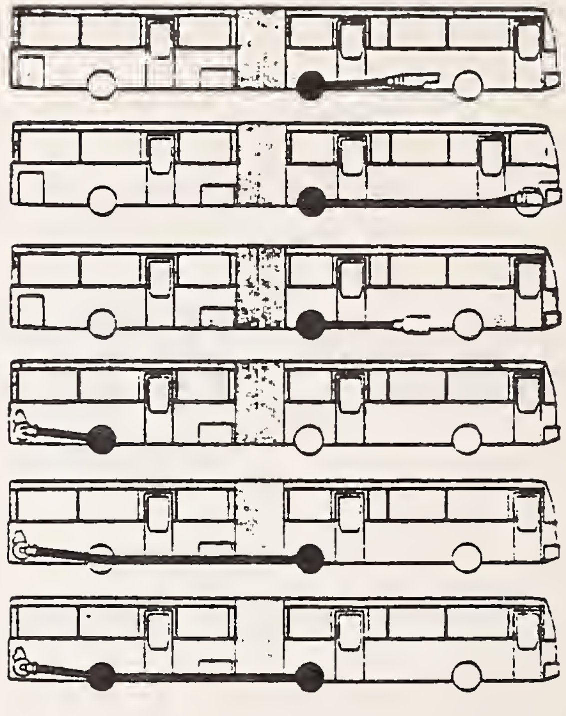
~~*Vertical front engine with second axle powered.*~~

~~*Side mounted engine with second axle powered.*~~

Rear engine with third axle powered.

~~*Rear engine with second axle powered.*~~

~~*Engine immaterial, with hydrostatic or electric transmission.*~~



APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer HEULIEZ-BUS

B. Bus Model Number 0 305 G

C. Dimensions

1. Overall Length 17,335 M. ______ Ft. ______ In.
2. Overall Width 2,5 M. ______ Ft. ______ In.
3. a. Overall Height (maximum) 2,984 M. ______ In.
   b. Height (main roof line) 2,155 M. ______ In.
4. Angle of Approach 8 Deg.
5. a. Breakover Angle Tractor ______ Deg.
   b. Breakover Angle Trailer 46 Deg.
6. Angle of Departure ______ Deg.
7. Articulation Angles
   a. Horizontal ± 45 Deg.
   b. Vertical ± 10 Deg.

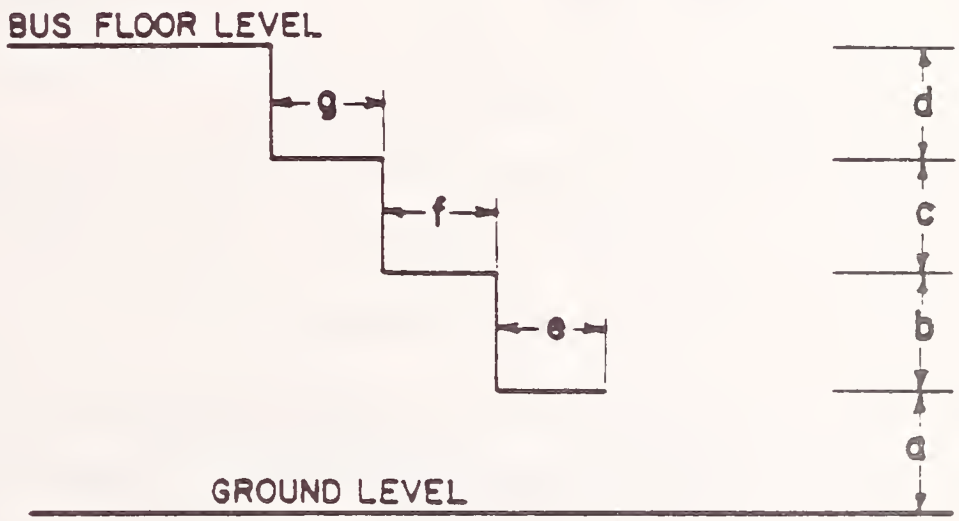
S.A. LOUIS HEULIEZ - MODEL O 305 G

FRANCE

8. Doorway Clear Opening (Including grab handles)

a. Front	Width	1,29	M.	In.
	Height	2,02	M.	In.
b. Center (if provided)	Width	1,29	M.	In.
	Height	2,02	M.	In.
c. Rear	Width	1,29	M.	In.
	Height	2,02	M.	In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	339 mm.	in.	339 mm.	in.	339 mm.	in.
Kneeling bus	339 mm.	in.	339 mm.	in.	339 mm.	in.
b.	195 mm.	in.	205 mm.	in.	205 mm.	in.
c.	195 mm.	in.	185 mm.	in.	185 mm.	in.
d.	mm.	in.	mm.	in.	mm.	in.
e.	40 mm.	in.	30 mm.	in.	30 mm.	in.
f.	38 mm.	in.	34 mm.	in.	34 mm.	in.
g.	mm.	in.	mm.	in.	mm.	in.

10. Interior Head Room (center of aisle)

a. Front Axle Location 214 mm. ________ in.

b. Drive Axle Location 210 mm. ________ in.

c. Trailer Axle Location 198 mm. ________ in.

11. Aisle Width

Between Transverse Seats (minimum) 540 mm. ________ in.

12. Floor Height Above Ground (at each door)

a. Front Door 729 mm. ________ in.

b. Center Door (if provided) 729 mm. ________ in.

c. Rear Door 729 mm. ________ in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

11,25 M. ________ Ft. ________ In.

b. Inside Turning Radius

4,70 M. ________ Ft. ________ In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

8 M. ________ Ft. ________ In.

14. Wheel Bases

a. Tractor 5,6 M. ________ Ft. ________ In.

b. Trailer 6,15 M. ________ Ft. ________ In.

c. Total 11,75 M. ________ Ft. ________ In.

15. Seats

a. Total Number of Seats ________

b. Minimum Knee to Hip Room 700 mm

c. Minimum Foot Room 0,125 m2

D. Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	____ Kg.	____ Lbs.	____ Kg.	____ Lbs.
2. On Center Axle	____ Kg.	____ Lbs.	____ Kg.	____ Lbs.
3. On Rear Axle	____ Kg.	____ Lbs.	____ Kg.	____ Lbs.
4. TOTAL	12 900 Kg.	____ Lbs.	25 300 Kg.	____ Lbs.

E. Main Engine

1. Manufacturer MERCEDES - DAIMLER-BENZ
2. Type OM 407 H 3. Model DIESEL
4. Net S.A.E. Horsepower 240 HP at 2200 RPM
5. Turbo Charge, Make & Type ____
6. Maximum Vehicle Speed 71 KPH ____ MPH

F. Transmission

1. Manufacturer DAIMLER-BENZ
2. Type ____ 3. Model W 3 D 080 R 4. Speeds 3
5. Retarder, Make, Type, and Size DAIMLER-BENZ

G. Axle, Front

1. Manufacturer DAIMLER-BENZ
2. Type V04/11DL 3. Model ____ 4. GAWR 6200 Kg. ____ Lbs.

H. Axle, Center Drive

1. Manufacturer DAIMLER-BENZ
2. Type NR7/4DL 10 3. Model ____ 4. GAWR 9500 Kg. ____ Lbs.

J. Axle, Rear

1. Manufacturer DAIMLER-BENZ
2. Type H07/8DL 10 3. Model ____ 4. GAWR 10500 Kg. ____ Lbs.

K. Suspension

Air ________ Steel Spring ________ Torsion Bar ________

L. Brakes

1. Make DAIMLER-BENZ Type DI 2 Kreis

M. Interior Lighting

1. Type Fluorescent

2. Number of Fixtures 7

N. Tires

1. Manufacturer ________

2. Size Front : 11 00 R 22.5 Rear : 11 00 R 22.5

3. Type ________

O. Air Conditioning

1. Make ________ 2. Model ________ 3. Capacity ________

P. Kneeling Feature Available Yes ____ No X

Q. Wheelchair Lift Available Yes ____ No X

R. Vehicle available as Electric Trolley Bus? Yes X No ____

1. Model ________

2. Auxiliary Thermal Power Plant? Yes X No ____ KW ____

MANUFACTURERS PROFILE

A. FIRM LEX VEHICLE ENGINEERING LTD

B. ADDRESS RINGWOOD ROAD, TOTTON, SOUTHAMPTON, HANTS SO4 3EA

C. TELEPHONE 0703 862137

D. TELEX 477756 LEXTIL G E. CABLE -

F. OTHER MANUFACTURING SITES None

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 25 years

H. BRIEF DESCRIPTION OF PRODUCT LINE Three ranges - MAXETA - Bus Range, HAMPSHIRE - Specialist Vehicle Bodies, TRANSTECH - Special Containers and Cabins

I. PRODUCTIVE CAPACITY 130 BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES ____ NO ____ UNKNOWN X

K. COMPLIANCE WITH NOISE STANDARDS

YES ____ NO ____ UNKNOWN X

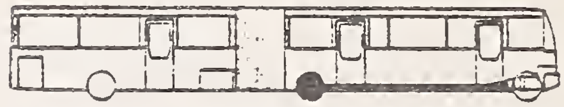
L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

YES ____ NO ____ UNKNOWN X

M. VEHICLE TYPE

Front end horizontal under floor axial engine with the second axle powered.

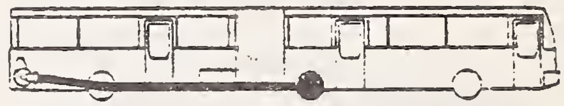
Vertical front engine with second axle powered.



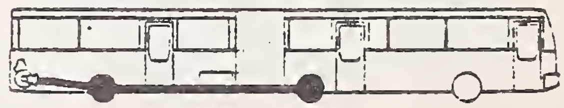
Side mounted engine with second axle powered.

Rear engine with third axle powered.

Rear engine with second axle powered.



Engine immaterial, with hydrostatic or electric transmission.



APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer Mercedes Benz or DAF

B. Bus Model Number 0305G

C. Dimensions

1. Overall Length 17.335 M. 56' Ft. 10½' In.
2. Overall Width 2.500 M. 8' Ft. 2½ In.
3. a. Overall Height (maximum) 3.048 M. 120" In.
   b. Height (main roof line) 2.172 M. 85½ In.
4. Angle of Approach 7½ Deg.
5. a. Breakover Angle Tractor ____ Deg.
   b. Breakover Angle Trailer ____ Deg.
6. Angle of Departure 8½ Deg.
7. Articulation Angles
   a. Horizontal 47.2 Deg.
   b. Vertical ____ Deg.

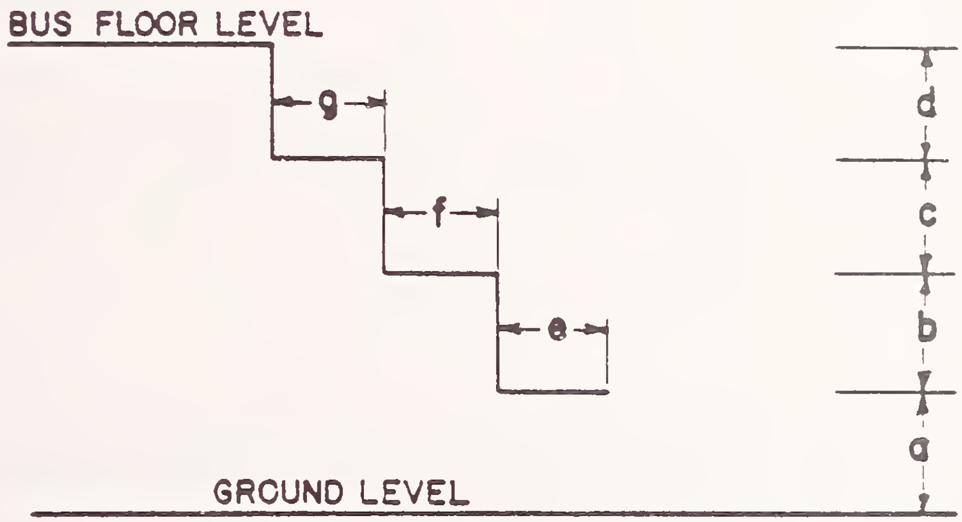
LEX VEHICLES ENGINEERING, LTD. - MODEL O 305 G

ENGLAND

8. Doorway Clear Opening (Including grab handles)

a.	Front	Width	1200	M.	47.2	In.
		Height	2030	M.	80	In.
b.	Center (if provided)	Width	1200	M.	47.2	In.
		Height	2030	M.	80	In.
c.	Rear	Width	1200	M.	47.2	In.
		Height	2030	M.	80	In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	339 mm.	13.3 in.	339 mm.	13.3 in.	339 mm.	13.3 in.
Kneeling bus	mm.	in.	mm.	in.	mm.	in.
b.	195 mm.	7.7 in.	195 mm.	7.7 in.	195 mm.	7.7 in.
c.	195 mm.	in.	mm.	in.	mm.	in.
d.	mm.	in.	mm.	in.	mm.	in.
e.	420 mm.	16.5 in.	340 mm.	13.4 in.	340 mm.	13.4 in.
f.	420 mm.	16.5 in.	340 mm.	13.4 in.	340 mm.	13.4 in.
g.	mm.	in.	mm.	in.	mm.	in.

10. Interior Head Room (center of aisle)

a. Front Axle Location 2172 mm. 85.5 in.

Centre b. Drive Axle Location 2147 mm. 84.5 in.

Drive c. Trailer Axle Location 2032 mm. 80 in.

11. Aisle Width

Between Transverse Seats (minimum) 600 mm. 23.6 in.

12. Floor Height Above Ground (at each door)

a. Front Door 729 mm. 28.7 in.

b. Center Door (if provided) 729 mm. 28.7 in.

c. Rear Door 729 mm. 28.7 in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

22.5 M. 73 Ft. 10 In.

b. Inside Turning Radius

______ M. ______ Ft. ______ In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

______ M. ______ Ft. ______ In.

14. Wheel Bases

a. Tractor 5.6 M. 18 Ft. 4.5 In.

b. Trailer 6.15 M. 20 Ft. 2 In.

c. Total 11.75 M. 3.8 Ft. 6.5 In.

