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Fixed Route Accessible Bus Service in Connecticut: A Case Study

Final Report
July 1981

Service and Methods Demonstration Program

U.S. DEPARTMENT OF TRANSPORTATION
Urban Mass Transportation Administration and
Research and Special Programs Administration
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16. Abstract

This study reports on the operating experience of Connecticut Transit's fleet of 280 Flxible buses equipped with wheelchair lifts. This fleet, purchased during 1979, provides service in the Hartford, New Haven, and Stamford areas. The study analyzes operating data on wheelchair lift boardings and denials, accessible and non-accessible bus schedules, bus breakdowns and repairs for all problems and for lifts, lift related accidents and injuries, marginal operating and capital costs, and wheelcahir lift marketing and promotional activities. This special evaluation is part of a larger TSC study of handicapped accessibility to public transit.

Connecticut Transit's experience with accessible service has been one of low lift utilization, lift equipment subject to frequent malfunctions, an inability to provide all of the scheduled lift service, and a high cost per lift-using passenger.

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PREFACE

This study was conducted by Charles River Associates Incorporated under the auspices of the U.S. Department of Transportation's Urban Mass Transportation Administration's Service and Methods Demonstration program. Ms. Lynn Sahaj of the Urban Mass Transportation Administration and Mr. Robert Casey of U.S. Department of Transportation, Transportation Systems Center, provided direction and guidance as the UMTA and TSC project managers. Mr. Richard Bradley, Deputy Commissioner of Transportation for Public Transportation for the State of Connecticut served as the Connecticut project manager.

At CRA this study was managed by David Nelson under the direction of Daniel Brand. The project staff consisted of David Nelson, Marcia Spano and Seth Shepetin. Diane Kemski Pierce served as project secretary.

The study team is endebted to the following individuals for their cooperation: Roger Sweeney, Director of Operations, Connecticut Transit; James Hodges, Director of Maintenance, Connecticut Transit; Stephen Warren, Director of Planning and Marketing, Connecticut Transit; Lloyd Schaffhauser, Director of Finance, Connecticut Transit; William Merton, Scheduling Department, Connecticut Transit; Henry Daversa, Claims Department, Connecticut Transit; Arlene Giglio, Maintenance Department, Connecticut Transit; Mark Mackensie, Maintenance Department, Connecticut Transit; Allen Wamester, Connecticut DOT; Ray Clarke, Connecticut Transit; and John Spaulding, Connecticut DOT.

METRIC CONVERSION FACTORS

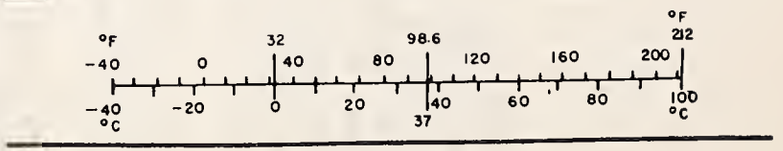
Approximate Conversions to Metric Measures

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 tempereture	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	squere 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	ecres	
	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



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EXECUTIVE SUMMARY

INTRODUCTION

This study was conducted by Charles River Associates Incorporated (CRA) for the Transportation Systems Center (TSC), under the sponsorship of the Urban Mass Transportation Administration's Service and Methods Demonstration (SMD) Program. CRA studied the operating experience of Connecticut Transit's 280 wheelchair lift accessible buses. At the time of this report, Connecticut Transit operated more accessible buses than any other transit agency in the nation. These vehicles are used in each of Conn Transit's three separate operating divisions based in the cities of Hartford, New Haven, and Stamford. Service with these vehicles was initiated in April 1979 in Hartford, July 1979 in New Haven and September 1979 in Stamford.

STUDY OBJECTIVES

U.S. Department of Transportation regulations implementing Section 504 of the Rehabilitation Act of 1973 requires transit agencies to provide handicapped (wheelchair) accessibility on fixed-route service. Since transit agencies have little experience with the emerging technology of transit wheelchair lifts, TSC is performing a series of evaluations funded by UMTA's SMD program to examine recent experience in providing fixed-route lift service for handicapped persons.

The study objectives are to report on Connecticut Transit's experience to guide other systems developing accessible service, and to estimate the costs of providing this service. In a three-month study CRA worked closely with

representatives of Connecticut Transit (Conn Transit) and the Connecticut Department of Transportation (Conn DOT) to develop and analyze data on service development, ridership, scheduling, road calls and repairs, incidents and claims, and costs of accessible service. This summary presents the most salient findings of the study.

STUDY SETTING

Connecticut is a small, thickly settled state in southern New England. It enjoys one of the highest per capita incomes of any state in the union. Conn Transit, owned and controlled by Conn DOT, provides only fixed-route bus service and consists of three seperate operating divisions based in Hartford, New Haven, and Stamford. This study considers service in all three divisions.

FINDINGS

SERVICE PLANNING AND DEVELOPMENT

Conn Transit initially expected that sufficient buses would be available to offer nearly full accessibility. Consequently planning efforts did not identify specific routes for accessible service. Rather, planners aimed at measuring the total market potential for accessible service using a mail-back survey. The survey form was widely distributed. Social service agencies received 20,000 copies of the survey and it was printed in local newspapers and special-interest publications. However, fewer than 400 handicapped individuals responded statewide. Since the advent of service, Conn Transit has modified some routes to provide improved service for the mobility impaired. The new buses have also precipitated changes on high volume routes reflecting the smaller seating capacity of the new buses.

LIFT OPERATION

When not in use, the wheelchair lift serves as the front steps of the bus. To use the lift handicapped passengers approach the front door of the bus where the operator causes the steps to form a platform at the level of the bus floor. This platform is then lowered to street level and the passenger rolls aboard. The platform is then raised, the passenger wheels into the bus and secures himself/herself at a special station equipped with wheelchair "tiedown" facilities. The platform is then collapsed back into the front steps.

The lift is hydraulically powered and controlled from the operator's seat. Operation requires 19 separate steps. Also, many automatic controls are attached to sensors in the lift mechanism. The lift is unforgiving of operator error and often difficult to stow after use.

