Chapter IX

CHAPTER IX

Vehicle Types

INTRODUCTION

In recent years, the need for vehicles smaller than the standard 35- or 40-foot transit bus has increased. Across the United States, small transit vehicles have become widely used by grantees of several state and/or federally funded programs. The use of small transit vehicles is increasing, as both small and large transportation providers are finding the vehicles appropriate in a variety of service environments. Small transit vehicles are advantageous over standard transit buses in several ways. They are more maneuverable, easier to drive, more cost-effective when passenger demand is low, quieter, and generally more attractive to many passengers and communities.

VEHICLE CHARACTERISTICS

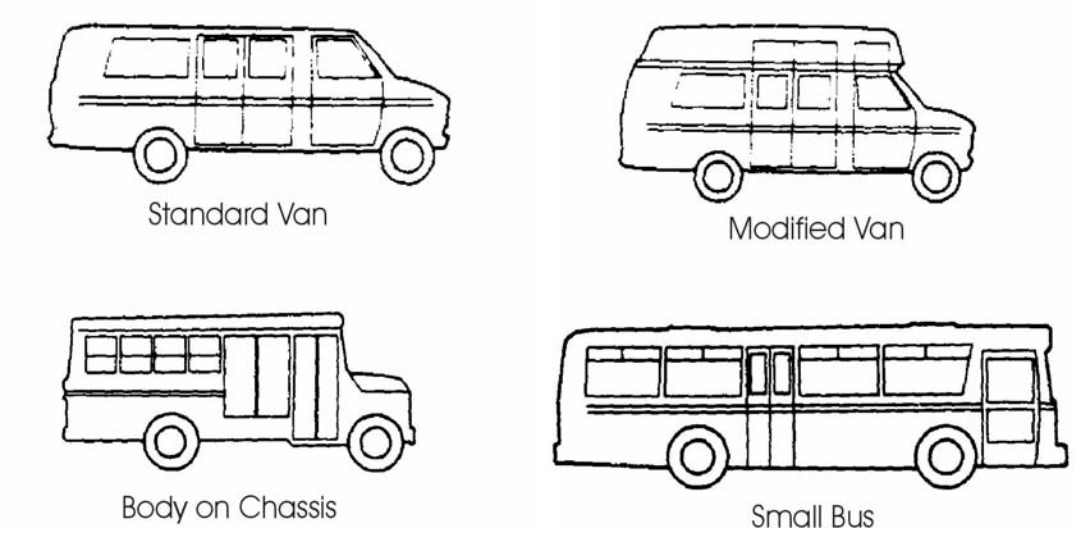
This chapter has been included to assist CTP and the Stakeholders Committee with choosing appropriate vehicle types in the development of future transit service. There are numerous types and sizes of small transit vehicles on the market and these are frequently changing. There is no standard method of grouping the various types of small transit vehicles. Also, there is a lack of conclusive vehicle performance data because of the novelty of this field of mass transit. The combination of these factors may result in questions and confusion for agencies desiring to procure a small transit vehicle.

Vehicle Overview

The expression "small transit vehicle" refers to a vehicle smaller than the 35- or 40-foot standard transit bus. Within this group of small transit vehicles, there are a number of different types and sizes. There is no accepted standard for the terms

used to describe the subgroups of small transit vehicles. For the purpose of this study therefore, LSC divided the vehicles into four groups based on their method of construction, vehicle source, and seating capacity. The four groups include: standard vans, modified vans, body-on-chassis vehicles, and small buses. The designs of the four groups are shown in Figure IX-1.

Figure IX-1



Source: Pennsylvania Department of Transportation

Standard Vans

Standard vans, also known as minivans, are produced by the major automobile manufacturers as part of their standard production line. Therefore, standard vans are readily available for purchase and the maintenance/service and parts are easier to obtain. Standard vans are relatively small, with a seating capacity ranging from 5 to 15 passengers. They offer greater maneuverability and are easy to drive because of their size. Standard vans also cost less initially than do other small transit vehicles.

However, standard vans have several disadvantages. Since standard vans are designed for personal use, they may not be durable in transit service. The

expected life of a standard van in transit service is three to five years of typical use, depending on a number of factors. Difficult entry into the vehicle is another problem. The high first step and the low roof make entry difficult for elderly and disabled passengers. The low roof also inhibits movement within the van, particularly for elderly and disabled passengers moving to and from their seats. Passengers with mobility impairments (i.e., using crutches or walkers) have difficulty gaining access to seats, especially in the rear of the vehicle, because of narrow aisles. If a wheelchair ramp or lift is stored in the vehicle, it often protrudes into the van, further limiting seating space and maneuvering room. In addition, the limited interior headroom of most standard vans makes it impossible for some people in wheelchairs to sit up straight when entering the vehicle.