15. Seats

a. Total Number of Seats 67

b. Minimum Knee to Hip Room 24 in.

c. Minimum Foot Room 9 in.

D. Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	____ Kg.	____ Lbs.	6305 Kg.	13888 Lbs.
2. On Center Axle	____ Kg.	____ Lbs.	9661 Kg.	21280 Lbs.
3. On Rear Axle	____ Kg.	____ Lbs.	10170 Kg.	22400 Lbs.
4. TOTAL	____ Kg.	____ Lbs.	25729 Kg.	56672 Lbs.

E. Main Engine

1. Manufacturer Mercedes Benz
2. Type 6 cyl. in line Diesel 3. Model OM 407 H
4. Net S.A.E. Horsepower 240 HP at 2200 RPM
5. Turbo Charge, Make & Type ____
6. Maximum Vehicle Speed 70 KPH 44 MPH

F. Transmission

1. Manufacturer Mercedes Benz
2. Type Automatic 3. Model W3D08/R 4. Speeds 3
5. Retarder, Make, Type, and Size Integrated with Service Brake

G. Axle, Front

1. Manufacturer ____
2. Type Rigid Knuckle Yoke 3. Model V04/11-DL-7 4. GAWR ____ Kg. ____ Lbs.

H. Axle, Center Drive

1. Manufacturer ____
2. Type Tubular 3. Model NR7/4DL-10 4. GAWR ____ Kg. ____ Lbs.

J. Axle, Rear Drive

1. Manufacturer ____
2. Type Planetary Gear Hub Reduction. 3. Model HO7/8DL-10 4. GAWR ____ Kg. ____ Lbs.

K. Suspension

Air X Steel Spring ______ Torsion Bar ______

L. Brakes

1. Make ______ Type
Service Brake - Dual Circuit Comp.Air
Parking Brake - Spring Actuated
Auxiliary Brake - MB Retarder/Exhaust Brake
Bus Stop Brake on Central Axle

M. Interior Lighting

1. Type Fluorescent

2. Number of Fixtures 12

N. Tires

1. Manufacturer ______

2. Size 11.00 x 22.5

3. Type Tubeless

O. Air Conditioning

1. Make ______ 2. Model ______ 3. Capacity ______

P. Kneeling Feature Available Yes ___ No X

Q. Wheelchair Lift Available Yes X No ___

R. Vehicle available as Electric Trolley Bus? Yes X No ___

1. Model ______

2. Auxiliary Thermal Power Plant? Yes ___ No ___ KW ___

MANUFACTURERS PROFILE

A. FIRM LEYLAND BUS

B. ADDRESS LEYLAND VEHICLES LTD
LEYLAND
PRESTON PR5 1SN ENGLAND

C. TELEPHONE LEYLAND 21400

D. TELEX 67515 E. CABLE ______

F. OTHER MANUFACTURING SITES LEYLAND - DAB SILKEBORG DENMARK
C H ROE LEEDS - LEYLAND NATIONAL WORKINGTON ENGLAND

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 80

H. BRIEF DESCRIPTION OF PRODUCT LINE DOUBLE & SINGLE DECK BUSES AND CHASSIS FOR URBAN, INTER-URBAN AND TOURING

I. PRODUCTIVE CAPACITY 5000 BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS
YES ______ NO ______ UNKNOWN ✓

K. COMPLIANCE WITH NOISE STANDARDS
YES ______ NO ______ UNKNOWN ✓

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS
YES ______ NO ______ UNKNOWN ✓

M. VEHICLE TYPE

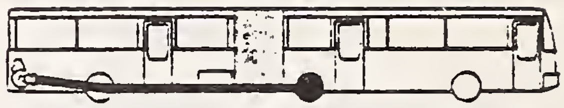
✓ *Front end horizontal under floor axial engine with the second axle powered.*

Vertical front engine with second axle powered.

Side mounted engine with second axle powered.

Rear engine with third axle powered.

Rear engine with second axle powered.



Engine immaterial, with hydrostatic or electric transmission.

APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer LEYLAND BUS

B. Bus Model Number ARTIC

C. Dimensions

1. Overall Length 17.355 M. 56 Ft. 11 In.
2. Overall Width 2.5 M. 8 Ft. 2½ In.
3. a. Overall Height (maximum) 3.2 M. 126 In.
   b. Height (main roof line) 3.2 M. 126 In.
4. Angle of Approach 8 Deg.
5. a. Breakover Angle Tractor 6 Deg.
   b. Breakover Angle Trailer 5 Deg.
6. Angle of Departure 8 Deg.
7. Articulation Angles
   a. Horizontal 45 Deg.
   b. Vertical 10 Deg.

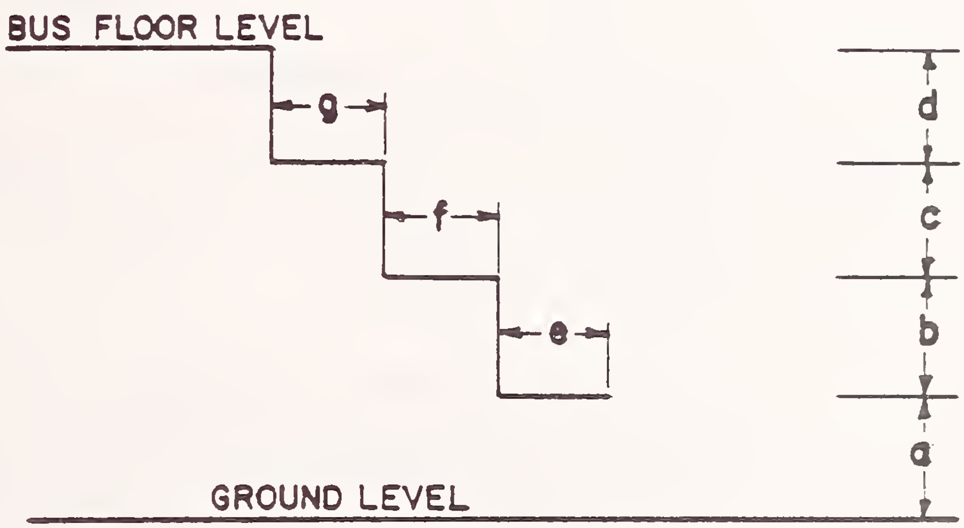
LEYLAND VEHICLES, LTD. - MODEL DAB

ENGLAND

8. Doorway Clear Opening (Including grab handles)

a.	Front	Width	1.2 M.	47.2 In.
		Height	1.96 M.	77.2 In.
b.	Center (if provided)	Width	1.2 M.	47.2 In.
		Height	2.04 M.	80.3 In.
c.	Rear	Width	1.2 M.	47.2 In.
		Height	2.04 M.	80.3 In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	383 mm.	15.1 in.	303 mm.	11.9 in.	303 mm.	11.9 in.
Kneeling bus	- mm.	- in.	- mm.	- in.	- mm.	- in.
b.	212 mm.	8.3 in.	205 mm.	8.1 in.	205 mm.	8.1 in.
c.	212 mm.	8.3 in.	205 mm.	8.1 in.	205 mm.	8.1 in.
d.	- mm.	- in.	205 mm.	8.1 in.	205 mm.	8.1 in.
e.	320 mm.	12.6 in.	325 mm.	12.8 in.	325 mm.	12.8 in.
f.	300 mm.	11.8 in.	275 mm.	10.8 in.	275 mm.	10.8 in.
g.	- mm.	- in.	215 mm.	8.5 in.	215 mm.	8.5 in.

10. Interior Head Room (center of aisle)

a. Front Axle Location 2100 mm. 82.7 in.

b. Drive Axle Location 2060 mm. 81.1 in.

c. Trailer Axle Location 2060 mm. 81.1 in.

11. Aisle Width

Between Transverse Seats (minimum) 500 mm. 19.6 in.

12. Floor Height Above Ground (at each door)

a. Front Door 804 mm. 31.7 in.

b. Center Door (if provided) 914 mm. 36 in.

c. Rear Door 914 mm. 36 in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

12 M. 39 Ft. 4 In.

b. Inside Turning Radius

5.5 M. 18 Ft. 0.5 In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

0.8 M. 2 Ft. 7.5 In.

14. Wheel Bases

a. Tractor	5.9 M.	19 Ft.	4 In.
b. Trailer	6.98 M.	22 Ft.	11 In.
c. Total	12.88 M.	42 Ft.	3 In.

15. Seats

a. Total Number of Seats ______

b. Minimum Knee to Hip Room ______

c. Minimum Foot Room ______

DEPENDANT ON CUSTOMER REQUIREMENT

D. Weight of Bus

	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	5100 Kg.	11244 Lbs.	7100 Kg.	15653 Lbs.
2. On Center Axle	5800 Kg.	12787 Lbs.	11000 Kg.	24251 Lbs.
3. On Rear Axle	3600 Kg.	7937 Lbs.	7100 Kg.	15653 Lbs.
4. TOTAL	14500 Kg.	31968 Lbs.	24000 Kg.	52910 Lbs.

E. Main Engine

1. Manufacturer LEYLAND VEHICLES
2. Type 6 CYL DIESEL 3. Model TL11H
4. Net S.A.E. Horsepower 218 HP at 2100 RPM
5. Turbo Charge, Make & Type GARRETT AIRESEARCH
6. Maximum Vehicle Speed 86 KPH 53.5 MPH

F. Transmission

1. Manufacturer LEYLAND VEHICLES
2. Type FLUID FLYWHEEL 3. Model HYDRACYCLIC 4. Speeds 5
5. Retarder, Make, Type, and Size INTEGRAL

G. Axle, Front

1. Manufacturer LEYLAND VEHICLES
2. Type I BEAM 3. Model ______ 4. GAWR 7100 Kg. 15653 Lbs.

H. Axle, Center Drive

1. Manufacturer LEYLAND - EATON
2. Type SPIRAL BEVEL 3. Model 19128 4. GAWR 11,000 Kg. 24251 Lbs.

J. Axle, Rear

1. Manufacturer LEYLAND VEHICLES
2. Type I BEAM 3. Model ______ 4. GAWR 7100 Kg. 15653 Lbs.

K. Suspension

Air ✓ Steel Spring ______ Torsion Bar ______

L. Brakes

1. Make LEYLAND Type AIR ACTUATED 'S' CAM

M. Interior Lighting

1. Type DIFFUSED FLUORESCENT TUBE

2. Number of Fixtures 7 CENTRALLY MOUNTED

N. Tires

1. Manufacturer TO CUSTOMER REQUIREMENT

2. Size 11R x 22.5 12R x 22.5

3. Type RADIAL

O. Air Conditioning

1. Make DEPENDANT ON CAPACITY REQUIREMENT 2. Model ______ 3. Capacity ______

P. Kneeling Feature Available Yes ____ No ✓

Q. Wheelchair Lift Available Yes ____ No ✓

R. Vehicle available as Electric Trolley Bus? Yes ____ No ✓

1. Model ______

2. Auxiliary Thermal Power Plant? Yes ____ No ____ KW ____

MANUFACTURERS PROFILE

A. FIRM MAGIRUS - IVECO CORP. (BUS DIVISION)

B. ADDRESS Hauptstrasse 17 - 19
6500 Mainz - Mombach

C. TELEPHONE 6131 696 271 or 696 456 or 6961

D. TELEX 4187851 A MAD D E. CABLE Cable

F. OTHER MANUFACTURING SITES Italy - France - Greece

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES Since 1948

H. BRIEF DESCRIPTION OF PRODUCT LINE Buses and Coaches for 12 - 170 Persons, Trucks From 1.5 to GVWR

I. PRODUCTIVE CAPACITY 5,000 per year BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS
YES x NO ___ UNKNOWN ___

K. COMPLIANCE WITH NOISE STANDARDS
YES x NO ___ UNKNOWN ___

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS
YES ___ NO ___ UNKNOWN x

M. VEHICLE TYPE

Front end horizontal under floor axial engine with the second axle powered.

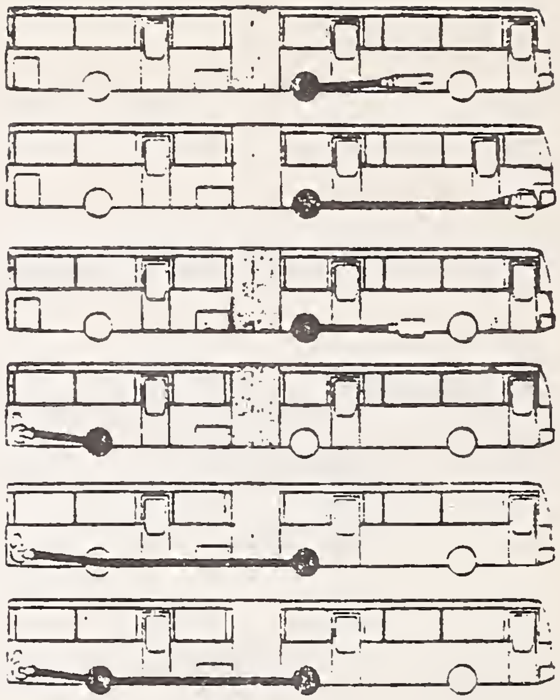
Vertical front engine with second axle powered.

Side mounted engine with second axle powered.

Rear engine with third axle powered.

(x) *Rear engine with second axle powered.*

Engine immaterial, with hydrostatic or electric transmission.



APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer MAGIRUS IVEGO

B. Bus Model Number ____________

C. Dimensions

1. Overall Length 16.7 M. ______ Ft. ______ In.
2. Overall Width 2.5 M. ______ Ft. ______ In.
3. a. Overall Height (maximum) 3.20 M. ______ In.
   b. Height (main roof line) 2.95 M. ______ In.
4. Angle of Approach 9 Deg.
5. a. Breakover Angle Tractor 6 Deg. 30′
   b. Breakover Angle Trailer 5 Deg. 30′
6. Angle of Departure 13 Deg.
7. Articulation Angles
   a. Horizontal 43 Deg.
   b. Vertical 10 Deg.