LIFT POLICIES AND PROCEDURES

The lift is available to any person in a wheelchair. The operator may also offer lift service to individuals using walkers or crutches. All elderly and handicapped patrons pay a 20-cent rather than the customary 50-cent fare.

All bus drivers received four hours of initial training in lift operation and handling handicapped passengers. New drivers joining since the advent of lift service go through the same training program. In addition to initial training a quarterly testing and retraining program was recently initiated to reduce operator error in using the lift. Conn Transit also recently developed a new program of frequent lift inspections to help reduce lift malfunctions which have created a problem with service reliability. The inspection program uses bus drivers to inspect lifts for 50 hours each week. Each lift will be inspected once every two weeks.

EQUIPMENT RELIABILITY

Conn Transit has found the wheelchair lift equipment subject to frequent breakdowns and failure. Two major sources of service unreliability have been identified: equipment malfunction and operator error.

The lift equipment is a complex and delicate machine which also serves as the primary means of entrance and exit to the bus for all passengers. Consequently it is subject to considerable wear and tear even when not in use as a wheelchair lift. The equipment is also subject to intermittent failures; loose connections and faulty relays can cause the lift to fail one time and then work the next. It is difficult and frustrating to try to identify and repair such problems. Lift malfunctions are most often detected and reported when the lift is being used to board or disembark a handicapped passenger.

Lift operation is also complex. Since lift boardings tend to be rare, few operators are extremely familiar with lift operation procedures. Many make mistakes. Failure to successfully complete the lift cycle prevents the bus from proceeding to the next step since a brake interlock system is engaged at all times when the lift is not stowed as steps.

A special ten-week study of boardings revealed that 68 percent of all boardings were completed with no problems. The operator reported some difficulties, usually mechanical problems, in 24 percent of all cases. In the remaining 8 percent of the cases the boarding was denied, usually due to a lift malfunction.

During the three-month study period there were 197 lift-related road calls reported by Conn Transit Maintenance. During this same period there were 855 lift boardings. This implies one lift-related road call for every 4.3 reported boardings.

SCHEDULE RELIABILITY

Conn Transit's scheduling philosophy for the accessible buses presumes that sufficient equipment will be available to provide full accessibility in the base period and nearly full accessibility on local routes during the peak. Local bus route schedules simply tell consumers that all trips on weekends and weekday off-peak hours and most trips during the rush hours are operated with accessible equipment. Nonaccessible trips are not indicated on public bus schedules.

Systemwide, Conn Transit bus assignment sheets call for 95 percent of all daily local trips to be serviced with accessible coaches (Hartford -- 96 percent, New Haven -- 94 percent, Stamford -- 99 percent). However, because of bus breakdowns and repairs and the low levels of spare accessible buses, only 85 percent of all local trips are actually serviced with handicapped accessible equipment (Hartford -- 84%, New Haven -- 86%, and Stamford -- 90%). This discrepancy between scheduled and actual accessibility results in part from the scheduling philosophy of assigning almost all available accessible equipment to service without maintaining an adequate roster of reserves. In Hartford, the peak weekday morning assignment calls for 152 of 155 accessible coaches to be on the road. New Haven assigns 82 of 100 accessible buses in the morning peak. Stamford assignments call for 24 of 25 accessible buses to be operating and available each day. It appears that these levels of reserve capacity are not sufficient to meet the requirements of the daily bus assignments given the rate of breakdowns and repairs experienced with the Grumman Flxible buses.

Since the older nonaccessible coaches have a distinctly different appearance from the advanced design accessible buses, it is readily apparent to even casual observers when an older bus has been substituted for a lift equipped coach. The common appearance of older buses on the road may undermine consumer acceptance of Conn Transit's claims that virtually all service is handicapped accessible.

MARKETING AND PROMOTION

When first initiated, the new accessible service was heavily advertised. Conn Transit used news releases, as well as newspaper, radio and television advertisements to increase public awareness of the new buses and their wheelchair lift capability. Some ads were specifically targeted to the

wheelchair market. A special how-to-use-the-bus handbook for the handicapped was prepared and distributed. Lift demonstrations were conducted for groups of handicapped individuals.

Since the lift service has proven to be less reliable than expected due to missed trips and breakdowns in the field, Conn Transit has become circumspect about aggressively promoting the lift service. Nonetheless, all Conn Transit consumer information aids describe the lift service, and programs of radio ads and public demonstrations are continuing.

RIDERSHIP

By October 1980, only 2,654 lift boardings had been reported. During the summer of 1980, systemwide monthly ridership averaged 285 lift boardings -- approximately one boarding for every bus in the system. Only one out of every 10,000 transit passengers used the lift. Handicapped ridership levels in Hartford averaged 137 lift boardings each month; New Haven averaged 128; Stamford averaged 19. Low ridership may be attributable to a number of factors including the difficulty of wheelchair patrons getting to fixed route bus stops, service unreliability, and the availability of alternative service from private autos and extensive dial-a-ride systems.

In each division handicapped ridership tended to be concentrated on only a few routes. It is also noteworthy that wheelchair traffic occurs principally on high volume routes. In comparing the levels of accessibility offered on different routes to the volume of handicapped ridership on the routes, there is no apparent relationship between accessibility levels and handicapped ridership.

An analysis of handicapped boardings by route and by time of day indicates that no more than a handful of handicapped individuals could be commuting by bus. Similarly an analysis of boardings by time of day shows that only 12.2 percent of all boardings occur before 10 a.m. The lift is most often used during the mid-day off-peak period and seldom used during the evening hours even during the summer months.

INCIDENTS AND CLAIMS

The Conn Transit reports 7 wheelchair-related incidents since the initiation of service. Several of these incidents resulted in claims, only one of which exceeded $400. One of the lesser claims was potentially serious as a wheelchair patron fell from his chair to the ground as the result of a lift malfunction.