Despite these disadvantages, many providers have successfully used standard vans to transport their riders. If limited interior space does not pose a problem, standard vans can be a useful alternative as a transit vehicle.

Modified Vans

As previously mentioned, standard vans have accessibility problems and limited headroom. As a result, vans are frequently modified to overcome these limitations and meet special needs. The modifications usually adjust the structure and/or include the addition of equipment to improve the performance of vans as transit vehicles. These modifications enable the vans to accommodate different types of passengers or provide added comfort and utility for passengers.

Increasing van size, particularly the height, is the most common modification. This is often accomplished by raising the roof through the addition of a bubble-top or pop-top, lowering the floor, or both. Other modifications may involve enlarging the entrances; reinforcing and insulating the walls and roof; adding wheelchair lifts, ramps, or low-rise steps to improve accessibility; widening the body and changing the seating arrangement to increase aisle width and make passenger movement easier inside the vehicle; installing rubber floor matting, padding on hard surfaces,

and grabrails/stanchions for support; and adding heaters and air conditioners for passenger safety and comfort.

Modifications can also be made to the chassis of the van to increase vehicle durability. These may include an extended or widened wheelbase, heavy-duty brakes, improved transmission, and heavy-duty suspension. Modified vans generally can seat from 9 to 16 passengers. Although modified vans may be longer and slightly wider than standard vans, they are still relatively easy to drive and maneuver. The modifications create more room inside the van so movement is less restricted, providing passengers with more comfort. Accessibility is generally easier in modified vans than in standard vans.

However, modified vans do possess potential drawbacks. A raised roof can make the vehicle difficult to handle in heavy winds or on sharp curves and there is a potential for leaks to develop at points where the raised roof is attached to the vehicle. Another drawback to modified vans is reduced fuel mileage due to the added weight of the modifications and the increased wind resistance caused by the raised roof.

Body-on-Chassis Vehicles

Body-on-chassis vehicles are produced in two ways. The first method involves building a bus body on the rear of a commercial van chassis. The second method involves building a complete bus body on a light-duty truck or motor home chassis. Since the second method is used to build standard school buses, a number of school bus manufacturers have expanded into the small transit vehicle market. A supplier of body-on-chassis vehicles will purchase a chassis produced by a company such as Chevrolet, Dodge, Ford, GMC, or International Harvester. The body is then constructed on the chassis, normally around a steel frame attached to the chassis.

Body-on-chassis vehicles are available in various sizes, with seating capacities ranging from 12 to 30 passengers. Body-on-chassis vehicles offer certain advantages over vans. For example, body-on-chassis vehicles tend to be more durable than vans, having an expected life of five to seven years depending on a number of factors. Another advantage is that some body-on-chassis vehicles have dual rear wheels, making them more stable than vans. Body-on-chassis vehicles offer more interior space, which is often necessary for lift equipment and wheelchair stations. Some body-on-chassis vehicles also have transit-type folding doors and low steps for ease of entry.

Another advantage is a larger fuel tank capacity, which can be especially helpful when fueling stops are infrequent. Body-on-chassis vehicles are available with diesel engines, which is advantageous since diesel fuel is normally less expensive and diesel engines are generally more durable and fuel-efficient. However, vehicles fueled by diesel may be louder than those fueled by gasoline, which is an important consideration to keep in mind.

A drawback of body-on-chassis vehicles is that they are not built on a durable transit chassis. Many transit experts feel that a small heavy-duty bus should be purchased when a passenger capacity greater than 22 passengers is needed. Also, some manufacturers produce body-on-chassis models with less than full standing room, making them unsuitable for many transit applications. Operators have commented that the body-on-chassis vehicles have stiff suspensions which produce a bumpy ride. The process of adding a body to a chassis can also result in special problems, such as the body being insecurely attached to the chassis, inaccessibility of chassis components for repair and inspection, and damage of electrical components during body assembly.