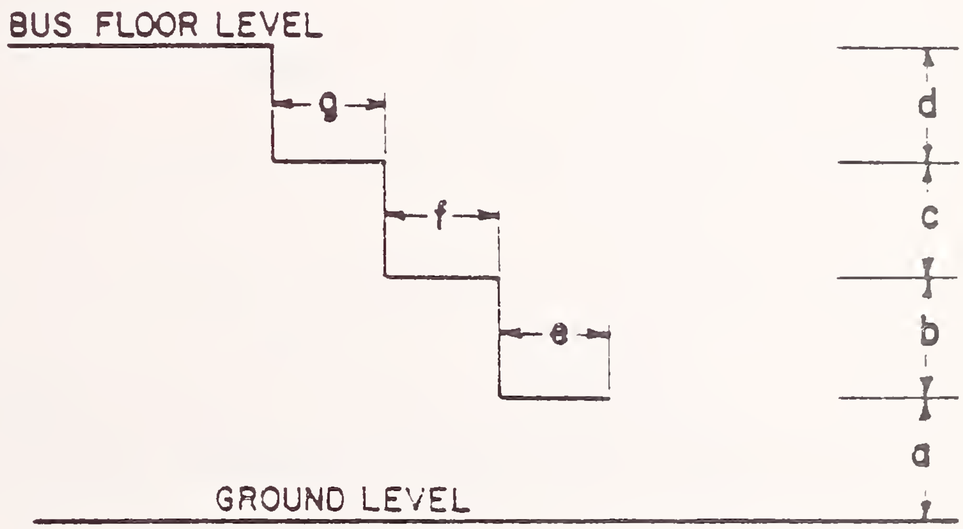
MAGIRUS-DEUTZ A.G. - MODEL SH170

W. GERMANY

8. Doorway Clear Opening (Including grab handles)

a. Front	Width	1.22	M.	____ In.
	Height	2.09	M.	____ In.
b. Center (if provided)	Width	1.22	M.	____ In.
	Height	2.09	M.	____ In.
c. Rear	Width	1.22	M.	____ In.
	Height	2.09	M.	____ In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	325 mm.	____ in.	325 mm.	____ in.	325 mm.	____ in.
Kneeling bus	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.
b.	200 mm.	____ in.	200 mm.	____ in.	225 mm.	____ in.
c.	200 mm.	____ in.	200 mm.	____ in.	225 mm.	____ in.
d.	[illegible] mm.	____ in.	[illegible] mm.	____ in.	[illegible] mm.	____ in.
e.	400 mm.	____ in.	315 mm.	____ in.	315 mm.	____ in.
f.	700 mm.	____ in.	310 mm.	____ in.	310 mm.	____ in.
g.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.

10. Interior Head Room (center of aisle)

a. Front Axle Location 2100 mm. ________ in.

b. Drive Axle Location 2100 mm. ________ in.

c. Trailer Axle Location 2050 mm. ________ in.

11. Aisle Width

Between Transverse Seats (minimum) 530 mm. ________ in.

12. Floor Height Above Ground (at each door)

a. Front Door 740 mm. ________ in.

b. Center Door (if provided) 740 mm. ________ in.

c. Rear Door 795 mm. ________ in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

10.90 M. ________ Ft. ________ In.

b. Inside Turning Radius

4.42 M. ________ Ft. ________ In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

7.77 M. ________ Ft. ________ In.

14. Wheel Bases

a. Tractor 5.600 M. ________ Ft. ________ In.

b. Trailer 6.355 M. ________ Ft. ________ In.

c. Total 11.955 M. ________ Ft. ________ In.

15. Seats

a. Total Number of Seats 63

b. Minimum Knee to Hip Room 680 mm

c. Minimum Foot Room 300 mm

D. Weight of Bus

	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	6.000 Kg.	____ Lbs.	____ Kg.	____ Lbs.
2. On Center Axle	10.500 Kg.	____ Lbs.	____ Kg.	____ Lbs.
3. On Rear Axle	8.200 Kg.	____ Lbs.	____ Kg.	____ Lbs.
4. TOTAL	24.700 Kg.	____ Lbs.	____ Kg.	____ Lbs.

E. Main Engine

1. Manufacturer KEOECKNER HUMBOLDT DEUTZ
2. Type 7 Cylinder V 3. Model BF 8 L 413 F
4. Net S.A.E. Horsepower 310 HP
at 2150 RPM
5. Turbo Charge, Make & Type KSB K 27/3060 G 13.11
6. Maximum Vehicle Speed 88 KPH 55 MPH

F. Transmission

1. Manufacturer VOITH
2. Type Automatic 3. Model DIWA 854 4. Speeds 4
5. Retarder, Make, Type, and Size Integrated - Voith

G. Axle, Front

1. Manufacturer MAGIRUS
2. Type ____ 3. Model ____ 4. GAWR 6.000 Kg. ____ Lbs.

H. Axle, Center Drive

1. Manufacturer MAGIRUS
2. Type ____ 3. Model ____ 4. GAWR 10.500 Kg. ____ Lbs.

J. Axle, Rear

1. Manufacturer MAGIRUS
2. Type ____ 3. Model ____ 4. GAWR 8.200 Kg. ____ Lbs.

K. Suspension

Air Torsion Bar Steel Spring ________ Torsion Bar ________

L. Brakes

1. Make Rockwell Type RD 1570 - M 1/M 2

M. Interior Lighting

1. Type On Request

2. Number of Fixtures On Request

N. Tires

1. Manufacturer MICHELIN AND OTHERS

2. Size 11 R 22.5 315/75 R 22.5

3. Type Radial

O. Air Conditioning

1. Make KONVEKTA 2. Model KL 10 3. Capacity 40.000 KCAL/H

P. Kneeling Feature Available Yes x No ____

Q. Wheelchair Lift Available Yes x No ____

R. Vehicle available as Electric Trolley Bus? Yes ____ No x

1. Model ________

2. Auxiliary Thermal Power Plant? Yes ____ No ____ KW ____

MANUFACTURERS PROFILE

A. FIRM M.A.N. TRUCK & BUS CORPORATION

B. ADDRESS 3000 TOWN CENTER
SOUTHFIELD, MICHIGAN 48075

C. TELEPHONE (313) 352-7850

D. TELEX 234249 MAN SOFD E. CABLE

F. OTHER MANUFACTURING SITES CLEVELAND, NORTH CAROLINA

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES N/A

H. BRIEF DESCRIPTION OF PRODUCT LINE Responsible for marketing, sales, engineering, manufacturing, assembly and supply of M.A.N. articulated buses, including product support, technical assistance, service and supply of spare parts.

I. PRODUCTIVE CAPACITY Approximately 390 BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES X NO ____ UNKNOWN ____

K. COMPLIANCE WITH NOISE STANDARDS

YES X NO ____ UNKNOWN ____

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

YES X NO ____ UNKNOWN ____

M. VEHICLE TYPE

XXX *Front end horizontal under floor axial engine with the second axle powered.*

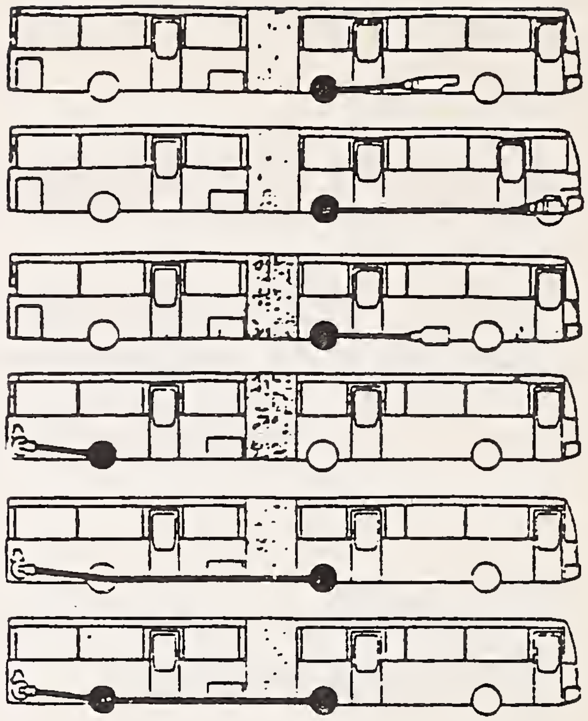
Vertical front engine with second axle powered.

Side mounted engine with second axle powered.

Rear engine with third axle powered.

Rear engine with second axle powered.

Engine immaterial, with hydrostatic or electric transmission.



APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer M.A.N. TRUCK & BUS CORPORATION

B. Bus Model Number SG220-16.5

C. Dimensions

1.	Overall Length	18251.46	M.	59	Ft.	10.56	In.
2.	Overall Width	2578.10	M.	N/A	Ft.	101.5	In.
3.	a. Overall Height (maximum)			3175	M.	125	In.
	b. Height (main roof line)			-	M.	-	In.
4.	Angle of Approach					8	Deg.
5.	a. Breakover Angle Tractor					8	Deg.
	b. Breakover Angle Trailer					N/A	Deg.
6.	Angle of Departure					8	Deg.
7.	Articulation Angles						
	a. Horizontal					Approx.32	Deg.
	b. Vertical (Maximum)					10	Deg.

M.A.N. TRUCK AND BUS CORP. - MODEL SG 220

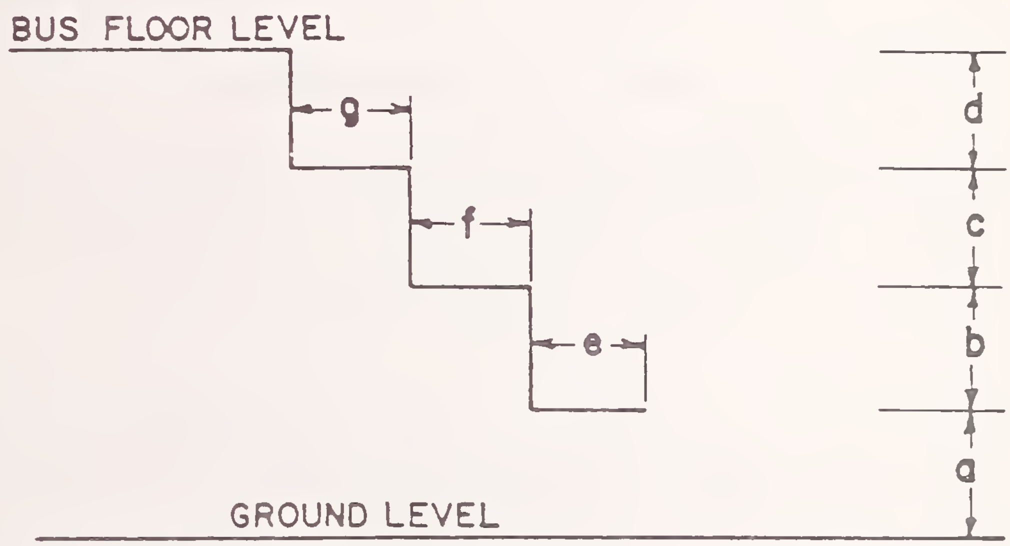
USA

M.A.N. TRUCK AND BUS CORP. - MODEL SG 220
USA

8. Doorway Clear Opening (Including grab handles)

a. Front	Width	1249.68 M.	49.2	In.
	Height	2032 M.	80	In.
b. Center (if provided)	Width	1249.68 M.	49.2	In.
	Height	2032 M.	80	In.
c. Rear	Width	1249.68 M.	49.2	In.
	Height	2032 M.	80	In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	mm.	14.45 in.	mm.	14.45 in.	mm.	14.45 in.
Kneeling bus	mm.	12.80 in.	mm.	12.80 in.	mm.	12.80 in.
b.	mm.	7.7 in.	mm.	7.7 in.	mm.	7.9 in.
c.	mm.	7.7 in.	mm.	7.7 in.	mm.	7.9 in.
d.	mm.	7.7 in.	mm.	7.7 in.	mm.	7.9 in.
e.	mm.	10.7 in.	mm.	10.7 in.	mm.	12.0 in.
f.	mm.	10.5 in.	mm.	10.5 in.	mm.	12.0 in.
g.	mm.	10.5 in.	mm.	10.5 in.	mm.	12.0 in.

10. Interior Head Room (center of aisle)

a. Front Axle Location 1981.2 mm. 78.0 in.

b. Drive Axle Location 1981.2 mm. 78.0 in.

c. Trailer Axle Location 1981.2 mm. 78.0 in.

11. Aisle Width

Between Transverse Seats (minimum) 584.2 mm. 23.0 in.

12. Floor Height Above Ground (at each door)

a. Front Door ______ mm. 35.8 in.

b. Center Door (if provided) ______ mm. - in.

c. Rear Door ______ mm. 36.5 in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

- M. 41.41 Ft. - In.

b. Inside Turning Radius

- M. 22.2 Ft. - In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

- M. - Ft. 28.3 In.

14. Wheel Bases

a. Tractor - M. - Ft. 222.437 In.

b. Trailer - M. - Ft. 255.5 In.

c. Total - M. - Ft. 447.937 In.

15. Seats

a. Total Number of Seats 65+Driver

b. Minimum Knee to Hip Room 29 in. tractor; 27 in. trailer

c. Minimum Foot Room -

D. Weight of Bus

Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	- Kg.	11620 Lbs.	- Kg.	14690 Lbs.
2. On Center Axle	- Kg.	14920 Lbs.	- Kg.	22670 Lbs.
3. On Rear Axle	- Kg.	11260 Lbs.	- Kg.	15290 Lbs.
4. TOTAL	- Kg.	37800 Lbs.	- Kg.	52650 Lbs.

