



CHAPTER VIII

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 was included to assist Opportunity Link and the Stakeholders Committee with choosing appropriate vehicle types in the development of a regional transit service. There are numerous types and sizes of small transit vehicles on the market, and these are frequently changing. There is also 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.

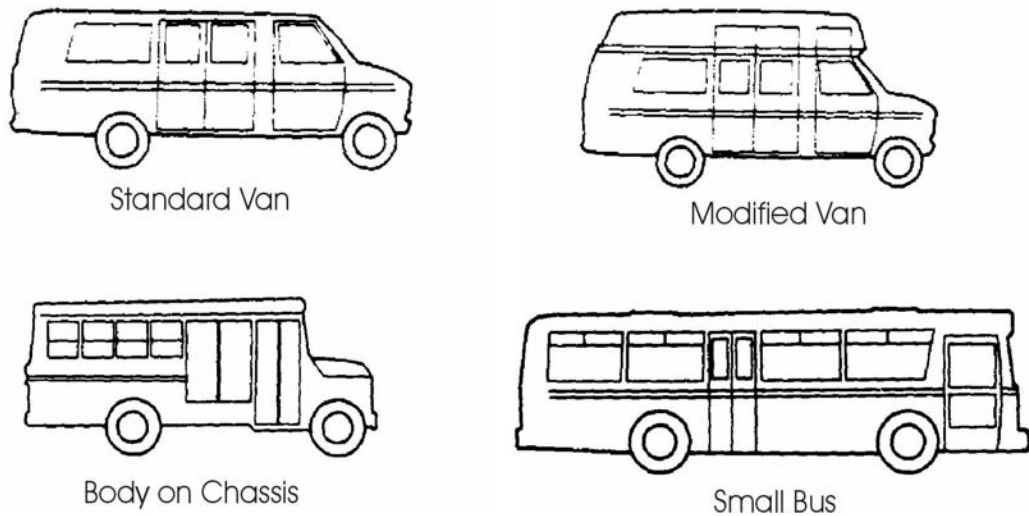
Vehicle Overview

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

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study therefore, LSC divided the vehicles into four groups based upon 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 VIII-1.

Figure VIII-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 buying, and maintenance/service and parts are easier to obtain. Standard vans are relatively small, with a seating capacity ranging from 5 to 15 passengers. Because of their size, they offer greater maneuverability and are easy to drive. 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 upon 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 to 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 to regular 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.

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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

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. The second method is used to build standard



school buses, and as a result, 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 upon 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 could 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



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buses have an expected service life of 10 to 15 years, depending upon 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 heavy-duty components of standard-sized transit buses. This 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 for information on small buses are usually the manufacturers themselves, dealers or distributors, and other transit systems which 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 VIII-1 provides a vehicle comparison which includes the existing information, advantages, and disadvantages for each vehicle type. Category C, in Table VIII-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 VIII-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	<ul style="list-style-type: none"> 1 Easy to maneuver 2 Cost less 	<ul style="list-style-type: none"> 1 Easy to maneuver 2 Passengers comfortable w/ modifications 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 1 Durable 2 Long vehicle life expectancy 3 Large size 4 Heavy-duty built - thus maintenance costs lower 5 Easily identify in community 6 More passenger space 7 Many seating options 8 Smooth passenger ride
E Disadvantages	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 1 Not durable - short vehicle life 2 Passenger crowding on vehicle 3 Increased maintenance on vehicle 4 Cannot accommodate large groups 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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, many criteria must be evaluated to ensure the best fit vehicle for any future regional 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 used 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. Buses, on the other hand, provide the comfort; but may be difficult to maneuver in city traffic, narrow streets, 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 which may be required. Passengers in wheelchairs, for example, 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 its maximum weight capacity.

Passenger comfort and safety is another area which 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 which 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 is 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 life should be covered by the vehicle warranties. After the warranties expire, the future regional transit service should develop adequate arrangements to ensure proper maintenance.

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, as one company manufactures the body and another

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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 and the type of tires the vehicle requires.

Road conditions are also an important consideration in choosing a vehicle. Service in urban or residential areas requires vehicles with a small turning radius which 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. Open highway travel, on the other hand, 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 heaviest-duty brake capacity, adequate power, and possibly brake retarders should be purchased.

The regional service will need to determine the impact that rural unpaved roads will have on vehicle selection. The regional service may need a more durable vehicle due to the rural conditions of north-central Montana.

Other Factors

There are several other considerations which must be made in selecting appropriate transit vehicles such as uniformity of fleet, driver 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 service are offered. A uniform fleet

offers certain advantages. 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 see that the problem does not recur with the other vehicles. In addition to maintenance, a fleet uniform in passenger capacity and seating arrangement makes scheduling and dispatching easier because the vehicles are interchangeable. The main disadvantage of a uniform fleet is that its very uniformity limits its responsiveness to the varying demands placed upon it.

Driver Considerations

The drivers of the transit vehicles operate long hours. The needs of the drivers should be considered in the 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.

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. This may be difficult due to vehicle operations and uniformity of the fleet. Service in residential areas may require small, relatively quiet, unobtrusive vehicles that will not be objectionable to residents. Small diesel buses, for example, may not be acceptable in some communities due to the engine noise.

SUMMARY

Table VIII-2 presents a wide range of vehicle characteristics. The approximate costs for the vehicles range from \$35,000 to \$160,000. The hybrid vehicles are much more expensive than the standard diesel engines. However, many communities are turning to the hybrid vehicles to assist in the fight against air pollution and reduce fuel costs.

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

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transit agency and the different types of services offered. The review of this information indicates that smaller vehicles may be appropriate for some of the service types detailed in Chapter XII.

**Table VIII-2
Vehicle Information for North-Central Montana**

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
1 Air Conditioning	<i>Small Bus</i> Available	<i>Body-on-Chassis</i> Available	<i>Small Bus</i> Available	<i>Small Bus</i> Available	<i>Small Bus</i> Available	<i>Small Bus</i> 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 VIII-2 (continued)
Vehicle Information for North-Central Montana

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
1 Air Conditioning	<i>Small Bus</i> Available	<i>Small Bus</i> Available	<i>Small Bus</i> Available	<i>Small Bus</i> Available	<i>Body-on-Chassis</i> Available
2 Altoona Tested	Yes	Yes	Yes	N/A	Yes
3 Cost	\$80,000	\$116,000	\$85,000	N/A	\$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 Engine Type	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.