Small Buses

Small buses contain one feature found in few other small transit vehicles—durability. In a small bus, the durability of a standard transit bus is combined with the advantages of a small transit vehicle. Small buses are the largest of the small transit vehicles, seating from

18 to 35 passengers. They are referred to as "purpose built buses," since they are designed specifically for transit service and each is constructed as a single unit. In other words, both the body and chassis are supplied by one manufacturer. Since they are designed for transit use, small buses have an expected service life of 10 to 15 years, depending on a number of factors.

Another advantage of small buses is their larger size, which provides a good amount of interior vehicle space. This is especially convenient for passengers in wheelchairs or those who require additional room in which to maneuver. Many of the components of small buses (i.e., transmission, engine, and axles) are identical to the heavy-duty components of standard-sized transit buses, which may make maintenance easier as those standard parts are more readily available.

Small buses use diesel fuel as opposed to gasoline. However, the fuel savings may be offset by the high purchase price of small buses. Also, small buses are less maneuverable and more difficult to drive because of their size.

The best sources of information on small buses are usually the manufacturers themselves, dealers or distributors, and other transit systems that have recently purchased similar equipment. The small bus industry is growing, with a variety of types and seating plan options now available.

Impact of Using Smaller Vehicles

Table IX-1 provides a vehicle comparison that includes the existing information, advantages, and disadvantages for each vehicle type. Category C, in Table IX-1, presents the seating capacity for the different vehicle types. The Americans with Disabilities Act of 1990, Section 38.23 requires all public transit agencies to have a minimum of two wheelchair tiedowns in all vehicles over 22 feet and a minimum of one wheelchair tiedown in all vehicles under 22 feet. This regulation has an impact on the actual number of seats in vehicles and the seating variations used in vehicles.

Table IX-1
Vehicle Type Comparison

Category	Standard Van / Minivan	Modified Van / Minivans	Body-on-Chassis	Small Bus
A Capital Cost	**$25,000**	**$35,000**	**$65,000**	**$160,000**
B Vehicle Life (yrs)	4	4	7	12
C Seating	5-11	5-11	12-21	23-30
D Advantages	1 Easy to maneuver 2 Cost less	1 Easy to maneuver 2 Passengers comfortable w/ modifications	1 More durable than vans 2 Dual rear wheels on some models 3 Low front entry step 4 Small vehicle appearance 5 Easy to maneuver	1 Durable 2 Long vehicle life expectancy 3 Large size 4 Heavy-duty built - thus maintenance costs lower 5 Easily identified in community 6 More passenger space 7 Many seating options 8 Smooth passenger ride
E Disadvantages	1 Not durable - short vehicle life 2 Difficult entry into vehicle 3 Low roof in vehicle 4 Hard to move within vehicle 5 Passenger crowding on vehicle 6 Increased maintenance on vehicle 7 Cannot accommodate large groups	1 Not durable - short vehicle life 2 Passenger crowding on vehicle 3 Increased maintenance on vehicle 4 Cannot accommodate large groups	1 Not durable - short vehicle life 2 Passenger crowding on vehicle 3 Increased maintenance on vehicle 4 Cannot accommodate large groups 5 Stiff suspension results in bumpy ride 6 Changes transit appearance in community	1 Buses may appear empty when passenger load low 2 Cost more than other small vehicles 3 Requires more storage space than small vehicles
F LSC Recommendation	Yes	Yes	Yes	No

*NOTE: *Based on available actual costs, 2007.*

VEHICLE SELECTION

In the vehicle selection process, the criteria must be evaluated to ensure the best vehicle fit for future transit service. The key is to match the vehicle to the particular type of service for which it will be used and to the physical environment in which it will be operated, while staying within budget constraints. The selection of a particular body style and vehicle size are affected primarily by the following factors: service considerations, costs, maintenance and storage requirements, operating environment, and other factors.

Service Type

The service type is an important consideration in the vehicle selection process. Larger vehicles (small buses), for example, may be effectively utilized for longer trips, while smaller vehicles (vans) seem better suited for demand-response service and short trips. Vans may become uncomfortable for passengers over long distances due to the limited interior space. On the other hand, buses provide comfort but may be difficult to maneuver in city traffic, narrow streets, neighborhoods, and driveways. The service area also determines how a vehicle should be equipped. In large service areas, for example, an extra-capacity fuel tank may be appropriate.

Service Demand

Another key factor in determining what size vehicle to purchase is service demand. In an efficient transit operation, the vehicle is usually sufficiently filled. Ideally, the number of people entering the vehicle is equal to the number of people exiting so that the vehicle is never overcrowded or empty.