E. Main Engine

1. Manufacturer M.A.N. AG
2. Type In line - turbocharged/ Intercooled 3. Model D2566 MLUM/US
4. Net ~~SXXXEX~~ D.I.N. Horsepower 305 HP at 2200 RPM
5. Turbo Charge, Make & Type KKK 4LGZ 352C 30.22
6. Maximum Vehicle Speed Full Load ______ KPH 2200 MPH

F. Transmission

1. Manufacturer Renk AG
2. Type Doromat 3. Model D874A 4. Speeds 5(4F/1R)
5. Retarder, Make, Type, and Size Renk

G. Axle, Front

1. Manufacturer M.A.N. AG
2. Type Independent 3. Model V-7 70SL 4. GAWR - Kg. 16534 Lbs.

H. Axle, Center Drive

1. Manufacturer M.A.N. AG
2. Type Planetary Drive 3. Model H07-10120 4. GAWR - Kg. 24250 Lbs.

J. Axle, Rear

1. Manufacturer M.A.N. AG
2. Type Independent 3. Model HN7-70SL 4. GAWR - Kg. 16534 Lbs.

K. Suspension

Full Air XX Steel Spring - Torsion Bar -

L. Brakes

1. Make M.A.N. AG Type -

M. Interior Lighting

1. Type Luminator Fluorescent or Equal

2. Number of Fixtures 13

N. Tires

1. Manufacturer Michelin

2. Size 13/75 R 22.5

3. Type Tubeless

O. Air Conditioning

1. Make Trane 2. Model - 3. Capacity -

P. Kneeling Feature Available Yes XX No ____

Q. Wheelchair Lift Available Yes XX No ____

R. Vehicle available as Electric Trolley Bus? Yes XX No ____

1. Model N/A

2. Auxiliary Thermal Power Plant? Yes - No - KW -

The above specifications are for 16.5m/55-foot articulated bus and are subject to change without prior notice. Some of the above items may change for 18m/60-foot articulated bus. For complete information, contact M.A.N. Truck & Bus Corporation.

M.A.N. 55 FT. ARTICULATED BUS AT CHICAGO
TRANSIT AUTHORITY - PART OF A TEN
MEMBER CONSORTIUM (1976)

MANUFACTURERS PROFILE

A. FIRM Neoplan USA Corporation

B. ADDRESS 700 Gottlob Auwaerter Drive
Lamar, Colorado 81052

C. TELEPHONE (303) 336 3256

D. TELEX 00230450365 E. CABLE

F. OTHER MANUFACTURING SITES Stuttgart, Pilsting, and Berlin, Germany; and Kumasi, Ghana.

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 47

H. BRIEF DESCRIPTION OF PRODUCT LINE Transit Buses, Luxury High Deck City Liners, Articulated Buses, Skyliner Double Deckers, Airport Buses and The Litl' Bus.

I. PRODUCTIVE CAPACITY 500 BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES x NO ____ UNKNOWN ____

K. COMPLIANCE WITH NOISE STANDARDS

YES x NO ____ UNKNOWN ____

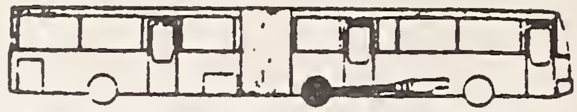
L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

YES x NO ____ UNKNOWN ____

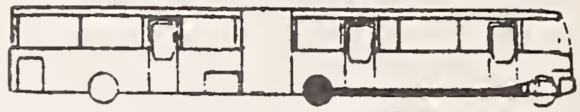
*Neoplan USA Corporation is represented by:
Rolf Ruppenthal and Associates
Neoplan USA Sales
627 South Broadway Suite B
Boulder, Colorado 80303
(303) 499 4040

M. VEHICLE TYPE

Front end horizontal under floor axial engine with the second axle powered.

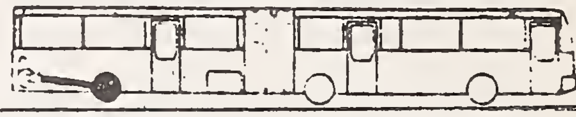


Vertical front engine with second axle powered.

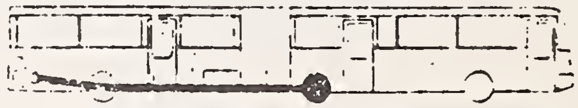


Side mounted engine with second axle powered.

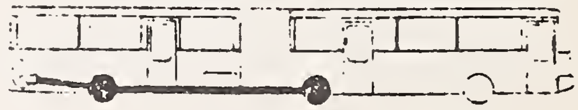
Rear engine with third axle powered.



Rear engine with second axle powered



Engine immaterial, with hydrostatic or electric transmission



APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer Neoplan USA Corporation

B. Bus Model Number N421

C. Dimensions

1.	Overall Length	______	M.	55 or 60*	Ft.	______	In.
2.	Overall Width	______	M.	______	Ft.	96-102	In.
3.	a. Overall Height (maximum)			______	M.	122	In.
	b. Height (main roof line)			______	M.	______	In.
4.	Angle of Approach					10	Deg.
5.	a. Breakover Angle Tractor					10	Deg.
	b. Breakover Angle Trailer					14	Deg.
6.	Angle of Departure					10	Deg.
7.	Articulation Angles						
	a. Horizontal					______	Deg.
	b. Vertical					______	Deg.

*All following technical information will be based on the 60' length

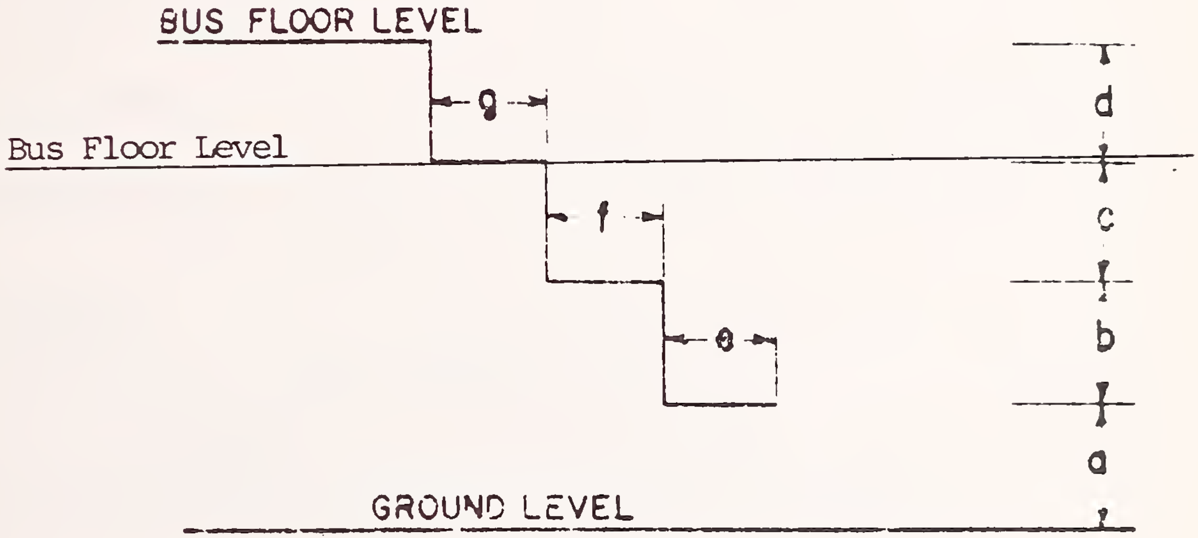
NEOPLAN - MODEL N421

USA

. Doorway Clear Opening (Including grab handles)

			M.	In.
a.	Front	Width		31.75
		Height		78.0
b.	Center (if provided)	Width		not applicable
		Height		not applicable
c.	Rear	Width		40
		Height		86.5

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door mm.	Front Door in.	Center Door mm.	Center Door in.	Rear Door mm.	Rear Door in.
a. Empty Bus		13.8	not applicable			15.5
Kneeling bus						
b.		8.7				10.6
c.		8.7				10.5
d.		not applicable				not applicable
e.		11.0				11.6
f.		11.0				11.5
g.		not applicable				not applicable

10. Interior Head Room (center of aisle)

a. Front Axle Location ________mm. 86.6 in.

b. Drive Axle Location ________mm. 83.5 in.

c. Trailer Axle Location ________mm. 79.5 in.

11. Aisle Width

Between Transverse Seats (minimum) ______mm. ______in.

12. Floor Height Above Ground (at each door)

a. Front Door ________mm. ________in.

b. Center Door (if provided) ________mm. ________in.

c. Rear Door ________mm. ________in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

________M. ________Ft. 498 In.

b. Inside Turning Radius

________M. ________Ft. ________In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

________M. ________Ft. ________In.

14. Wheel Bases

a. Tractor ________M. ________Ft. 219.2 In.

b. Trailer ________M. ________Ft. 206.6 In.

c. Total ________M. ________Ft. 425.8 In.*

15. Seats **

a. Total Number of Seats up to 74

b. Minimum Knee to Hip Room 29.1-30.7"

c. Minimum Foot Room ________

*Varies subject to specifications, another version has a 46.7" wheel base

**Subject to seat specifications

D.	Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
	1. On Front Axle	____ Kg.	____ Lbs.	____ Kg.	____ Lbs.
	2. On Center Axle	____ Kg.	____ Lbs.	____ Kg.	____ Lbs.
	3. On Rear Axle	____ Kg.	____ Lbs.	____ Kg.	____ Lbs.
	4. TOTAL	____ Kg.	40,300 Lbs.	____ Kg.	____ Lbs.

E. Main Engine

1. Manufacturer Detroit Diesel Allison

2. Type Rear Diesel 3. Model 8V-92TA

4. Net S.A.E. Horsepower 381 HP

at 2100 RPM

5. Turbo Charge, Make & Type D.D.A.

6. Maximum Vehicle Speed ____ KPH ____ MPH

F. Transmission

1. Manufacturer Detroit Diesel Allison

2. Type Automatic 3. Model HT740D 4. Speeds 4

5. Retarder, Make, Type, and Size Telma Focal 170

G. Axle, Front

1. Manufacturer Neoplan with Daimler Benz VO4 hub

2. Type independent 3. Model ____ 4. capacity ~~GVWR~~ ____ Kg. 6.5 tons ~~Lbs~~.

H. Axle, Center Drive

1. Manufacturer Daimler Benz

2. Type ____ 3. Model NR 7/4 DL-10 4. capacity ~~GVWR~~ ____ Kg. 10 tons ~~Lbs~~.

J. Axle, Rear

1. Manufacturer Daimler Benz

2. Type Hypoid with Hubreduction 3. Model Ho7 4. GVWR ____ Kg. ____ Lbs.

K. Suspension

Air __x__ Steel Spring ______ Torsion Bar ______

L. Brakes

1. Make Daimler Benz Type S Cam

M. Interior Lighting

1. Type ______
2. Number of Fixtures ______

N. Tires

1. Manufacturer Michelins are standard
2. Size 12.5 x 22.5
3. Type tubeless

O. Air Conditioning

1. Make Suetrak 2. Model ac 38 s 3. Capacity 16 tons

Heating - 240,000 BTU

P. Kneeling Feature Available Yes __x__ No ____

Q. Wheelchair Lift Available Yes __x__ No ____

R. Vehicle available as Electric Trolley Bus? Yes __x__ No ____

* 1. Model __/__

2. Auxiliary Thermal Power Plant? Yes ____ No ____ KW ____

* Subject to customer's electrical system

MANUFACTURERS PROFILE

A. FIRM Renault Vehicules Industriels

B. ADDRESS c/o Mack Trucks, Inc.
Box M - 2100 Mack Boulevard
Allentown, Pa. 18105

C. TELEPHONE 215/439-3756

D. TELEX 0847429 E. CABLE MACKWORLDWIDE ATW

F. OTHER MANUFACTURING SITES Lyon, France

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 75 years

H. BRIEF DESCRIPTION OF PRODUCT LINE Complete line of Intra-City and Inter-City buses and coaches

I. PRODUCTIVE CAPACITY Not Public BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS
YES X NO ____ UNKNOWN ____

K. COMPLIANCE WITH NOISE STANDARDS
YES X NO ____ UNKNOWN ____

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS
YES X NO ____ UNKNOWN ____

M. VEHICLE TYPE

Front end horizontal under floor axial engine with the second axle powered.

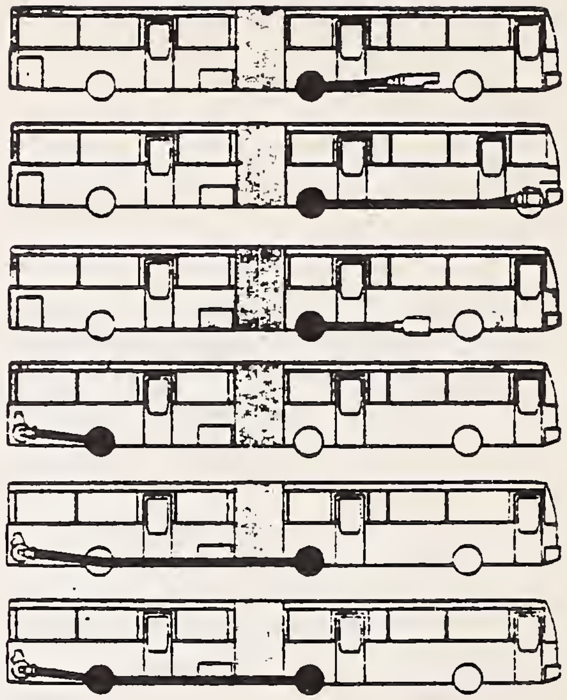
Vertical front engine with second axle powered.

Side mounted engine with second axle powered.

Rear engine with third axle powered.

Rear engine with second axle powered.

Engine immaterial, with hydrostatic or electric transmission.



Rear Engine driving both rear and middle axle - using four speed automatic transmission, and torque splitter between rear and middle axle.

APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer: Renault Vehicules Industries

B. Bus Model Number: PR 180

C. Dimensions

1.	Overall Length	17542	M.	57.66	Ft.		In.
2.	Overall Width	2500	M.		Ft.	98	In.
3.	a. Overall Height (maximum)			2890	M.	119	In.
	b. Height (main roof line)				M.		In.
4.	Angle of Approach					8	Deg.
5.	a. Breakover Angle Tractor					8	Deg.
	b. Breakover Angle Trailer					8	Deg.
6.	Angle of Departure					8	Deg.
7.	Articulation Angles						
	a. Horizontal					51	Deg.
	b. Vertical					± 7	Deg.

RENAULT VEHICLES INDUSTRIES &
MACK TRUCK, INC. - MODEL PR180

FRANCE & USA

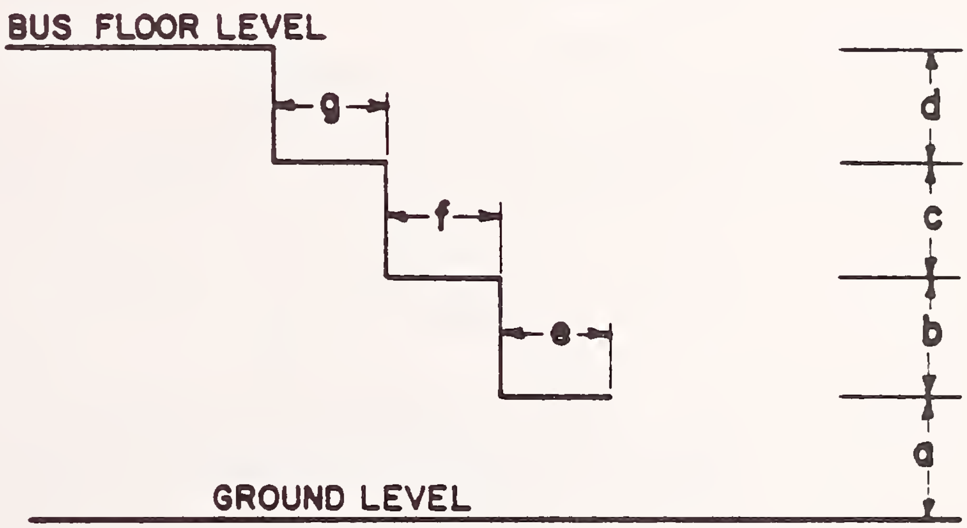
RENAULT VEHICLES INDUSTRIES &
MACK TRUCK, INC. - MODEL PR180

FRANCE & USA

8. Doorway Clear Opening (Including grab handles)

			M.	In.
a.	Front	Width		47.2
		Height	2190	86.25
b.	Center (if provided)	Width		47.2
		Height	2190	86.25
c.	Rear	Width		47.2
		Height	2190	86.25

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door mm.	Front Door in.	Center Door mm.	Center Door in.	Rear Door mm.	Rear Door in.
a. Empty Bus		14.3		14.3		14.3
~~Kneeling bus~~						
b.		5.9		5.9		5.9
c.		5.5		5.5		5.5
~~d.~~						
e. Not Given Variable Width						
f.						
g.						

10. Interior Head Room (center of aisle)

a. Front Axle Location ________ mm. 86.25 in.

b. Drive Axle Location ________ mm. 86.25 in.

c. Trailer Axle Location ________ mm. 86.25 in.

11. Aisle Width

Between Transverse Seats (minimum) Variable mm. ______ in.

12. Floor Height Above Ground (at each door)

a. Front Door ________ mm. 24.4 in.

b. Center Door (if provided) ________ mm. 24.4 in.

c. Rear Door ________ mm. 24.4 in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

________ M. 38.2 Ft. ________ In.

b. Inside Turning Radius

________ M. 15.5 Ft. ________ In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

________ M. ________ Ft. ________ In.

14. Wheel Bases

a. Tractor 5600 M. ________ Ft. 220.5 In.

b. Trailer 6270 M. ________ Ft. 246.9 In.

c. Total 11870 M. ________ Ft. 467.4 In.

15. Seats

a. Total Number of Seats 68

b. Minimum Knee to Hip Room -

c. Minimum Foot Room -

D. Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	_____Kg.	_____Lbs.	_____Kg.	_____Lbs.
2. On Center Axle	_____Kg.	_____Lbs.	_____Kg.	_____Lbs.
3. On Rear Axle	_____Kg.	_____Lbs.	_____Kg.	_____Lbs.
4. TOTAL	_____Kg.	_____Lbs.	_____Kg.	_____Lbs.

E. Main Engine

1. Manufacturer ______________________________

2. Type ____________________ 3. Model ____________________

4. Net S.A.E. Horsepower __________HP

at __________RPM

5. Turbo Charge, Make & Type ______________________________

6. Maximum Vehicle Speed _________KPH __________MPH

F. Transmission

1. Manufacturer ______________________________

2. Type ________________ 3. Model___________ 4. Speeds _____

5. Retarder, Make, Type, and Size ____________________

G. Axle, Front

1. Manufacturer ______________________________

2. Type _______ 3. Model _______ 4. GAWR ______Kg. _____Lbs.

H. Axle, Center Drive

1. Manufacturer ______________________________

2. Type _______ 3. Model _______ 4. GAWR ______Kg. _____Lbs.

J. Axle, Rear

1. Manufacturer ______________________________

2. Type _______ 3. Model _______ 4. GAWR ______Kg. _____Lbs.

K. Suspension

Air ________ Steel Spring ________ Torsion Bar ________
Combination Air Bag and Steel Spring

L. Brakes

1. Make ________ Type Drum

M. Interior Lighting

1. Type Florescent

2. Number of Fixtures Variable

N. Tires

1. Manufacturer Michelin

2. Size 11.70 x 22.5

3. Type Radial (Or Cross Ply)

O. Air Conditioning

1. Make Optional 2. Model ________ 3. Capacity ________

P. Kneeling Feature Available Yes ____ No x

Q. Wheelchair Lift Available Yes x No ____

R. Vehicle available as Electric Trolley Bus? Yes x No ____

1. Model PER 180

2. Auxiliary Thermal Power Plant? Yes X No ____ KW Variable

MANUFACTURERS PROFILE

A. FIRM SAAB-SCANIA, Scania Division

B. ADDRESS 151-87 Sodertalje, Sweden

C. TELEPHONE 0755/810 00

D. TELEX 10 200 Scania S E. CABLE ______

F. OTHER MANUFACTURING SITES Nederland, Argentina, Brazil

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 70

H. BRIEF DESCRIPTION OF PRODUCT LINE Chassis and buses for city, intercity, and long distance operation

I. PRODUCTIVE CAPACITY 2700 chassis, 220 buses BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES X NO ______ UNKNOWN ______

K. COMPLIANCE WITH NOISE STANDARDS

YES X NO ______ UNKNOWN ______

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

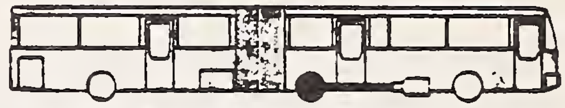
YES X NO ______ UNKNOWN ______

M. VEHICLE TYPE

Front end horizontal under floor axial engine with the second axle powered.

Vertical front engine with second axle powered.

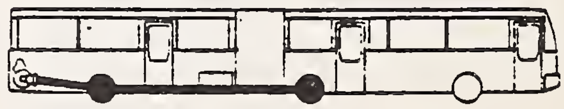
Side mounted engine with second axle powered.



Rear engine with third axle powered.

Rear engine with second axle powered.

Engine immaterial, with hydrostatic or electric transmission.



APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer SAAB-SCANIA

B. Bus Model Number 112A

C. Dimensions

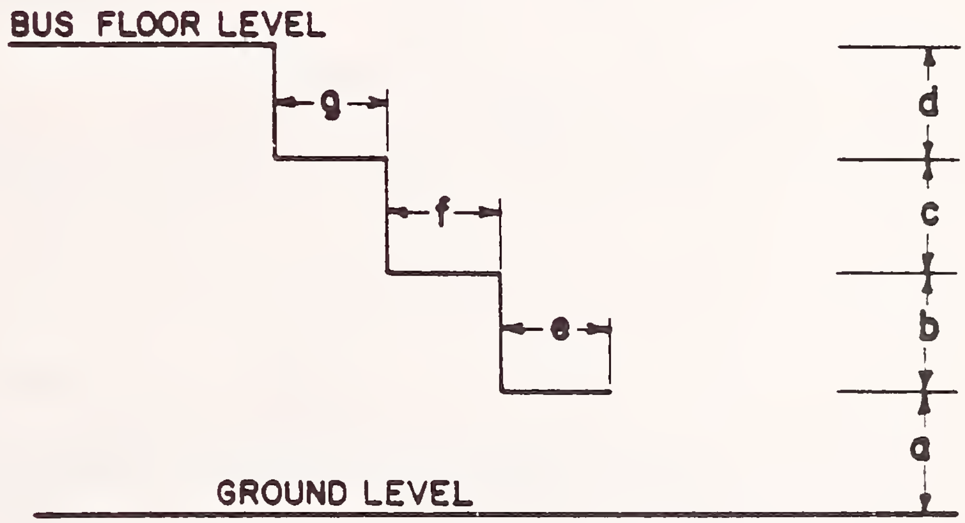
1.	Overall Length		M.	57,5	Ft.		In.
2.	Overall Width		M.		Ft.	102	In.
3.	a. Overall Height (maximum)				M.	124	In.
	b. Height (main roof line)				M.	124	In.
4.	Angle of Approach					8,3	Deg.
5.	a. Breakover Angle Tractor						Deg.
	b. Breakover Angle Trailer						Deg.
6.	Angle of Departure					7°	Deg.
7.	Articulation Angles						
	a. Horizontal						Deg.
	b. Vertical						Deg.

SAAB-SCANIA - MODEL BR 112A (CHASSIS ONLY)
SWEDEN

8. * Doorway Clear Opening (Including grab handles)

a.	Front	Width	1.2 M.		In.
		Height	2.1 M.		In.
b.	Center (if provided)	Width	1.2 M.		In.
		Height	2.1 M.		In.
c.	Rear	Width	1.2 M.		In.
		Height	2.1 M.		In.

9. * Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	350 mm.	in.	350 mm.	in.	350 mm.	in.
Kneeling bus	250 mm.	in.	mm.	in.	mm.	in.
b.	255 mm.	in.	255 mm.	in.	255 mm.	in.
c.	255 mm.	in.	255 mm.	in.	255 mm.	in.
d.	mm.	in.	mm.	in.	mm.	in.
e.	300 mm.	in.	300 mm.	in.	300 mm.	in.
f.	250 mm.	in.	250 mm.	in.	250 mm.	in.
g.	mm.	in.	mm.	in.	mm.	in.

10.* Interior Head Room (center of aisle)

a. Front Axle Location 2100 mm. ________ in.

b. Drive Axle Location 2000 mm. ________ in.

c. Trailer Axle Location 2100 mm. ________ in.

11.* Aisle Width

Between Transverse Seats (minimum) 500 mm. ______ in.

12.* Floor Height Above Ground (at each door)

a. Front Door 670-930 mm. ________ in.

b. Center Door (if provided) 670-930 mm. ________ in.

c. Rear Door 670-930 mm. ________ in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

12 M. ________ Ft. ________ In.

b. Inside Turning Radius

5.5 M. ________ Ft. ________ In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

0.25 M. ________ Ft. ________ In.

14. Wheel Bases

a. Tractor 5.000 M. ________ Ft. ________ In.

b. Trailer 6.630 M. ________ Ft. ________ In.

c. Total 11.630 M. ________ Ft. ________ In.

15. *Seats

a. Total Number of Seats 56-68

b. Minimum Knee to Hip Room Dependent on seat configuration

c. Minimum Foot Room " " " "

D. **Weight of Bus**

Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	4 100 Kg.	____ Lbs.	6 300 Kg.	____ Lbs.
2. On Center Axle	4 380 Kg.	____ Lbs.	8 300 Kg.	____ Lbs.
3. On Rear Axle	7 550 Kg.	____ Lbs.	10 000 Kg.	____ Lbs.
4. TOTAL	16 030 Kg.	____ Lbs.	24 600 Kg.	____ Lbs.

E. **Main Engine**

1. Manufacturer Scania
2. Type diesel, inline 6 cylinder 3. Model DS1104
4. Net S.A.E. Horsepower 260 HP at 2200 RPM
5. Turbo Charge, Make & Type Schwitzer 4 LG7/352
6. Maximum Vehicle Speed 107 KPH ____ MPH

F. **Transmission**

1. Manufacturer Scania
2. Type Automatic 3. Model GAV 762 4. Speeds 4
5. Retarder, Make, Type, and Size Scania hydraulic retarder integrated in gearshifting program

G. **Axle, Front**

1. Manufacturer Scania
2. Type Steering 3. Model AM 60 4. GAWR 6 500 Kg. ____ Lbs.

H. **Axle, Center Drive**

1. Manufacturer Scania
2. Type Trailing 3. Model AT 90 4. GAWR 10000 Kg. ____ Lbs.

J. **Axle, Rear**

1. Manufacturer Scania
2. Type Driving 3. Model AD 90 4. GAWR 10500 Kg. ____ Lbs.

K. <u>Suspension</u>

Air X Steel Spring ________ Torsion Bar ________

L. <u>Brakes</u>

1. Make Scania Type drum B&W

M. <u>Interior Lighting</u>

1. Type Fluorescent Tube
2. Number of Fixtures ________

N. <u>Tires</u>

1. Manufacturer Michelin Continental
2. Size 11 R 22.5 12 R 22.5
3. Type Radial

O. <u>Air Conditioning</u>

1. Make ________ 2. Model ________ 3. Capacity ________

P. Kneeling Feature Available Yes X No ____

Q. Wheelchair Lift Available Yes X No ____

R. Vehicle available as Electric Trolley Bus? Yes ____ No X

1. Model ________
2. Auxiliary Thermal Power Plant? Yes ____ No X KW ____

MANUFACTURERS PROFILE

A. FIRM STEYR-DAIMLER-PUCH AG, WERKE WIEN

B. ADDRESS Zweite Haidequerstra 3
A-1110 VIENNA
AUSTRIA

C. TELEPHONE (0222) 76 45 11

D. TELEX 131810 E. CABLE ______

F. OTHER MANUFACTURING SITES See attached information material

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES since 1906

H. BRIEF DESCRIPTION OF PRODUCT LINE See attached information material

I. PRODUCTIVE CAPACITY 1 - 2 BUSES PER ~~YEAR~~ DAY

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES ______ NO ______ UNKNOWN X

K. COMPLIANCE WITH NOISE STANDARDS

YES ______ NO ______ UNKNOWN X

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

YES ______ NO ______ UNKNOWN X

M. VEHICLE TYPE

Front end horizontal under floor axial engine with the second axle powered.

