

## Pierce Transit - Tacoma, Washington

<p>What is your total fixed-route bus fleet size?</p>	<p>204 (not including vehicles contracted for regional express service)</p>
<p>What mix of heavy-duty bus sizes do you use?</p>	<p>154 forty feet, 30 thirty feet, 20 less than thirty feet</p>
<p>Do you use non-heavy duty buses in your fixed-route bus fleet?</p>	<p>The twenty short vehicles that are identified above are all El Dorado vans consisting of an Aerotech shell placed on a Ford chassis - cutaways. We use these to provide deviated fixed route services in low-density suburban neighborhoods. Traditional fixed route services all use heavy-duty transit vehicles, thirty feet or longer.</p>
<p>Has your transit system done a study on proper fleet size (i.e. 40 foot vs. smaller options)?</p>	<p>Prior to introducing the 30-foot vehicles in 2002, we performed a study that identified the number of smaller-capacity buses the system could accommodate. I've attached a copy of that study. It's a bit dated, and the methodology complex, but time has shown that routes identified in the report are capable of supporting a smaller vehicle.</p>
<p>Does your system have a "Friends of Transit" or a similar organization that helps with fund-raising and awareness of transit in your community?</p>	<p>At this time, no. We do have a citizens group that addresses transit issues encountered by the disabled community but it does not include members of the broader local community. FYI, Pierce Transit is actively considering the formation of such a citizens' group.</p>
<p>Does your system use non-traditional revenue sources to help fund the system, such as parking revenues?</p>	<p>Again, no. Pierce Transit is wholly supported by a combination of farebox revenues, sales tax collections and federal/state grants. The City of Tacoma has discussed using parking charges as a mechanism for funding transit improvements within the city but these discussions are highly speculative at this time.</p>

Pierce Transit  
Small Vehicle Analysis

February 28, 2002

**Study Purpose:**

Pierce Transit contracted with GMP Consulting to review existing route ridership trends and to identify routes where the use of 'small' vehicles may be appropriate.

**Summary of Conclusions:**

The use of vehicles with a seated capacity of about thirty passengers, plus fifteen standees, is appropriate on thirteen current Pierce Transit routes, including:

Route 13 – N. 30 <sup>th</sup> Street	Route 220 – Orchard Street
Route 26 – Martin Luther King Jr. Way	Route 402 – Meridian
Route 51 – Union Avenue	Route 405 – Tacoma/Bonney Lk.
Route 60 – Port of Tacoma	Route 406 – Bonney Lake
Route 61 – N.E. Tacoma	Route 407 – Prairie Ridge
Route 65 – 'D' Street/Fife Industrial	Route 413 -Wildwood
Route 100 – Gig Harbor	

Together, these routes utilize about nineteen peak hour vehicles.

This analysis did not attempt to identify the impacts of small vehicles on current interline patterns, or the added operating costs associated with modifying interline patterns to utilize small vehicles. However, with the prominent exception of Route 402, which currently interlines with Route 46, these issues appear to be manageable on most routes.

**Methodology:**

The consultant's approach involved six separate steps, identified below.

1. Development of a Sampling Plan – Pierce Transit's data sources were reviewed to determine possible sources of information about current loading patterns. Two sources were identified – the TRIPS ridecheck database and farebox ridership records. Each has shortcomings, which will be discussed in detail later in this report. After conversing with Pierce Transit's project manager, the consultant elected to use both.
2. Determination of Variability in Loading Trends – The TRIPS system accurately portrays boarding trends, and peak loads encountered on the specific day when a traffic check was conducted. While accurate, this database is also limited, with most trips only receiving one or two checks per year. Before TRIPS information could be used to determine vehicle size needs, it was important to understand how much peak loads vary on the same trip from day to day.

To do this the consultant compared recorded ridership when the TRIPS system contains more than one check for the same weekday trip. A total of

620 duplicated ridechecks were analyzed. Overall, when the difference in the peak load observed on two days was calculated, the standard deviation of the difference in peak load carried was 68%. In other words, the second trip varied from the first by 68%. The amount of variability was most pronounced when the peak loads were small, as shown below.

- When the average peak was less than 10 – Standard Deviation = 97%
- When the average peak was between 10 and 15 – Standard Deviation = 52%
- When the average peak was between 15 and 20 – Standard Deviation = 54%
- When the average peak was greater than 20 – Standard Deviation = 45%
- There were not enough trips with loads exceeding 25 to accurately identify deviations for larger loads

Figures 1 through 5 illustrate the frequency distribution for each subset contained identified above. Overall, they suggest that the distribution of these deviations follows a normal curve. This report is primarily concerned with instances when the peak load is more than twenty passengers. Accordingly, it assumes that the standard deviation for such loads is about 50%. Assuming a normal distribution, this means that about 95% of all maximum loads will normally not exceed twice the load observed during a single observation. This assumption was employed when developing Test 3, discussed below.