ROAD CALLS, REPAIRS, AND MAINTENANCE

During the summer of 1980 Conn Transit maintenance responded to 2,677 road calls for the 280 new lift-equipped buses. Of these, 7.4 percent were lift-related. Many lift related road calls were small problems that could be corrected in the field. Also during the study period 339 lift repairs were reported requiring 573 hours of mechanic time and $21,229 in parts. The mechanic time cost for lifts is roughly equivalent to having 1.5 full-time lift mechanics on Conn Transit staff . However, this level of effort was only 1.5 percent of mechanic time spent systemwide during the study period.

COSTS

According to bids from Grumman Flxible, the wheelchair lifts and related equipment added $8,000 to the total cost of each coach. This amounts to 8.7 percent of total costs for the 35-foot buses and 8.5 percent to the cost for the 40-foot buses.

Since this study collected data on an ongoing program, CRA was not able to estimate many of the start up costs of accessible service including initial inspection and preparation of the equipment, initial training of mechanics, marketing materials development and administrative oversight. However, the initial costs of driver training, service planning, and promotion were in the neighborhood of $75,000. Since these one time start up costs do not represent a recurring expense or an asset which will depreciate and must be replaced, CRA did not include them in the estimates of monthly costs.

CRA estimates the average systemwide monthly cost of accessible service at $46,677. The largest component of monthly cost is the amortization of capital ($29,600). Net monthly revenues were estimated at $57. The current average cost of accessible service is approximately $164 per ride. For the regular wheelchair commuter this implies an annual service cost of $82,000 per commuter. Since capital costs are a large proportion of total costs, the marginal costs of fairly large numbers of additional riders is likely to be modest.

TRANSFERABILITY

For other transit agencies acquiring lift-equipped coaches, there are three basic lessons to be learned from the Conn Transit experience. First, although the emerging technology of transit wheelchair lift equipment will hopefully improve over time and operators with other equipment may experience a different pattern of breakdowns and repairs, it appears inevitable that some level of repairs will be required. Operators should plan for this in their allocation of equipment and maintenance resources. Second, the pattern

of ridership in the first months of accessible service in Connecticut does not indicate that ubiquitous lift accessible service stimulates high demand on all routes. On some routes, substantial levels of wheelchair ridership have been observed. However, many others reported no ridership during the study period. For those operators with significantly less lift capacity than would be necessary for full accessibility, this suggests that a selective strategy would be preferred to a minimal coverage approach for scheduling lift vehicles. If possible, service planners at such agencies should devise techniques to target specific routes for accessible service and eliminate lifts on other routes with limited ridership potential. Third, driver familiarity with lift operation is important to ensure service reliability. This is especially true if lift controls are complex to operate.

UNANSWERED QUESTIONS

With respect to further research on the Conn Transit experience, CRA suggests that it would be worthwhile to examine the following issues which were outside the scope of this study but could be easily investigated with a minimum of new data collection. First, what impacts will the new inspection and training programs have on lift reliability and operating costs? Second, how often do the wheelchair handicapped use alternative services to fixed route accessible transit, such as private autos and dial-a-ride paratransit? Third, what impacts will a severe winter have on ridership and repairs?

1

INTRODUCTION

This study reports on the operating experience of Connecticut Transit's 280 wheelchair lift accessible buses. At the time of this report Connecticut Transit (Conn Transit) operated more accessible buses than any other transit agency in the nation. These vehicles are used in each of Conn Transit's three separate operations divisions based in the cities of Hartford, New Haven and Stamford. Service with these buses was initiated in April 1979 in Hartford, July 1979 in New Haven, and September 1979 in Stamford.

This study investigated ridership, schedules, road calls and repairs, incidents and claims involving passengers, service planning and development, and the costs of accessible service for a three-month period in each of these three operating divisions.

STUDY OBJECTIVES

U.S. Department of Transportation regulations implementing Section 504 of the Rehabilitation Act of 1973 require local transit agencies to provide handicapped (wheelchair) accessibility on fixed-route bus service. (This policy is described in more detail later in this chapter.) Since transit agencies have little experience with the emerging technology of transit bus wheelchair lifts, the Urban Mass Transportation Administration's Service and Methods Demonstration (SMD) Program is sponsoring a series of Transportation Systems Center studies on the experience of operators providing fixed-route wheelchair lift service for the handicapped. This study is part of the series which also includes studies in Seattle, Washington and Washington, D.C.

The objectives of the study are to report on Connecticut Transit's experience with the new service to provide information for other systems developing accessible service, and to estimate the costs of providing this service. CRA worked closely with representatives of Connecticut Transit (Conn Transit) and the Connecticut Department of Transportation (Conn DOT) to develop and analyze data of the following types.

Service Planning and Development:

- A description of service planning
- A description of service implementation
- A description of the promotional and marketing efforts

Ridership (Demand):

- Lift-assisted boardings by wheelchair users by route and time of day
- The number of boardings denied and the reasons for them

Scheduling (Supply):

- Total number of scheduled accessible bus trips and non-accessible bus trips per weekday by route
- The number of accessible bus trips missed each day

Road Calls and Repairs:

- The number of road breakdowns of all buses and the number of road breakdowns due to lift-related problems
- Labor hours to repair all buses and the labor hours to repair the lift equipment
- Description of lift problems and the number of occurrences of each

Incidents and Claims:

- The number and types of passenger injuries or incidents involving the lifts and tiedowns

Costs of Accessible Service:

- Total marginal costs of operating accessible buses and a breakdown of these costs. Ideally, the breakdown would include costs for each capital and operating cost element

The subsequent chapters report CRA's findings on these topics based on a three-month analysis of data from the summer of 1980 (June, July and August).*

ORGANIZATION OF REPORT

This report is divided into eight chapters. Each chapter is briefly described below.

The remainder of this first chapter describes the Section 504 Regulation and its relationship to this report, the study setting, and the Grumman Flxible lift-equipped bus.

Chapter 2 describes Conn Transit's Service Planning and Development for wheelchair accessible service. It describes the planning survey of potential ridership and marketing and promotional efforts.