Passenger Needs

Passenger needs must also be considered when selecting transit vehicles. Not only must the vehicle be able to accommodate every passenger, but also any special equipment that may be required. For example, passengers in wheelchairs require a ramp or lift to enter/exit the vehicle, handrails for support, wheelchair securement devices for safety, and sufficient room in which to ride and maneuver. Although this equipment is essential for wheelchair passengers, it adds weight to

the vehicle and caution must be taken not to exceed the maximum weight capacity.

Passenger comfort and safety is another area that should never be overlooked when selecting a vehicle. Certain tradeoffs, however, may be made. For example, seats with arms may make a bus ride more comfortable for some passengers, but these seats can be difficult to get in and out of. Comfortable padded seats and interior improvements may be desired for long trips, but may be an unnecessary expense for short routes.

Costs

The decision to buy a small transit vehicle and what type to buy will be based upon available funds. Initial purchase (capital), maintenance, and operating costs should be considered when selecting a vehicle. The costs for fuel, vehicle durability, replacement parts, and labor can be a worthwhile trade-off to capital cost. For example, a more costly vehicle is sometimes more durable and less expensive to operate over its useful life than a vehicle with a lower purchase price.

Maintenance and Storage Requirements

A good maintenance program is as important to a successful transit operation as is the purchase of the vehicles themselves. Major maintenance work early in the vehicle's life should be covered by the vehicle's warranty. After the warranty expires, the transit service needs to develop a maintenance program for the transit vehicle through the City of Cheyenne Public Works Department, which handles the maintenance of all transit vehicles.

One issue that may be encountered with vehicle warranty provisions stems from the fact that some small transit vehicles are constructed by several manufacturers. With modified vans, for example, the modifications are not usually made by the original manufacturer. A modifier acquires the van and alters it according to an agreement with the buyer. Since the vans are assembled or modified by more

than one company, it may be difficult for the regional transit service to prove which company is responsible if problems occur. Similar problems may occur with body-on-chassis vehicles, since one company manufactures the body and another the chassis. To facilitate clear warranties and ensure the future transit service receives the most complete and trouble-free warranty service, all responsibility should be with the bidder and the warranties the bidder provides should cover the entire vehicle.

Operating Environment

Climate dictates whether auxiliary heaters or air conditioners are needed, as well as the type of tires the vehicle requires.

Road conditions are an important consideration in choosing a vehicle. Service in urban or residential areas requires vehicles with a small turning radius that can maneuver through narrow or one-way streets, cul-de-sacs, and driveways. Narrow or limited-capacity bridges, low underpasses, and winding roads located along service routes may also limit the selection of vehicles. On the other hand, open highway travel requires less vehicle maneuverability and virtually any vehicle type may be appropriate.

Another consideration is the terrain. For service areas with a lot of steep hills, for example, a vehicle with heavy-duty brake capacity, adequate power, and possibly brake retarders should be purchased.

Other Factors

There are several other considerations in selecting appropriate transit vehicles, such as uniformity of fleet, drivers' needs, insurance, community acceptance, and government regulations. Some of these considerations are discussed below.

Uniformity of Fleet

It is advantageous to have a uniform fleet of vehicles. This may, however, be difficult to obtain when different types of transit services are offered. The primary advantage of uniformity relates to maintenance and repairs. Mechanics need only be familiar with one type of vehicle and it is simpler and cheaper to acquire and

keep a parts inventory. This improves the efficiency of the maintenance operation since, as problems develop in one vehicle, steps can be taken to ensure the problem does not recur with the other vehicles. Fleet uniformity in passenger capacity and seating arrangement also makes scheduling and dispatching easier because the vehicles are interchangeable. The main disadvantage of fleet uniformity is that it limits the fleet's responsiveness to the varying demands of transit service.

Drivers' Needs

The transit vehicle drivers operate long hours. The drivers' needs should be considered in vehicle purchase. Driver visibility and comfort play a key role in many transit agencies. Some transit operations depend upon volunteers to drive the vehicles. As these volunteer drivers may be inexperienced, vehicles should be purchased that are maneuverable and relatively easy to drive. However, this is not the case for CTP since the transit vehicle drivers are full-time employees.