3. Identification of Criteria for Determining Appropriate Vehicle Size – While Pierce Transit’s service standards suggest that local services should not exceed 150% of their seated capacity during peak hours, and 100% at other times, there are no specific standards that address the size of vehicle that should be assigned to individual trips. For this analysis, the consultant employed three separate tests.
  - Test 1 – No observed load should exceed 80% of the standing capacity of the vehicle.
  - Test 2 – No more than 5% of observed loads should exceed 80% of the seated capacity of the vehicle.
  - Test 3 – No more than 10% of observed loads multiplied by two should exceed the standing capacity of the vehicle.

The Appropriate size is the largest coach size required to meet each of these three tests. Five possible ‘reduced’ vehicle capacities were initially tested, with the following thresholds established for each vehicle size, as illustrated in Table 1 on the next page.

**Table 1**  
**Test Thresholds for Possible Vehicle Sizes**

Vehicle Capacity	#1-80% of standing capacity	#2-80% of seated capacity	#3-Half the standing capacity
15 seated 15 total	12	12	8
20 seated 20 total	16	16	10
25 seated 37 total	30	20	19
30 seated 45 total	36	24	23
35 seated 52 total	42	28	27

4. Phase 1 Analysis – TRIPS Data Review – The three tests identified above were then employed using the TRIPS ridecheck database. Both weekday and weekend traffic checks were included in the sample. Table 2 illustrates the results of this first screening, highlighting all routes that could be accommodated by each size vehicle. Table 3, at the back of this report, summarizes test results for each Pierce Transit route.

**Table 2**  
**Appropriate Vehicle Size for Individual Routes**

Seated Capacity	15	20	25	30	35	40			
Standing Capacity	15	20	37	45	52	60			
Routes Accommodated by Each Coach Size	60	60 65 406 407 413	13 26 51 56 60 61 65 100 220 405 406 407 413	11 13 16 26 28 42 45 51 53 54 56 59 60	61 65 100 102 200 202 204 212 220 405 406 407 413	10 11 13 16 26 27 28 41 42 45 48 51 53 56 60 61	65 100 102 200 202 204 212 220 300 400 402 405 406 413 500	10 11 13 16 25 26 27 28 41 42 45 46 48 51 52 53 54 55 56 57 59 60	61 65 100 102 200 202 204 206 210 212 214 220 300 400 402 405 406 407 500

While providing a good starting point, Pierce Transit staff expressed concern that unusual events, such as school field trips or community activities, might overwhelm smaller vehicles. While all parties recognized that this is a potential problem on any route regardless of vehicle size, staff members believe that such occasional overloads may be more prevalent on some routes than on others. For this reason, the consultant elected to perform a second test, using farebox counts from October 2001.

5. Identification of a Target Vehicle Capacity – After reviewing the Phase 1 information, Pierce Transit staff suggested that any ‘small’ vehicles purchased by Pierce Transit will likely have a seated capacity of about thirty passengers. Accordingly, the Phase 2 analysis considered the twenty-five routes that can be accommodated by a thirty passenger vehicle, according to the Phase 1 analysis.
6. Phase 2 Analysis – Farebox Records – Pierce Transit’s GFI fareboxes provide a wealth of information about ridership trends by route and hour of the day. Information about individual trips, and especially peak load information on individual trips, is less reliable. There are several reasons for this shortcoming:
  - Operators are instructed to timestamp their farebox whenever they start a new trip. If they neglect this action, boarding information from two trips will be consolidated into a single record. For example, October farebox records identify one Route 53 trip that carried 127 passengers. In all likelihood, this total actually reflected ridership on two or more trips that were consolidated when the operator failed to timestamp at the beginning of a new trip.
  - GFI fareboxes timestamp records each hour, whether or not the farebox was properly time stamped at the beginning of the trip. This means boardings associated with a single peak load occurrence may be recorded on two separate records. This characteristic of the current farebox could have the potential to make any large-scale analysis of GFI data almost impossible. Fortunately, most Pierce Transit routes are in a ‘drop-off’ mode at the top of the hour, making this problem less significant than it first appears. For example, a visual review of Route 402 records for October suggests that most boardings on a single trip are associated with the hourly stamp or the beginning of trip stamp, but not both.
  - GFI fareboxes do not count how many people are on a bus at any given time, only how many people get on a bus along its route. On long routes, such as Route 402, the peak load on at any given trip may be a fraction of the total number of boarding passengers.