Chapter 3 describes the study findings on the "supply side" of the accessible bus service. It covers service scheduling, wheelchair lift operation, policies and procedures, and the schedule of accessible services. Finally, it includes an analysis of accessible service schedule reliability.

Chapter 4 describes study findings concerning demand for wheelchair lift service. It describes wheelchair ridership development and the pattern of ridership by route and time of day.

Chapter 5 provides a brief description and analysis of incidents and claims involving wheelchair passengers since the initiation of service.

Chapter 6 presents and analyzes the findings with respect to the maintenance and repair of wheelchair lifts. Three broad categories of activity were investigated: road calls, repairs and maintenance, and inspections.

Chapter 7 analyzes the costs of accessible service.

Chapter 8 provides recommendations and suggestions for further research.

The report also contains a number of technical appendices providing more complete route- and month-specific detail on ridership, service reliability, lift operation and repairs.

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*Boardings and denials were studied from July through September.

SECTION 504 REGULATION AND THIS STUDY

The U.S. Department of Transportation's Final Rule implementing Section 504* of the Rehabilitation Act of 1973 requires systems receiving federal funds to achieve handicapped accessibility within a specified time frame. Among the several elements included in the accessibility program, it is the requirement that at least one-half of the peak-hour fixed-route bus service be accessible to wheelchair users** within ten years.+ During off-peak hours, transit systems must use accessible vehicles before inaccessible vehicles. In addition, all new fixed-route buses of any size for which solicitations were issued since July 2, 1979 must be accessible to handicapped persons, including wheelchair users.

These provisions of the regulations will require a gradual phase-in of accessible buses into fixed-route service so as to achieve accessibility by July 1, 1989.

All urbanized areas receiving federal funds will be submitting their transition plans (by July 1, 1981 for multimodal systems) which describe their selected strategy and timetable for meeting the program accessibility requirements. The transit systems will be conducting detailed planning activities as their target dates for the phasing-in approach. This study considers the experience of a large fleet of accessible vehicles. It provides some lessons to guide the planning and implementation of accessible services.

STUDY SETTING

Connecticut is a thickly settled small state in the Northeast Corridor. This southern New England state is highly industrialized and enjoys one of the

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*Title 49, Code of Federal Regulations, Part 27, published in Federal Register, Volume 44, No. 106, page 31,441 on May 31, 1979.

**When the term "wheelchair users" is used in the regulation, the Department also intends that accessibility be provided to persons whose handicap is not severe enough to require the use of a wheelchair, e.g., persons who use crutches or walkers.

+Interim accessible service, such as paratransit, is required if this level of accessibility is not achieved within three years.

highest per capita incomes of any state in the union -- $8,061 per capita.* (For purposes of comparison between metropolitan areas, the 1969 mean income per family member for Connecticut was $3,862.**)

Connecticut has a temperate climate with an annual mean temperature of 49.1°F, a high monthly average of 72.7°F and a low monthly average of 24.8°F.+

CONNECTICUT TRANSIT

Connecticut Transit (Conn Transit) is a transit operating agency owned by the State of Connecticut and controlled by the Connecticut Department of Transportation (Conn DOT). Since June 1979, Conn Transit has been operating under the management of ATE Management and Service Co., Inc. through a contract with Conn DOT. Conn Transit provides fixed route bus service only.

Conn Transit consists of three operating divisions (formerly private bus companies) based in three cities: Hartford, New Haven, and Stamford (see Figure 1-1). Each of these cities, and Conn Transit service in each, are described below.

HARTFORD

Hartford is the capital of Connecticut and one of the three original colonial settlements in the state. Today, Hartford is the state's largest city (see Tables 1-1 and 1-2) and an international center for the insurance industry. The capital region is Connecticut's most populated and largest metropolitan area, with over 1 million inhabitants (1,056,000). The inhabitants are moderately well-to-do, with a per capita income equivalent to that of the state as a whole.

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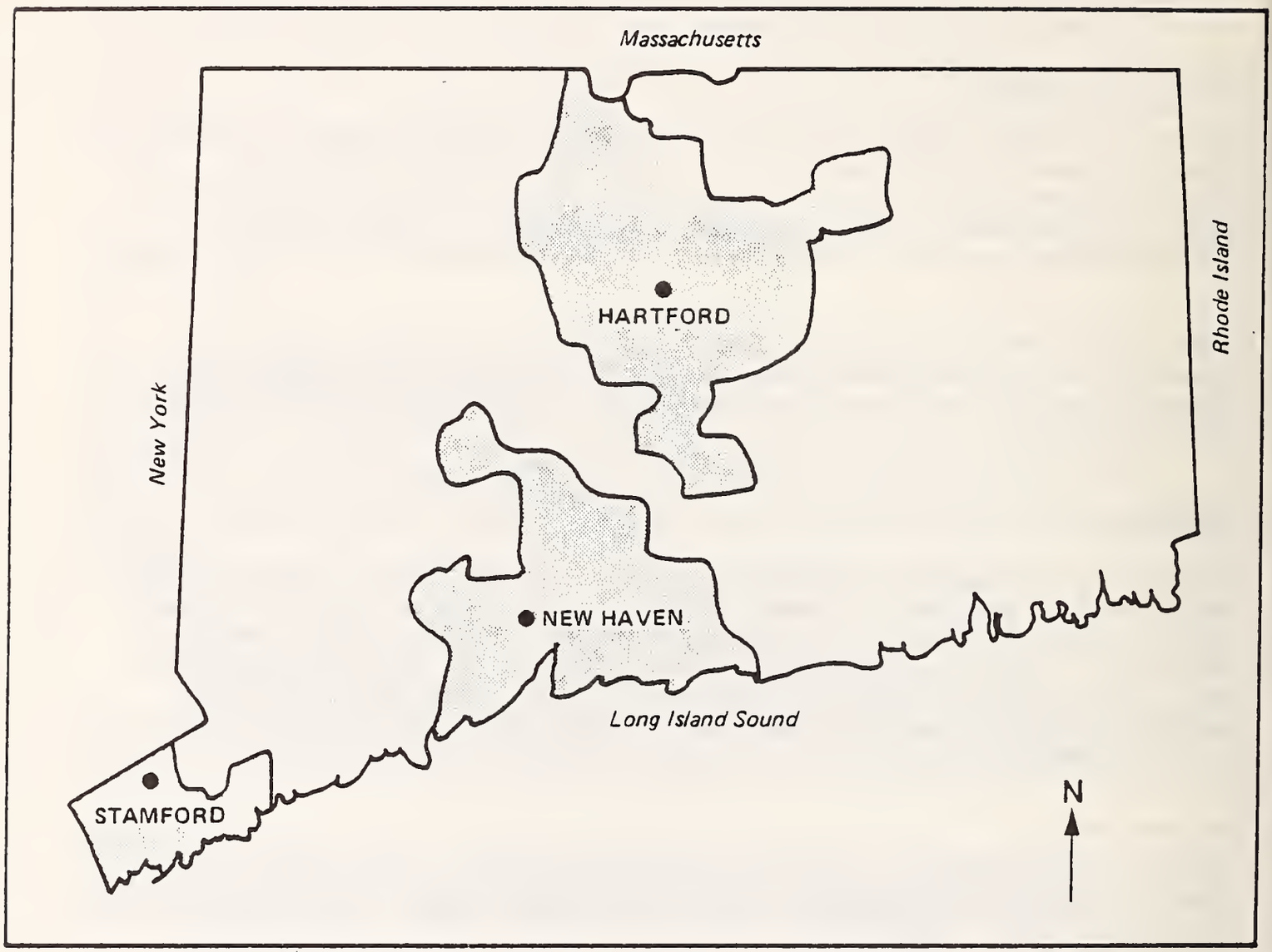
*Connecticut is second to Alaska in income per capita. U.S. Bureau of the Census, Statistical Abstract of the United States: 1978. 99th Edition. Washington, D.C., Table 725.