Vertical front engine with second axle powered.

Side mounted engine with second axle powered.

Rear engine with third axle powered.

Rear engine with second axle powered.

Engine immaterial, with hydrostatic or electric transmission.

APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer STEYR-DAIMLER-PUCH AG

B. Bus Model Number SG 18 HUA 250

C. Dimensions

1. Overall Length 18.135 M. ______ Ft. ______ In.
2. Overall Width 2.500 M. ______ Ft. ______ In.
3. a. Overall Height (maximum) 3.111 M. ______ In.

   b. Height (main roof line) ______ M. ______ In.
4. Angle of Approach 8 Deg.
5. a. Breakover Angle Tractor ______ Deg.

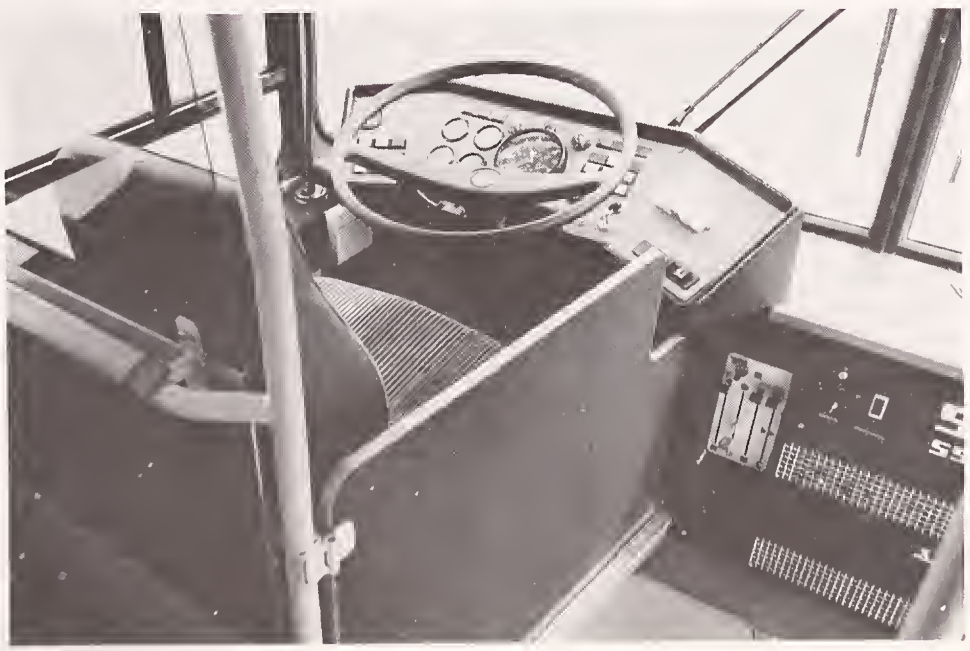
   b. Breakover Angle Trailer ______ Deg.
6. Angle of Departure 8 Deg.
7. Articulation Angles

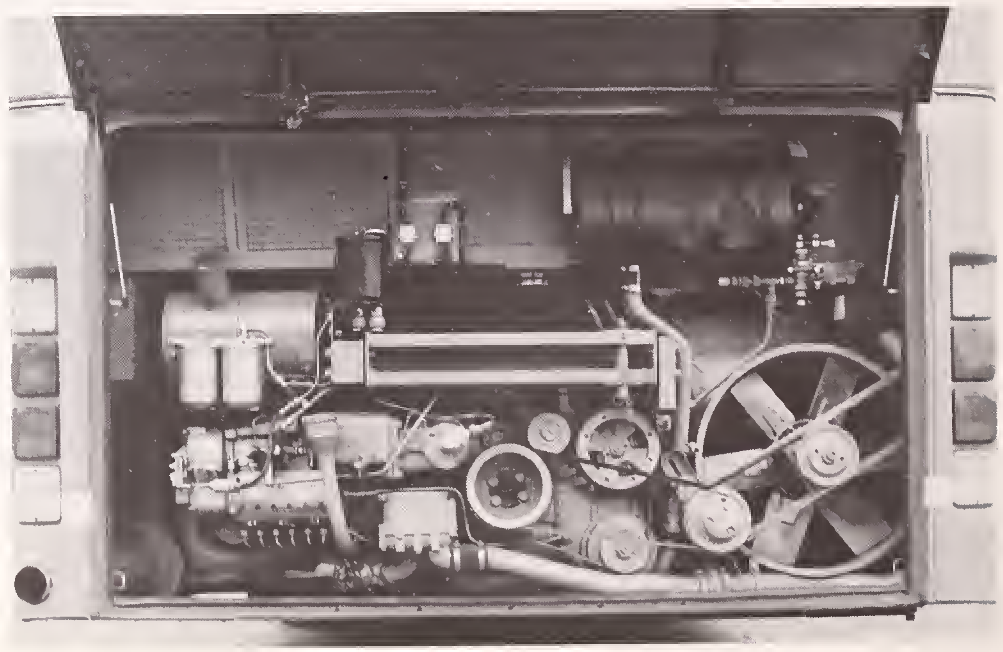
   a. Horizontal 43 Deg.

   b. Vertical 12 Deg.

STEYR-DAIMLER-PUCH A.G. - MODEL SG 18 HVA 250

AUSTRIA

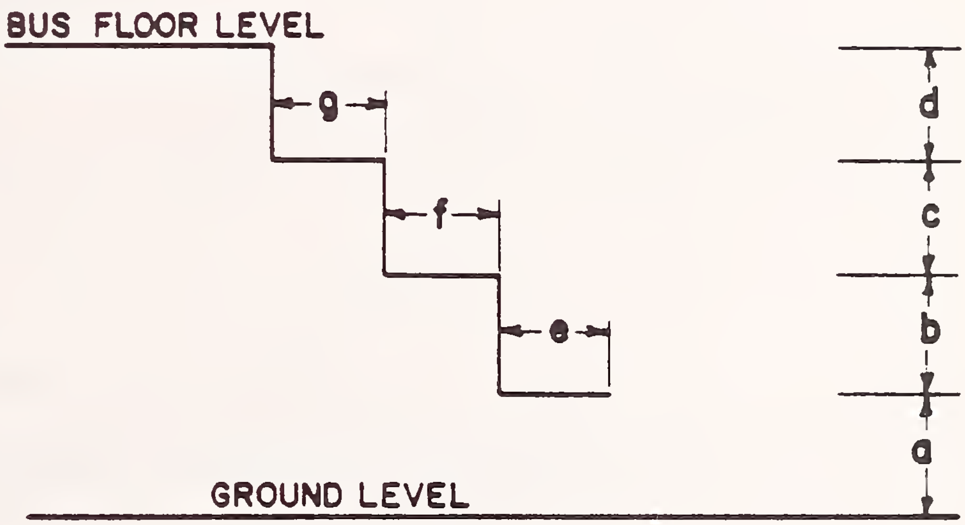




8. Doorway Clear Opening (Including grab handles)

a. Front		Width	1.250 M.	____ In.
	TRACTOR	Height	2.050 M.	____ In.
b. ~~Center~~ Rear (if provided)		Width	1.250 M.	____ In.
		Height	2.050 M.	____ In.
c. ~~Rear~~ Front		Width	1.250 M.	____ In.
	TRAILER	Height	2.050 M.	____ In.
d. Rear		Width	1.250 M	
		Height	2.050 M	

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Rear ~~Center~~ Door		Front ~~Rear~~ Door		Rear Door
a. Empty Bus	328 mm.	____ in.	328 mm.	____ in.	328 mm.	____ in.	328 mm
Kneeling bus	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.	
b.	175 mm.	____ in.	200 mm.	____ in.	200 mm.	____ in.	193 mm
c.	175 mm.	____ in.	200 mm.	____ in.	200 mm.	____ in.	194 mm
d.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.	194 mm
e.	400 mm.	____ in.	320 mm.	____ in.	320 mm.	____ in.	265 mm
f.	500 mm.	____ in.	320 mm.	____ in.	320 mm.	____ in.	265 mm
g.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.	265 mm

10. Interior Head Room (center of aisle)

a. Front Axle Location 2190 mm. ______ in.

b. Drive Axle Location 2105 mm. ______ in.

c. Trailer Axle Location 2105 mm. ______ in.

11. Aisle Width

Between Transverse Seats (minimum) 550 mm. ______ in.

12. Floor Height Above Ground (at each door)

a. Front Door 680 mm. ______ in.

b. Rear ~~Center~~ Door TRACTOR (~~if provided~~) 730 mm. ______ in.

c. Front ~~Rear~~ Door TRAILER 730 mm. ______ in.

d. Rear Door 909

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

11 M. ______ Ft. ______ In.

b. Inside Turning Radius

9.05 M. ______ Ft. ______ In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

1.30 M. ______ Ft. ______ In.

14. Wheel Bases

a. Tractor 5.810 M. ______ Ft. ______ In.

b. Trailer 6.897 M. ______ Ft. ______ In.

c. Total 12.707 M. ______ Ft. ______ In.

15. Seats

a. Total Number of Seats 48

b. Minimum Knee to Hip Room 450 mm

c. Minimum Foot Room 240 mm

d. Distance between seat backs 690 mm

D. **Weight of Bus**

Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	3,160 Kg.	____ Lbs.	6,050 Kg.	____ Lbs.
2. On Center Axle	5,000 Kg.	____ Lbs.	10,740 Kg.	____ Lbs.
3. On Rear Axle	6,200 Kg.	____ Lbs.	9,700 Kg.	____ Lbs.
4. TOTAL	14,360 Kg.	____ Lbs.	26,490 Kg.	____ Lbs.

E. **Main Engine**

1. Manufacturer STEYR-DAIMLER-PUCH AG
2. Type 9 FU A 3. Model ____________
4. ~~[illegible]~~ DIN Horsepower 250 HP at 2300 RPM
5. Turbo Charge, Make & Type Kuhnle / Kopp and Kausch
6. Maximum Vehicle Speed 75 KPH ______ MPH

F. **Transmission**

1. Manufacturer ZV or VOITH
2. Type 4 HP 500 3. Model 854 4. Speeds 4
5. Retarder, Make, Type, and Size ____________

G. **Axle, Front**

1. Manufacturer STEYR
2. Type ______ 3. Model ______ 4. GAWR ______ Kg. ______ Lbs.

H. **Axle, Center Drive**

1. Manufacturer STEYR
2. Type ______ 3. Model ______ 4. GAWR ______ Kg. ______ Lbs.

J. **Axle, Rear**

1. Manufacturer STEYR
2. Type ______ 3. Model ______ 4. GAWR ______ Kg. ______ Lbs.

K. Suspension

Air ___X___ Steel Spring ________ Torsion Bar ________

L. Brakes

1. Make WESTINGHOUSE Type ________

M. Interior Lighting

1. Type Dome Lights
2. Number of Fixtures 6

N. Tires

1. Manufacturer SEMPERIT
2. Size Front and Rear Axle 11 R 22, 5
3. Type Drive Axle (center) 14/80 R 20

O. Air Conditioning

1. Make ________ 2. Model ________ 3. Capacity ________

P. Kneeling Feature Available Yes _X_ No ____

Q. Wheelchair Lift Available Yes _X_ No ____

R. Vehicle available as Electric Trolley Bus? Yes _X_ No ____

1. Model ________
2. Auxiliary Thermal Power Plant? Yes ____ No _X_ KW ____

MANUFACTURERS PROFILE

A. FIRM VAN HOOL N.V.

B. ADDRESS B VAN HOOLSTRAAT 58
B-2578 KONINGSHOOIKT
BELGIUM

C. TELEPHONE 031/82.15.00

D. TELEX 31709 E. CABLE ____

F. OTHER MANUFACTURING SITES ZARAGOZA, SPAIN

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 30

H. BRIEF DESCRIPTION OF PRODUCT LINE Midi-bus; city, intercitybus; articulated bus; luxury coach; articulated coach; double-deck coach; airport bus

I. PRODUCTIVE CAPACITY 1400 BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES ____ ~~NO~~ BUT POSSIBLE UNKNOWN ____

K. COMPLIANCE WITH NOISE STANDARDS

YES ____ ~~NO~~ BUT POSSIBLE UNKNOWN ____

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

YES ____ ~~NO~~ BUT POSSIBLE UNKNOWN ____

M. VEHICLE TYPE

Front end horizontal under floor axial engine with the second axle powered.