Community Acceptance

Systems with small transit vehicles often operate in residential communities. Therefore, any vehicles purchased should be as acceptable to the community as possible. Service in residential areas may require small, relatively quiet, unobtrusive vehicles. This may be difficult due to vehicle operations and fleet uniformity. Small diesel buses, for example, may not be acceptable in some communities due to the engine noise.

SUMMARY

This chapter has discussed the advantages and disadvantages of the different types of vehicles. Many factors are involved in sizing the appropriate vehicle for a transit agency and the different types of services offered. Table IX-2 presents a wide range of vehicle characteristics. The approximate costs for the vehicles range from $35,000 to $275,000. Hybrid fuel vehicles are much more expensive than the standard diesel engines. However, many communities are turning to hybrid fuel vehicles to assist in the fight against air pollution and reduce fuel costs.

Table IX-2
Vehicle Information for CTP

Factors	VEHICLE TYPE					
	El Dorado National Escort FE-25 Custom Chassis	**StarTrans Senator Cutaway - Chevrolet**	**AVS - 22 Hybrid - Electric**	**Blue Bird Q-Bus**	**Thomas MVP-EF**	**World Trans 3000**
	Small Bus	***Body-on-Chassis***	***Small Bus***	***Small Bus***	***Small Bus***	***Small Bus***
1 Air Conditioning	Available	Available	Available	Available	Available	Available
2 Altoona Tested	Yes	Yes	Yes	Yes	Yes	Yes
3 Cost	**$90,000**	**$60,000- $75,000**	**$275,000**	**$230,000**	**$160,000**	**$160,000**
4 Driver Visibility	Good	Good	Good	Good	Good	Good
5 Est. Annual Maintenance Cost	**$10,000**	**$10,000**	**$20,000**	**$15,000**	**$12,000**	**$15,000**
6 Length	25'	24'	22'	29'	25'	26' 9"
7 Seating Capacity	18 + 2 wc	16 + 2 w/c	22 +1 wc/ perimeter only	20 - 26 + w/c	varies - approx. 20 + w/c	17 + 2 w/c
8 Step Height	10"	11"	15"	14"	N/A	11"
9 Number of Wheelchair Ties	2	2	1	2	2	2
10 Aisle Width	14"	92.5"	93"	15"	N/A	N/A
11 Appearance / Visibility	Good	Good	Good	Good	Good	Good
12 Brakes	Front/Rear Disc	Power	Air over Hydraulic	Disc or Air	N/A	Dual hydraulic disc
13 Door Width	31" x 80"	32" x 83"	36"	30"	N/A	32" x 88"
14 Doors Opening In or Out	out	out	out	out	out	out
15 Empty Weight	11,300	N/A	N/A	N/A	N/A	N/A
16 Engine Size	7.4 L or 8.1L Gas or 6.5 L Diesel	Vortec 5700 or 7400 or 6.5 L Diesel	Micro Turbine ; Diesel, CNG, LP	Diesel/Gas	Diesel/Gas	175 Cummins diesel
17 Engine Type	7.4 L or 8.1L Gas or 6.5 L Diesel	Vortec 5700 or 7400 or 6.5 L Diesel	Micro Turbine ; Diesel, CNG, LP	Diesel/Gas	Diesel/Gas	175 Cummins diesel
18 Expected Vehicle Life	7 yrs	4-5 yrs	7 yrs	10-12 yrs	7 yrs	7 yrs
19 Floor Height	28"	80"	N/A	N/A	N/A	83"
20 Fuel Consumption	10-11 mpg	N/A	N/A	N/A	N/A	N/A
21 Fuel Tank Capacity	40 gal	35 gal	electric / Diesel or CNG	40 or 60 gal	N/A	51 gal
22 GVWR	14,800	12,300	27,000	26,300-30,000	N/A	18,780
23 Interior Headroom	77"	75"	75"	76"	73" or 78"	83"
24 Noise	80 DB	N/A	N/A	N/A	N/A	N/A
25 Number of Doors	1 + 1 wc	1 + 1 wc	N/A	2	1 + 1 wc	1 + 1 w/c
26 Overhang	97.5"	N/A	67"/45"	varies	varies	71" / 70"
27 Safety	N/A	N/A	N/A	N/A	N/A	N/A
28 Standing Room Availability	Yes	Yes	Yes	Yes	Yes	Yes
29 Steering	Power/Tilt	Power/Tilt	Power	TAS 65	N/A	Power/Tilt
30 Suspension	Front - Coil w/ Air Springs; Rear - Multi-leaf Spring	HD Spring & Shock	pneumatic	Spring or Air	Spring or Air	Air Suspension
31 Tire Size	225/70R x 19.5"	225 - 16 D	265 / 70R 19.5	10 R 22.5 G	N/A	245 / 70 R 19.5
32 Transmission	Automatic	Automatic	N/A	Automatic	Automatic	Allison AT 545 - automatic
33 Turning Radii	29'	N/A	32'	25'	N/A	24'
34 Wheelbase	158"	177"	147"	132"	136" or 155"	154"
35 Wheelchair Access Type	Rear	Rear	Front	Rear / Side	Rear	Center
36 Width	87"	96"	92'	96"	N/A	96"