**U.S. Department of Commerce, Social Economic Statistics Administration, U.S. Bureau of the Census, 1970 Census of Population: General Social and Economic Characteristics, Connecticut. Mean Income Per Family Member, Table 89.

+Hartford data from U.S. Department of Commerce, Monthly Normals of Temperature, Precipitation and Heating and Cooling Degree Days, 1941-1970, National Oceanic and Atmospheric Administration (National Climatic Center, Asheville, NC, August 1973).

Figure 1–1

CONNECTICUT TRANSIT SERVICE AREAS BY DIVISION*



* Map shows towns and cities served by local or express bus, (no scale).

SOURCE: Bus System Maps, Connecticut Transit, October 1980.

Table 1-1

STUDY AREA CHARACTERISTICS

	Hartford	New Haven	Stamford	Total
Metropolitan Area Characteristics				
1976 SMSA Population (in thousands)[1]	730	413	203	1,346
Annual SMSA Growth Rate 1960-1976[2] (percent)	1.01	1.01	1.01	1.01
Per Capita Income[3] (dollars)	3,860	3,627	6,289	4,155
1976 NECMA Population[4] (in thousands)	1,056	759	799	2,614
Conn Transit Service Area Characteristics				
1970 Population (in thousands)[5]	670	587	268	1,525
Area (square miles)[6]	568.7	371.6	120.5	1,060.8
Total Revenue Passengers, August 1980 (in thousands)[7]	1,353	764	133	2,250
Wheelchair Riders, August 1980[8]	137	75	28	240

Table continued on following page.

Table 1-1 (Continued)

STUDY AREA CHARACTERISTICS

	Hartford	New Haven	Stamford	Total
Service Characteristics				
Accessible Buses[9]	155	100	25	280
Total Buses[10]	280	140	36	456
Number of Local Bus Routes[11]	28	29	13	70
Number of Scheduled Weekday Local Bus Trips[12]	1,398	1266.5	347.5	3,012
Percent of Weekday Bus Trips Scheduled Accessible[13]	96	94	99	95

Notes:

(1) U.S. Bureau of the Census, Statistical Abstract of the United States: 1978. 99th edition. Washington, D.C., 1978. Table 20: "Large Metropolitan Areas -- Population: 1960 to 1976."

(2) Derived from Statistical Abstract above.

(3) Mean income per family member, Table 89, U.S. Department of Commerce, Social and Economic Statistics Administration, Bureau of the Census, 1970 Census of Population: General Social and Economic Characteristics, Connecticut.

(4) New England County Metropolitan Areas data from Statistical Abstract.

Table continued on following page.

Table 1-1 (Continued)

STUDY AREA CHARACTERISTICS

(5) U.S. Bureau of the Census.

(6) U.S. Bureau of the Census.

(7) Connecticut Transit.

(8) Connecticut Transit.

(9) Ibid.

(10) Ibid.

(11) Ibid.

(12) Charles River Associates Incorporated.

(13) Charles River Associates Incorporated.

Table 1-2

CITIES AND TOWNS SERVED BY CONNECTICUT TRANSIT

	Population (in Thousands)	Area (Square Miles)
Hartford Division		
Local Service		
Bloomfield	18	26.3
Cromwell	7	12.3
East Hartford	58	18.1
Farmington	14	28.4
Glastonbury	21	51.7
Hartford	158	17.2
Middletown	37	41.7
New Britain	83	13.3
Newington	26	13.2
Rocky Hill	11	13.6
South Windsor	16	28.0
Vernon	27	18.3
West Hartford	68	21.9
Wethersfield	27	12.5
Winchester	11	32.3
Windsor	23	30.2
TOTAL	605	379.0
Commuter Express Service Only		
Avon	8	23.5
Canton	7	24.6
East Granby	4	17.4
Granby	6	41.1
Simsbury	17	34.5
Tolland	8	39.7
Windsor Locks	15	8.9
TOTAL	65	189.7
TOTAL (Hartford Division)	670	568.7

Table continued on following page.