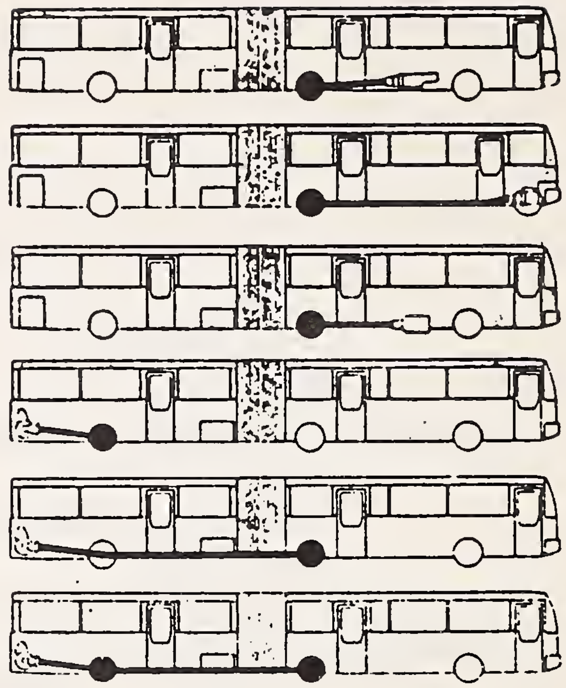
Vertical front engine with second axle powered.

* *Side mounted engine with second axle powered.* *

Rear engine with third axle powered.

Rear engine with second axle powered.

Engine immaterial, with hydrostatic or electric transmission.



APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer VAN HOOL N.V.

B. Bus Model Number AG 280

C. Dimensions

1. Overall Length 17340 M. 56 Ft. 3 In.

2. Overall Width 2490 M. 8 Ft. ____ In.

3. a. Overall Height (maximum) 3150 M. 10ft1 In. 10'-4"

   b. Height (main roof line) ____ M. ____ In.

4. Angle of Approach 8° Deg.

5. a. Breakover Angle Tractor 8° Deg.

   b. Breakover Angle Trailer 8° Deg.

6. Angle of Departure 8° Deg.

7. Articulation Angles

   a. Horizontal 36° Deg.

   b. Vertical +8to-8° Deg.

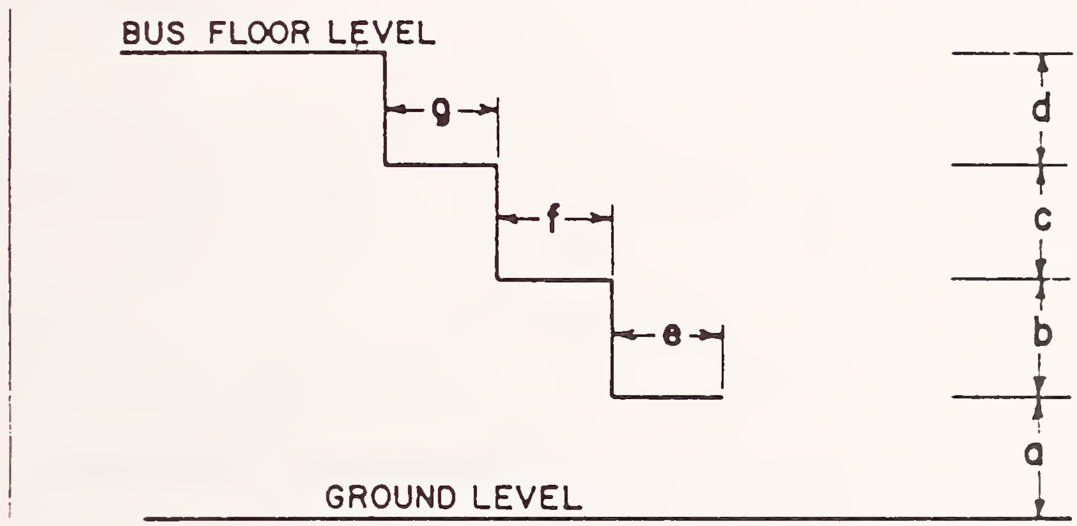
VAN HOOL BUS WORKS - MODEL AG 280

BELGIUM

8. Doorway Clear Opening (Including grab handles)

a.	Front	Width	1,150 M.	45,3 In.
		Height	____ M.	____ In.
b.	Center (if provided)	Width	1,150 M.	45,3 In.
		Height	____ M.	____ In.
c.	Rear	Width	1,150 M.	45,3 In.
		Height	____ M.	____ In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	350 mm.	13,77 in.	350 mm.	13,77 in.	350 mm.	13,77 in.
Kneeling bus	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.
b.	165 mm.	6,49 in.	165 mm.	____ in.	165 mm.	____ in.
c.	165 mm.	____ in.	165 mm.	____ in.	165 mm.	____ in.
d.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.
e.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.
f.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.
g.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.

10. Interior Head Room (center of aisle)

a. Front Axle Location 2.325 mm. 91.53 in.

b. Drive Axle Location 2.325 mm. ________ in.

c. Trailer Axle Location 2.325 mm. ________ in.

11. Aisle Width

Between Transverse Seats (minimum) 450 mm. ______ in.

12. Floor Height Above Ground (at each door)

a. Front Door 680 mm. 26.8 in.

b. Center Door (if provided) 680 mm. 26,8 in.

c. Rear Door 680 mm. 26,8 in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

10.765 M. 35 Ft. 1 In.

b. Inside Turning Radius

6.500 M. 21 Ft. 1 In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

________ M. ________ Ft. ________ In.

14. Wheel Bases

a. Tractor 5.200 M. 17 Ft. ________ In.

b. Trailer 6.650 M. 21 Ft. 3 In.

c. Total 11.850 M. 38 Ft. 3 In.

15. Seats

a. Total Number of Seats 51 basic version

b. Minimum Knee to Hip Room ________

c. Minimum Foot Room ________

D. **Weight of Bus**

Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	____ Kg.	____ Lbs.	6800 Kg.	3084 Lbs.
2. On Center Axle	____ Kg.	____ Lbs.	10500 Kg.	4762 Lbs.
3. On Rear Axle	____ Kg.	____ Lbs.	6850 Kg.	3107 Lbs.
4. TOTAL	____ Kg.	____ Lbs.	24000 Kg.	10886 Lbs.

E. **Main Engine**

1. Manufacturer MAN
2. Type DIESEL 3. Model D2566
4. Net S.A.E. Horsepower 280 HP DIN
   at 2.200 RPM
5. Turbo Charge, Make & Type ____
6. Maximum Vehicle Speed 76 KPH 47,2 MPH

F. **Transmission**

1. Manufacturer VOITH
2. Type AUTOMATIC 3. Model D854 4. Speeds 4
5. Retarder, Make, Type, and Size VOITH, HYDRAULIC, INTEGRATED

G. **Axle, Front**

1. Manufacturer MAN
2. Type INDEPENDENT 3. Model V7-70SL 4. GAWR 6800 Kg. 3084 Lbs.

H. **Axle, Center Drive**

1. Manufacturer SOMA-VAN HOOL
2. Type ECCENTRIC 3. Model 10.5T 4. GAWR 10500 Kg. 4762 Lbs.

J. **Axle, Rear**

1. Manufacturer MAN
2. Type INDEPENDENT 3. Model V7-70SL 4. GAWR 6850 Kg. 3107 Lbs.

K. Suspension

Air YES ______ Steel Spring ______ Torsion Bar NO ______

L. Brakes

1. Make ______ Type AIR OPERATED

M. Interior Lighting

1. Type fluorescent luminators
2. Number of Fixtures continuous light ramp

N. Tires

1. Manufacturer MICHELIN
2. Size 8,25 x 22,5
3. Type D22,5 PILOTE X

O. Air Conditioning

1. Make OPTION 2. Model ON ROOF 3. Capacity 40.000 KCAL/

P. Kneeling Feature Available Yes X No ____

Q. Wheelchair Lift Available Yes x No ____

R. Vehicle available as Electric Trolley Bus? Yes X No ____

1. Model AG280T
2. Auxiliary Thermal Power Plant? Yes X No ____ KW (40T0101)

MANUFACTURERS PROFILE

A. FIRM WALTER VETTER GmbH & Co

B. ADDRESS Ringstrasse 28, D-7012 Fellbach

C. TELEPHONE 0711 / 58 90 41

D. TELEX 07-254 496 E. CABLE VETTER FELLBACH

F. OTHER MANUFACTURING SITES

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES 50

H. BRIEF DESCRIPTION OF PRODUCT LINE Buses made to measure, articulated buses, double deck buses, low floor and apron buses

I. PRODUCTIVE CAPACITY 220 BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES PARTLY NO ______ UNKNOWN ______

K. COMPLIANCE WITH NOISE STANDARDS

YES PARTLY NO ______ UNKNOWN ______

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

YES PARTLY NO ______ UNKNOWN ______

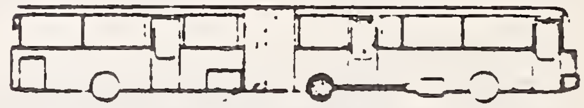
For export to USA compliance with J, K and L is possible

M. VEHICLE TYPE

X *Front end horizontal under floor axial engine with the second axle powered.*

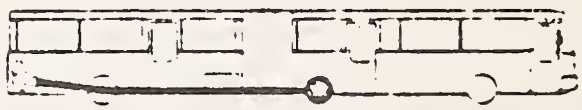
Vertical front engine with second axle powered.

Side mounted engine with second axle powered.



Rear engine with third axle powered.

Rear engine with second axle powered.



Engine immaterial, with hydrostatic or electric transmission.

APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer WALTER VETTER GmbH & Co

B. Bus Model Number Standardgelenkzug Typ 16-18

C. Dimensions

1. Overall Length 16,6 - 18 M. ______ Ft. ______ In.

2. Overall Width 2,5 M. ______ Ft. ______ In.

3. a. Overall Height (maximum) 3,15 M. ______ In.

   b. Height (main roof line) 2,05 M. ______ In.

4. Angle of Approach $8^{\circ}\ 30'$ Deg.

5. a. Breakover Angle Tractor ______ Deg.

   b. Breakover Angle Trailer ______ Deg.

6. Angle of Departure $8^{\circ}\ 40'$ Deg.

7. Articulation Angles

   a. Horizontal $\pm 5^{\circ}$ Deg.

   b. Vertical 45° Deg.

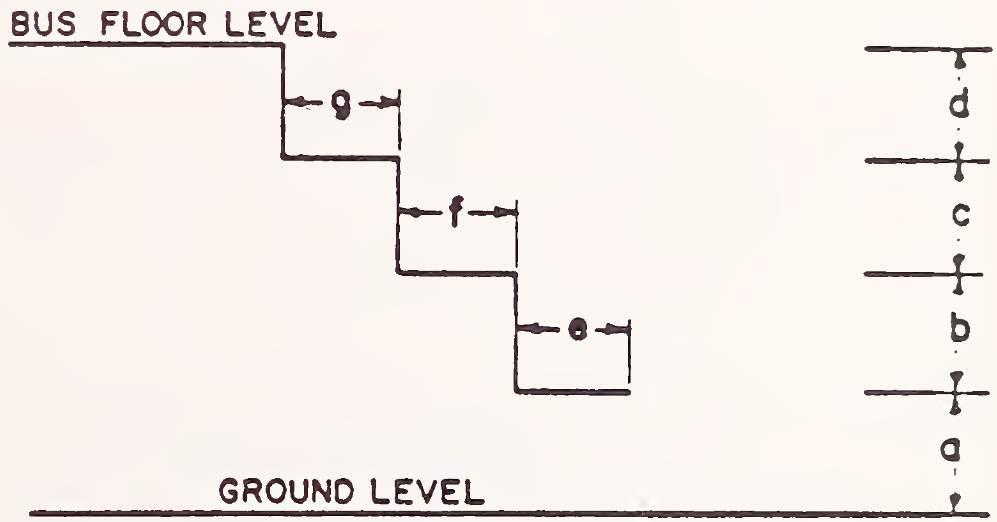
WALTER VETTER GmbH - MODEL 18R

W. GERMANY

8. Doorway Clear Opening (Including grab handles)

a. Front	Width	1,25	M.		In.
	Height	2,05	M.		In.
b. Center (if provided)	Width	1,25	M.		In.
	Height	2,05	M.		In.
c. Rear	Width	1,25	M.		In.
	Height	2,05	M.		In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	350 mm.	in.	350 mm.	in.	350 mm.	in.
Kneeling bus	300 mm.	in.	300 mm.	in.	300 mm.	in.
b.	289 mm.	in.	173 mm.	in.	173 mm.	in.
c.	289 mm.	in.	173 mm.	in.	173 mm.	in.
d.	mm.	in.	173 mm.	in.	173 mm.	in.
e.	280 mm.	in.	280 mm.	in.	280 mm.	in.
f.	500 mm.	in.	280 mm.	in.	280 mm.	in.
g.	mm.	in.	280 mm.	in.	280 mm.	in.

10. Interior Head Room (center of aisle)

a. Front Axle Location 2.050 mm. ______ in.

b. Drive Axle Location 2.050 mm. ______ in.

c. Trailer Axle Location 2.050 mm. ______ in.

11. Aisle Width

Between Transverse Seats (minimum) 2.380 mm. ______ in.

12. Floor Height Above Ground (at each door)

a. Front Door 768 mm. ______ in.

b. Center Door (if provided) 868 mm. ______ in.

c. Rear Door 868 mm. ______ in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

12.0 M. ______ Ft. ______ In.

b. Inside Turning Radius

6 M. ______ Ft. ______ In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

0.80 M. ______ Ft. ______ In.

14. Wheel Bases

a. Tractor 5,0 M. ______ Ft. ______ In.

b. Trailer 6,45-7,65 M. ______ Ft. ______ In.

c. Total 11,45-12,65 M. ______ Ft. ______ In.

15. Seats

a. Total Number of Seats upon request

b. Minimum Knee to Hip Room ______

c. Minimum Foot Room ______

D. Weight of Bus

	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	____ Kg.	____ Lbs.	7000 Kg.	____ Lbs.
2. On Center Axle	____ Kg.	____ Lbs.	11000 Kg.	____ Lbs.
3. On Rear Axle	____ Kg.	____ Lbs.	7200 Kg.	____ Lbs.
4. TOTAL	____ Kg.	____ Lbs.	25000 Kg.	____ Lbs.