#3 - Estimates from vendors subject to change.

#5 - Maintenance estimates from vendors.





Table IX-2 (continued)
Vehicle Information for CTP

Factors	***VEHICLE TYPE***				
	El Dorado National Escort FE-23 Chevrolet Chassis	**Blue Bird CS Series**	**Champion CTS**	**Mercedes Sprinter Public Service-16**	**El Dorado National Aerotech**
	Small Bus	***Small Bus***	***Small Bus***	***Small Bus***	***Body-on-Chassis***
1 Air Conditioning	Available	Available	Available	Available	Available
2 Altoona Tested	Yes	Yes	Yes	N/A	Yes
3 Cost	**$80,000**	**$116,000**	**$85,000**	**$75,000**	**$60,000**
4 Driver Visibility	Good	Good	Good	Good	Good
5 Est. Annual Maintenance Cost	**$10,000**	**$12,000**	**$10,000**	**N/A**	**$10,000**
6 Length	23'	25'	26'	22'	20'
7 Seating Capacity	13 + 2 wc	21 - 26 + w/c	16 + w/c	13+w/c	10
8 Step Height	10"	14"	N/A	N/A	11"
9 Number of Wheelchair Ties	2	2	2	2	2
10 Aisle Width	14"	16"	N/A	N/A	varies
11 Appearance / Visibility	Good	Good	Good	Good	Good
12 Brakes	Front/Rear Disc	Air over Hydraulic	N/A	N/A	Hydraulic disc
13 Door Width	31" x 80"	30"	N/A	N/A	27"
14 Doors Opening In or Out	out	out	out	out	out
15 Empty Weight	11,300	N/A	N/A	11,000	N/A
16 Engine Size	7.4 L or 8.1L Gas or 6.5 L Diesel	Diesel	Gas/Diesel	Gas/Diesel	Diesel
17 EngineType	7.4 L or 8.1L Gas or 6.5 L Diesel	Diesel	Gas/Diesel	Gas/Diesel	Diesel
18 Expected Vehicle Life	7 yrs	10-12 yrs	7 yrs	7 yrs	4 - 5 yrs
19 Floor Height	28"	N/A	N/A	N/A	N/A
20 Fuel Consumption	10-11 mpg	N/A	N/A	N/A	N/A
21 Fuel Tank Capacity	40 gal	45 gal	60 gal	N/A	35 gal
22 GVWR	14,800	25,000	N/A	N/A	9,500
23 Interior Headroom	77"	77"	76"	N/A	80"
24 Noise	80 DB	N/A	N/A	N/A	N/A
25 Number of Doors	1 + 1 wc	1 + 1 wc	1 + 1 wc	1	1 + 1 w/c
26 Overhang	97.5"	81" / 97"	N/A	37" / 64"	30" / 92"
27 Safety	N/A	N/A	N/A	N/A	N/A
28 Standing Room Availability	Yes	Yes	Yes	Yes	Yes
29 Steering	Power/Tilt	TAS 65	N/A	N/A	Power
30 Suspension	Front - Coil w/ Air Springs; Rear - Multi-leaf Spring	Spring or Air	N/A	N/A	Coil / Leaf
31 Tire Size	225/70R x 19.5"	10 R 22.5 G	8 x 19.5	N/A	LT 225 / 17 R 16E
32 Transmission	Automatic	Automatic	Automatic	N/A	Automatic
33 Turning Radii	29'	25'	N/A	N/A	24'
34 Wheelbase	158"	132"	158"	158"	138"
35 Wheelchair Access Type	Rear	Rear / Side	Rear	Side	Rear / Side
36 Width	87"	96"	96"	78"	96"

#3 - Estimates from vendors subject to change.

#5 - Maintenance estimates from vendors.