Table 1-2 (Continued)

CITIES AND TOWNS SERVED BY CONNECTICUT TRANSIT

	Population (in Thousands)	Area (Square Miles)
New Haven Division		
Local Service		
Ansonia	21	6.2
Branford	20	21.5
Cheshire	19	32.4
Derby	13	5.2
Hamden	49	32.7
Guilford	12	46.6
Madison	10	36.0
Milford	51	22.3
New Haven	138	18.4
North Haven	22	21.0
Orange	14	17.4
Seymour	13	14.4
Wallingford	36	39.4
Waterbury	108	28.6
West Haven	53	10.6
Woodbridge	8	18.9
TOTAL	587	371.6
Stamford Division		
Local Service		
Darien	20	12.9
Greenwich	60	47.3
Norwalk	79	23.0
Stamford	109	37.3
TOTAL	268	120.5
SYSTEM TOTAL	1,525	1,060.8

SOURCES: Population figures from: U.S. Bureau of the Census, U.S. Census of Population: 1970 Number of Inhabitants Final Report PC(1)-A8. Connecticut. U.S. Government Printing Office, Washington, D.C., 1971, Table 6.

Area measurement figures from: U.S. Bureau of the Census, U.S. Census of Population: 1960, Area Measurement Report GE20-8, Connecticut. U.S. Government Printing Office, Washington, D.C., 1960, Table 1.

The service area of Conn Transit's Hartford division includes 28 local routes and several express routes serving 23 central Connecticut cities and towns with a total land area of 568.7 square miles. On the local routes Conn Transit schedules 1,398 bus trips each weekday. Conn Transit bus assignment sheets call for 96 percent of Hartford's local weekday bus trips to be accessible to the handicapped.

During August 1980, Conn Transit carried 1.353 million revenue passengers in the Hartford division. It is estimated that the Capital Region Planning Region has 64,000 handicapped inhabitants, including elderly persons with disabilities.* For the planning region, this implies a handicap incidence rate of 9.5 percent.

NEW HAVEN

New Haven is the state's second largest city and the home of Yale University. The "Elm City" metropolitan area is somewhat smaller and less populous than Hartford, having 759,000 inhabitants. Incomes in the area are approximately equivalent to Hartford's.

The New Haven division service area includes 29 local routes and several express runs serving 16 southern Connecticut cities and towns with a total land area of 371.6 square miles. On the local routes Conn Transit schedules approximately 1,266 round-trip bus trips each weekday. Conn Transit bus assignment sheets call for 94 percent of all local weekday trips to be covered with accessible vehicles.

During August 1980, Conn Transit carried 764,000 revenue passengers in the New Haven area.

STAMFORD

Stamford is one of a number of smaller cities on the Connecticut-New York border. This "conurbation" of cities in the greater New York metropolitan region comprises Connecticut's second largest statistical metropolitan area. The Stamford Division service area of Connecticut Transit, however, only serves a small portion of this urban area, essentially only the small Connecticut "panhandle." The income distribution in the Stamford metropolitan area is skewed to the high end of the scale in comparison to the

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*Greater Hartford Transit District, Transition Plan, January 1980. (Revised May 27, 1980.)

rest of Connecticut and the nation as a whole. This results in part from the fact that Connecticut has no income tax. (Southwestern Connecticut is a tax haven for wealthy New Yorkers).

The Stamford division service area provides service in 4 cities with 13 local routes using a fleet of 36 buses. Each weekday the division runs approximately 348 round-trip bus trips. Stamford's bus assignment sheets call for virtually all trips to be covered with accessible vehicles.

During August 1980, the division served 133,000 revenue passengers.

GRUMMAN FLXIBLE BUS

Conn Transit provides wheelchair accessible service with a fleet of 280 Grumman Flxible 870 transit vehicles. These vehicles, ordered in the summer of 1977, were in full service by the fall of 1979. Each bus is of the so-called "Advanced Design" and are among the first advanced design buses manufactured by Grumman Flxible. The total cost for the fleet was $26,310,840 for an average cost of approximately $94,000 per coach.* This includes the bid price for the wheelchair lift, tiedown, and related equipment of $8,000 per unit.

Each bus is equipped with a wheelchair lift manufactured by the Environmental Equipment Corporation. When not in use, the lift mechanism serves as the front steps to the bus. It is designed to operate entirely from the driver's compartment of the vehicle. (Lift operation is described in Chapter 3.)

Each bus is equipped with two tiedown stations. Each tiedown consists of a padded restraining arm and a safety belt. The tiedown stations are attached to the underside of hinged jumpseats which must be latched in an upright position to expose the tiedowns. The hinged seats are available for other passengers when not in use by wheelchair patrons.

In addition to the lift, each bus is equipped with a kneeling feature which lowers the front right side of the bus to accommodate elderly and handicapped passengers who lack the strength and range of motion to negotiate the first step onto the bus.

Each bus is also air conditioned and features very large tinted windows. Two sizes of buses were purchased; 118 thirty-five foot coaches with a seating capacity of 37 each and 162 forty-foot coaches with a seating capacity of 47 each.

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*Grumman Flxible is now offering these buses for $125,000 to $140,000 each (based on an interview with Dan Law, Administrative Aide, Grumman Flxible Corp., April 2, 1980.)

2

SERVICE PLANNING AND DEVELOPMENT

SERVICE PLANNING

Planning for the wheelchair accessible service was initiated in June 1977 approximately one year before the fleet of new accessible buses was to arrive in Connecticut. Efforts began in earnest during January of 1978 when a survey was conducted to determine the market for accessible services. The planning effort was designed to identify the routes which should have highest priority in the assignment of first deliveries from the accessible fleet. From the outset, however, it was understood that sufficient buses would be available once the entire fleet of accessible buses was received to offer fully accessible service in base periods. Consequently, planning efforts were not designed to identify specific routes and runs for accessible service over the long term.

THE SURVEY

The survey form shown in Figure 2-1 was designed and printed to identify potential transit patrons in the handicapped population. Conn DOT distributed approximately 20,000 of these surveys to social service agencies, for return to Conn Transit. Respondents were asked to return the surveys within one month. In many cases the agencies returned packets of completed surveys.