For all these reasons, farebox information needs to be treated with a degree of skepticism. Still, fareboxes do provide a crosscheck on traffic check data, and were used in this analysis to hone down the list of routes where small vehicles may be appropriate.

The methodology employed in this analysis was very similar to that employed for Phase 1.

- Test 1 – No more than one percent of observed boardings should exceed 80% of the standing capacity of the vehicle. Because total boardings on a route tend to exceed the peak load, this first test was modified slightly from its Phase 1 counterpart in order to allow for some instances where boardings exceed vehicle capacity.
- Test 2 – No more than 5% of observed boardings should exceed 80% of the seated capacity of the vehicle.
- Test 3 – No more than 10% of observed boardings multiplied by two should exceed the standing capacity of the vehicle.
- In addition, the largest number of boardings recorded by the farebox was tracked. Generally, a route was rejected for a small bus if more than 60 people were recorded on any trip during the month. In one instance (Route 402) this test was discounted after reviewing the trip record.

The results of this second phase test are illustrated in Table 4, below. It suggests that small vehicles may be appropriate on thirteen routes, which were identified at the beginning of this paper.

Table 4  
Farebox Counts of Total Boarding Riders

Route	>36 Riders		>24 Riders		>15 Riders		Largest Load	Small Bus	Peak Vehicles
	Number	Percent	Number	Percent	Number	Percent			
11	16	0.41%	106	2.73%	393	10.12%	53		
13	3	0.15%	17	0.86%	75	3.80%	59	Yes	2
16	48	1.28%	192	5.10%	620	16.48%	74		
26	8	0.82%	33	3.38%	96	9.85%	59	Yes	1
28	64	1.33%	286	5.93%	974	20.19%	76		
42	41	1.10%	257	6.91%	763	20.51%	62		
45	16	0.60%	182	6.78%	525	19.56%	49		
51	1	0.04%	6	0.25%	74	3.11%	38	Yes	2
53	127	2.54%	531	10.61%	1238	24.75%	76		
54	42	1.49%	178	6.33%	514	18.29%	63		
56	10	0.51%	59	3.00%	265	13.48%	70		
59	30	1.53%	71	3.61%	215	10.94%	58		
60	0	0.00%	4	0.58%	35	5.04%	36	Yes	2
61	4	0.46%	12	1.38%	57	6.54%	39	Yes	1
65	1	0.07%	1	0.07%	34	2.52%	43	Yes	1
100	0	0.00%	3	0.12%	102	4.13%	32	Yes	1
102	5	0.65%	35	4.58%	107	13.99%	66		
202	23	0.70%	191	5.85%	711	21.78%	53		
220	1	0.03%	6	0.19%	63	2.04%	43	Yes	2

Route	>36 Riders		>24 Riders		>15 Riders		Largest Load	Small Bus	Peak Vehicles
	Number	Percent	Number	Percent	Number	Percent			
300	26	0.67%	219	5.61%	741	18.99%	62		
402	9	0.30%	110	3.65%	453	15.03%	104	Yes	3
405	2	0.11%	26	1.39%	123	6.56%	45	Yes	2
406	0	0.00%	0	0.00%	3	0.62%	21	Yes	0.5
407	0	0.00%	0	0.00%	0	0.00%	9	Yes	0.5
413	0	0.00%	1	0.10%	7	0.67%	32	Yes	1

Entries in **RED** exceed loading standards for a 30 passenger vehicle

**Considerations:**

1. These recommendations are based upon historical ridership trends. They do not attempt to predict future ridership growth, or make allowance for such possibilities. While there does not appear to be any instance where moderate growth will make a small vehicle impractical, significant ridership growth may necessitate use of a larger vehicle. This is a special concern on Route 402, which appears to have more ridership potential than it currently attracts.
2. Similarly, these recommendations do not make allowance for changes included in the, "Twenty-Year System Vision." Because routes that can appropriately employ a smaller vehicle tend to be the system's least productive services, many are also targeted for changes in early phases of the long-range plans.
3. The effects of current interline patterns were not addressed in this study. Several routes that are targeted for a small vehicle are currently paired with routes that need a larger vehicle. A cursory review suggests that every route except the 402 could operate without interlining to another Pierce Transit service that would continue to use a larger vehicle. Some, such as the 60-series routes, would need substantial rescheduling.