E. Main Engine

1. Manufacturer Mercedes-Benz or upon request
2. Type OM 407 hA 3. Model ____
4. Net S.A.E. Horsepower 280 HP
at 2200 RPM
5. Turbo Charge, Make & Type yes KKK
6. Maximum Vehicle Speed ca 100 KPH ____ MPH

F. Transmission

1. Manufacturer upon request
2. Type ____ 3. Model ____ 4. Speeds ____
5. Retarder, Make, Type, and Size yes upon request

G. Axle, Front

1. Manufacturer Mercedes-Benz
2. Type VL 4 3. Model ____ 4. GAWR 7000 Kg. ____ Lbs.

H. Axle, Center Drive

1. Manufacturer Mercedes-Benz
2. Type HD 7 3. Model ____ 4. GAWR 12500 Kg. ____ Lbs.

J. Axle, Rear

1. Manufacturer Mercedes-Benz
2. Type VL 4 3. Model ____ 4. GAWR 7200 Kg. ____ Lbs.

K. Suspension

Air X Steel Spring ____ Torsion Bar ____

L. Brakes- System

1. Make Westinghouse Type ____

M. Interior Lighting

1. Type upon request

2. Number of Fixtures ____

N. Tires

1. Manufacturer upon request

2. Size 12 R 22,5

3. Type ____

O. Air Conditioning

1. Make upon request 2. Model ____ 3. Capacity ____

P. Kneeling Feature Available Yes X No ____

Q. Wheelchair Lift Available Yes X No ____

R. Vehicle available as Electric Trolley Bus? Yes X No ____

1. Model O-Bus Gelenkzug

2. Auxiliary Thermal Power Plant? Yes X No ____ KW to 180

MANUFACTURERS PROFILE

A. FIRM Volvo Bus Corporation

B. ADDRESS S-405 08 Gothenburg Sweden

C. TELEPHONE 031/59 00 00

D. TELEX 27000 E. CABLE ____

F. OTHER MANUFACTURING SITES All over Sweden, Europe, Latin America, Far East, Australia

G. NUMBER OF YEARS EXPERIENCE PRODUCING BUSES Since 1932

H. BRIEF DESCRIPTION OF PRODUCT LINE Single, articulated and doubledecker buses GVW 11-23 tons

I. PRODUCTIVE CAPACITY 5500 units BUSES PER YEAR

J. COMPLIANCE WITH U.S. OR CALIFORNIA EMISSION STANDARDS

YES X 1983 NO ____ UNKNOWN ____

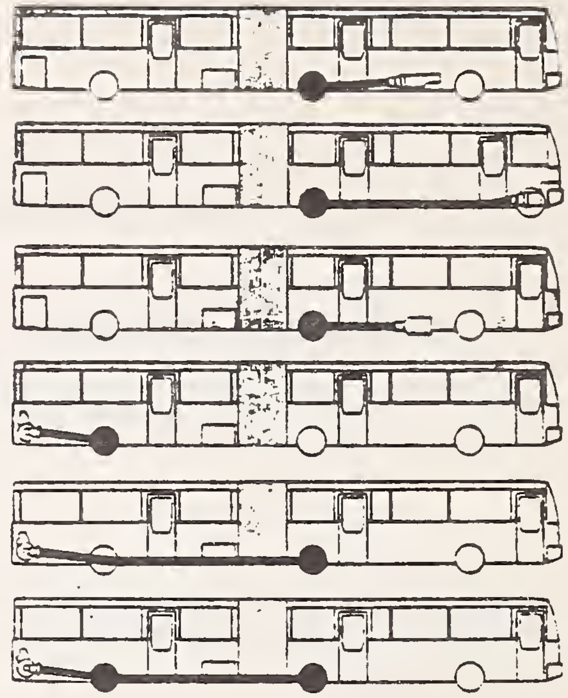
K. COMPLIANCE WITH NOISE STANDARDS

YES X NO ____ UNKNOWN ____

L. COMPLIANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARDS

YES X 1983 NO ____ UNKNOWN ____

M. VEHICLE TYPE



I. *Front end horizontal under floor axial engine with the second axle powered.*

II. *Vertical front engine with second axle powered.*

III. *Side mounted engine with second axle powered.*

IV. *Rear engine with third axle powered.*

V. *Rear engine with second axle powered.*

VI. *Engine immaterial, with hydrostatic or electric transmission.*

APPENDIX C

TECHNICAL INFORMATION TO BE FURNISHED

A. Bus Manufacturer Volvo Bus Corporation

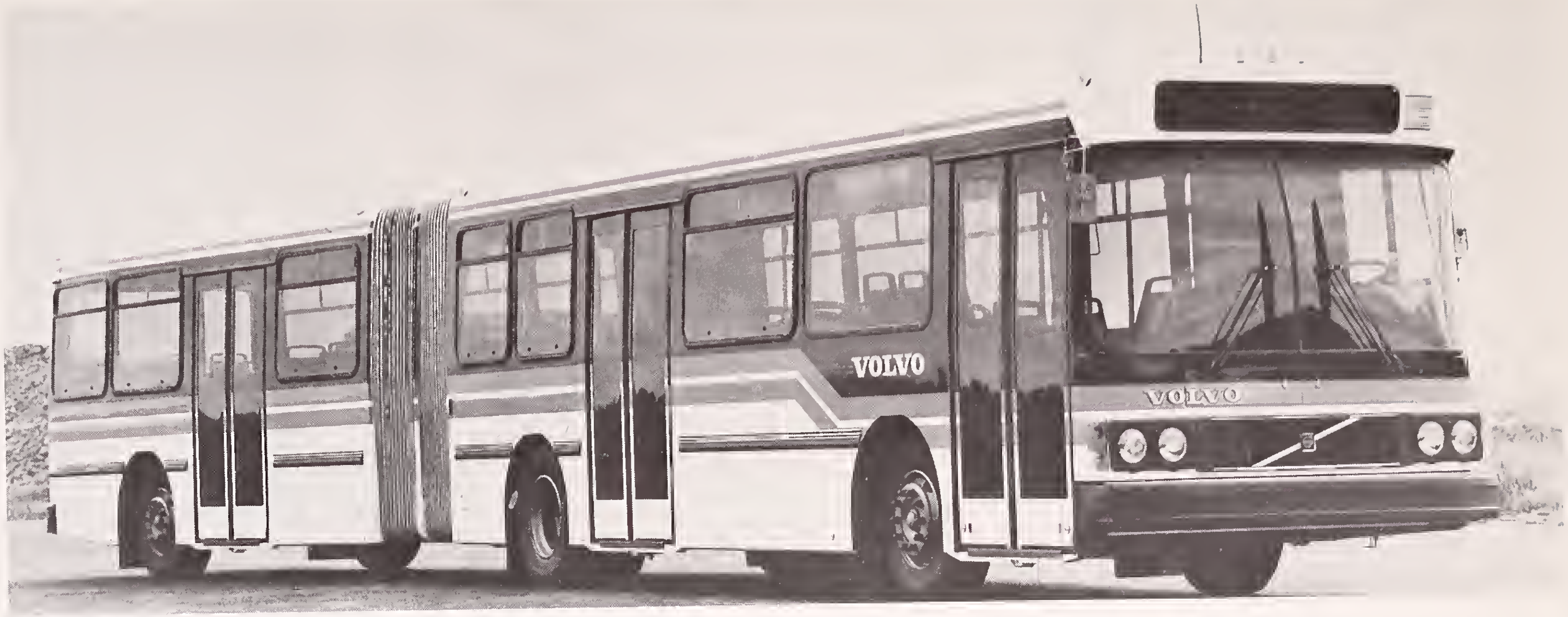
B. Bus Model Number B10M articulated-I

C. Dimensions

1. Overall Length	____ M.	55 and 60 Ft.	____ In.		
2. Overall Width	____ M.	____ Ft.	96 and 102 In.		
3. a. Overall Height (maximum)		____ M.	124 In.		
b. Height (main roof line)		____ M.	120 In.		
4. Angle of Approach			8 Deg.		
5. a. Breakover Angle Tractor			8 Deg.		
b. Breakover Angle Trailer			____ Deg.		
6. Angle of Departure			9 Deg.		
7. Articulation Angles					
a. Horizontal			48 Deg.		
b. Vertical			____ Deg.		

AB VOLVO (WITH HESS BODY) - MODEL B10M

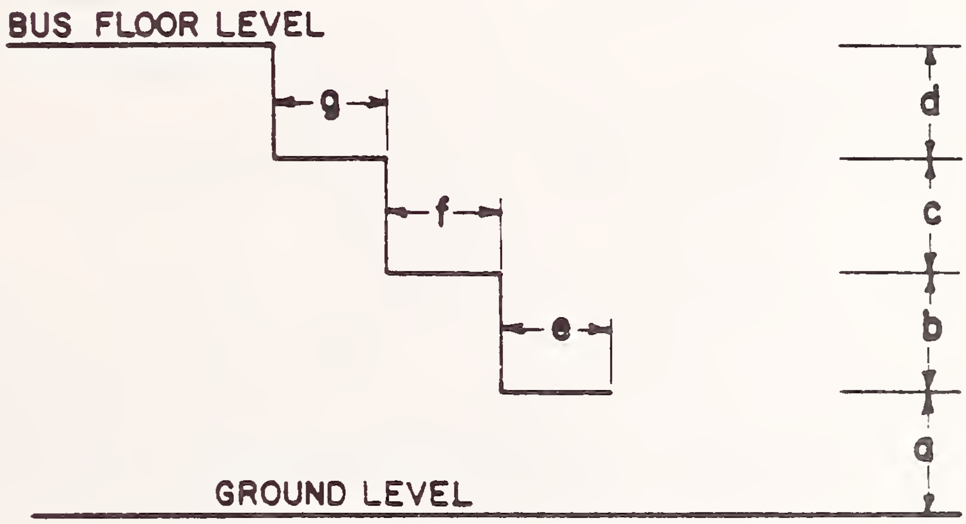
SWEDEN



8. Doorway Clear Opening (Including grab handles)

a. Front	Width	____ M.	48	In.
	Height	____ M.	85	In.
b. Center (if provided)	Width	____ M.	48	In.
	Height	____ M.	85	In.
c. Rear	Width	____ M.	48	In.
	Height	____ M.	85	In.

9. Step height from Ground, Step Riser Heights and Step Depths (step height and depth to be measured at center of step).



	Front Door		Center Door		Rear Door	
a. Empty Bus	____ mm.	14 in.	____ mm.	14 in.	____ mm.	14 in.
Kneeling bus	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.
b.	____ mm.	9 in.	____ mm.	10 in.	____ mm.	10 in.
c.	____ mm.	9 in.	____ mm.	10 in.	____ mm.	10 in.
d.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.
e.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.
f.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.
g.	____ mm.	____ in.	____ mm.	____ in.	____ mm.	____ in.

10. Interior Head Room (center of aisle)

a. Front Axle Location ________ mm. 85 in.

b. Drive Axle Location ________ mm. 80 in.

c. Trailer Axle Location ________ mm. 80 in.

11. Aisle Width

Between Transverse Seats (minimum) ______ mm. 23 in.

12. Floor Height Above Ground (at each door)

a. Front Door ________ mm. 32 in.

b. Center Door (if provided) ________ mm. 34 in.

c. Rear Door ________ mm. 34 in.

13. Horizontal Turning Envelope

a. Outside Body Turning Radius including bumper

________ M. 39 Ft. 6 In.

b. Inside Turning Radius

________ M. 20 Ft. ________ In.

c. Maximum Swing Out Radius of Right Rear curbside corner of Trailer

________ M. ________ Ft. ________ In.

14. Wheel Bases

a. Tractor ________ M. ________ Ft. 216.5 In.

b. Trailer ________ M. ________ Ft. 291.4 In.

c. Total ________ M. ________ Ft. 507.9 In.

15. Seats

a. Total Number of Seats 68 + 1

b. Minimum Knee to Hip Room 27 in

c. Minimum Foot Room ________

D. Weight of Bus

Weight of Bus	Full Complement of Fuel, Oil, Water		At GVWR	
1. On Front Axle	____ Kg.	____ Lbs.	____ Kg.	14000 Lbs.
2. On Center Axle	____ Kg.	____ Lbs.	____ Kg.	21000 Lbs.
3. On Rear Axle	____ Kg.	____ Lbs.	____ Kg.	15000 Lbs.
4. TOTAL	____ Kg.	____ Lbs.	____ Kg.	50000 Lbs.

E. Main Engine

1. Manufacturer Volvo
2. Type THD 100 DC 3. Model 6 cylinders, Turbo
4. Net S.A.E. Horsepower 242 HP
at 2200 RPM
5. Turbo Charge, Make & Type Holset
6. Maximum Vehicle Speed ____ KPH ____ MPH
dependant on gear ratios

F. Transmission

1. Manufacturer ZF or Allison
2. Type Automatic 3. Model ____ 4. Speeds ____
5. Retarder, Make, Type, and Size Telma 160 on Allison

G. Axle, Front

1. Manufacturer Volvo
2. Type ____ 3. Model ____ 4. GAWR ____ Kg. ____ Lbs.

H. Axle, Center Drive

1. Manufacturer Volvo
2. Type ____ 3. Model ____ 4. GAWR ____ Kg. ____ Lbs.

J. Axle, Rear

1. Manufacturer Volvo
2. Type ____ 3. Model ____ 4. GAWR ____ Kg. ____ Lbs.

K. Suspension

Air Yes Steel Spring ______ Torsion Bar Yes

L. Brakes

1. Make European Type S-type

M. Interior Lighting

1. Type ______

2. Number of Fixtures ______

N. Tires

1. Manufacturer Michelin XZA

2. Size 12 x 22.5

3. Type ______

O. Air Conditioning Optional

1. Make ______ 2. Model ______ 3. Capacity ______

P. Kneeling Feature Available Yes X No ____

Q. Wheelchair Lift Available Yes ____ No ____

R. Vehicle available as Electric Trolley Bus? Yes ____ No ____

1. Model ______

2. Auxiliary Thermal Power Plant? Yes ____ No ____ KW ____

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