Figure 2–1

HANDICAPPED MARKET SURVEY FORM

ATTENTION
MOBILITY HANDICAPPED CONNECTICUT RESIDENTS

Connecticut Transit will be introducing special new buses in the near future that are equipped with elevator platforms that provide accessibility for wheelchair confined and other mobility handicapped persons. If you have a physical handicap that limits your use of the bus, please fill out and mail in the self-identification survey provided. This information will be kept completely confidential and will be used for planning purposes only. Connecticut Transit will send you a free "How-To-Ride-The-Special-Lift-Buses" brochure when available in the near future. Thank you!

PLEASE CIRCLE THE NUMBER IN FRONT OF YOUR ANSWER

1. Do you have any permanent medical condition or impairments which affect your mobility?
   1. yes 2. no

   If yes, what is the primary or major condition or impairment? (choose one)
   1. Physical Impairment
   2. Amputee
   3. Visual Impairment
   4. Hearing Impairment
   5. Mental Disorder
   6. Other (specify) _____

2. Do you need to use any of the aids listed below to help you get around?
   1. Wheelchair
   2. Walker
   3. Crutches, cane or walking stick
   4. Leg or foot brace, Artificial leg or foot
   5. Guide dog
   6. Hearing aid
   7. Other (specify) _____

3. Select the phrase which best describes your ability to get on or off the present Connecticut Transit buses equipped with the regular steps.
   1. With no difficulty
   2. With some difficulty
   3. With great difficulty
   4. Cannot do at all

4. Is there a Connecticut Transit bus stop near your home?
   1. yes 2. no

   If yes select the phrase which best describes your ability to get to the nearest bus stop if a bus you could ride (equipped with a lift and other special equipment) stopped there.
   1. With no difficulty
   2. With some difficulty
   3. With great difficulty
   4. Could not do at all

5. Suppose that this specially equipped bus you could ride stopped two blocks from your home. Select the phrase which best describes your ability to get to the bus stop.
   1. With no difficulty
   2. With some difficulty
   3. With great difficulty
   4. Could not do at all

6. How often do you expect to ride the new accessible buses?
   1. 6 to 7 days a week
   2. 3 to 5 days a week
   3. 1 to 2 days a week
   4. less than once a week
   5. Never

7. Select the purpose which best describes your most predominant use of the buses.
   1. To and from work
   2. To and from shopping
   3. To and from social/recreational activities
   4. Other

FOR FURTHER INFORMATION ON THE NEW BUSES OR SURVEY FORM, PLEASE CALL:

STEPHEN W. WARREN
DIRECTOR OF PLANNING AND MARKETING
CONNECTICUT TRANSIT

522-8101

PLEASE MAIL SURVEY TO:

DIRECTOR OF PLANNING & MARKETING
CONNECTICUT TRANSIT
53 VERNON STREET
HARTFORD, CONNECTICUT 06106

MY NAME _____

ADDRESS _____

CITY _____ STATE _____

ZIP _____

The survey form was also printed in most area newspapers including major dailies, local weeklies, and special-interest publications serving the elderly. In all, fewer than 400 completed surveys were received.

The principal finding of the survey was that potential wheelchair ridership tended to have the same geographic distribution as current able-bodied ridership. Hospitals and other medical care facilities represented the only significant concentrations of potential wheelchair patronage.

PHASE-IN OF ACCESSIBLE SERVICE

Accessible service was initiated in each division (city) before the entire fleet of lift equipped vehicles was finally delivered. Accessible service was first initiated in Hartford during April, 1979. New Haven service began in July of 1979. Stamford ran its first accessible bus in September 1979. As new buses arrived they were assigned one route at a time to make individual routes fully accessible in the base (off-peak) period. In Hartford, the first fully accessible route was the E Route (Farmington Avenue) which has the heaviest total ridership in the division. Connecticut Transit reports no complaints from the mobility-impaired community regarding the distribution and scheduling of wheelchair accessible service.

SCHEDULE MODIFICATIONS

Since the advent of accessible service in April 1979, the planning department has made some marginal changes (route deviations) on approximately eight to ten routes to provide improved service to major traffic generators in the mobility-impaired market segment. These traffic generators are primarily hospitals and elderly housing complexes. For instance, the P route linking Hartford and New Britain was modified as it passed through downtown Newington to provide service to a new high-rise complex for the elderly and the Newington Children's Hospital (formerly the Crippled Children's Hospital). Similarly, in New Haven a shuttle to the Veteran's Administration Hospital was started and then replaced with direct service to downtown. A rehabilitation center which was formerly served in only one direction on a loop-end route is now served bidirectionally.

The introduction of the new buses has precipitated some other schedule changes on selected high-volume routes. These changes have been prompted by three related circumstances. First, the new buses have somewhat less seating

capacity than the older GMC buses.* Second, on short headway/high volume routes, schedule adherence is a problem. Third, anticipated dwell times for wheelchair patrons are longer than for other passengers. These considerations have led Conn Transit to schedule additional buses on several high-density (7.5- to 10-minute headway) routes in Hartford and New Haven. Conn Transit's general scheduling philosophy with respect to dwell times and schedule adherence for wheelchair service, however, has been to take a "wait and see" attitude. Due to the generally low level of wheelchair ridership, no changes specifically to adjust for this service have been required. Most route and service changes have taken place in response to general overcrowding or changes in the pattern of demand (e.g., the opening of a new apartment complex).

MARKETING AND PROMOTION

The marketing and promotion of accessible services has had two components. First, advertising for and information about wheelchair accessible services are included in Conn Transit's regular advertising and information aids. Second, Conn Transit conducts wheelchair lift demonstrations on request from groups or organizations representing potential wheelchair patrons.

MARKETING PHILOSOPHY

Two points should be made to provide perspective on the Conn Transit marketing programs. First, Conn Transit is generally overloaded on-peak. The system is not in the market to expand its peak period work trip modal share. Most new marketing initiatives have focused on stimulating off-peak ridership. To this end students have been identified as a fruitful off-peak market and Conn Transit is now advertising on school book covers. Second, because its lift service is somewhat unreliable, Conn Transit has not engaged in an aggressive promotional campaign for the lifts, fearing that many customers might be disappointed with the quality of service.

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*Conn Transit's older 40-foot GMC buses have a seating capacity of 51 passengers (47 in the 35-foot model) versus 47 passengers in the Grumman Flxibles (37 in the 35-foot model). This reduction in capacity results in part from the seating configuration dictated by the wheelchair tiedowns and the necessity for wide aisles toward the front of the bus to facilitate wheelchair maneuvering. However, according to an interview with a representative of Grumman Flxible, the seating capacity for a non-accessible coach is only one more seat per 40-foot coach (3 seats in the 35-foot coach). Therefore, the accessible feature per se is responsible for only a small portion of the capacity reduction (Interviews with Don Law, Administrative Aide, Grumman Flxible Corporation, April 2, 1980 and February 3, 1981).

ADVERTISING

Conn Transit uses a variety of media for transit promotion. The curent budget allocates $70,000 for newspaper advertising. Newspaper ads are primarily used to introduce schedule or service changes. The ad describing the new buses, shown in Figure 2-2, ran when the Flxible fleet was introduced. Other advertisements such as the ones shown in Figure 2-3 were specifically targeted to the wheelchair market.

Conn Transit spends $25,000 annually for radio advertising. In addition to this sum it also trades some bus side advertising space to major radio stations in return for $75,000 worth of free airtime. Some Conn Transit radio spots on selected stations air messages about specific services or service changes (e.g., reverse commutation services are advertised on Spanish language stations). However, most radio ads are run from a "cart" of twelve standard 60-second messages about Conn Transit services. One of the twelve is specifically targeted to the wheelchair market.

Since one-twelfth of the standard radio ads are wheelchair-oriented and approximately $100,000 are annually spent on radio ads, it is conservative to estimate $8,000 as the annual cost of promoting accessible service.

During 1979 Conn Transit ran television spots. One of the four standard messages highlighted wheelchair service. This television campaign, organized around the theme of the "The Bus is Just for Us," has been discontinued due to its high cost.

INFORMATION AIDS

The basic consumer information aids for Connecticut Transit include material on the wheelchair accessible service including a telephone number to call for more information. All regular local route service schedules (e.g., not commuter express buses) contain a special message for handicapped riders, as shown in Figure 2-4.

Conn Transit also distributes a pamphlet entitled "How-To-Ride The Bus." Among other things, this booklet describes how to use the wheelchair lift and tiedown facilities.

DEMONSTRATIONS

Conn Transit has been cooperating with Conn DOT in running demonstrations of the wheelchair lift and kneeling features of the new accessible buses. These demonstrations are conducted on a request basis. All requests from groups or

Figure 2–2

ADVANCED DESIGN BUS ADVERTISEMENT

Hey! Look me over.

I'm your new Connecticut Transit Bus.

Over the next few months Connecticut Transit will be replacing a majority of its fleet with the most modern buses ever made. Now when you ride the bus, you'll really travel in luxury. These new vehicles are quieter, have a smoother ride, are spacious, and are designed to give you the most pleasant enjoyable ride ever.

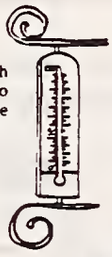
What a view!

Huge, tinted, picture windows made of space age break proof plastic permit 50% more visibility for you.

Sit on it!

Contoured orthopedic designed seats are attached to the side of the bus leaving a totally unobstructed area underneath to stretch out tired legs or for storing packages.

Hot or cold!



Even if it's in the high nineties or below zero outside, you'll be comfortable inside due to the automatic climate control system designed to provide year-round comfort.

Kneeling for you!

The specially designed "kneeling" feature allows the right front corner of the bus to lower six inches so that boarding for our elderly and handicapped passengers will be a lot easier.

Wider front door
Wider rear door
Wider aisle

will make your trip much less cramped.

How BIG?

The illuminated overhead destination signs are over a foot tall which will make them much easier for you to read.

Can we give you a lift?

Our new bus is even equipped with a safe, easy to use wheelchair lift. A secure platform is lowered to the curb which will lift you on and off the bus if you are confined to a wheelchair. Exact details on the use of the lift are available in our "How-To-Ride-The-Special-Lift-Bus" brochure. To obtain your free copy simply call the number listed below and it will be mailed to you free of charge.

Where's the pull cord?

A mere light touch to the pressure sensitive tape strip located vertically between each window will sound a pleasant chime to remind the driver that you wish to get off at the next stop.

NEW BUSES, PURCHASED BY THE CONNECTICUT DEPARTMENT OF TRANSPORTATION WILL BE ON PUBLIC DISPLAY
APRIL 4 & 5, 11:15 AM - 1:30 PM
At the Travelers Rotunda
Downtown Hartford

FOR BUS INFORMATION AND SCHEDULES CALL
525-9181

CONNECTICUT TRANSIT

Figure 2–3

WHEELCHAIR LIFT ADVERTISEMENT

how to ride

the special lift buses

CONNECTICUT TRANSIT

CAN WE GIVE YOU A LIFT?

Connecticut Transit is in the process of replacing a majority of its fleet with buses equipped with a safe, easy-to-use wheelchair lift. A secure platform is lowered to the curb which lifts persons confined to wheelchairs on and off the bus. Exact details on the use of the lift are available in our "How-To-Ride-The-Special-Lift-Bus" brochure.
To obtain your free copy simply call

525-9181

or mail the coupon below to:

CONNECTICUT TRANSIT INFORMATION CENTER
53 Vernon Street, Hartford, CT 06106

CONNECTICUT TRANSIT

Please send me:

How-to-Ride-The-Special-Lift-Bus brochure
System-Wide Bus Map
Schedule information and route for following trip. I want to travel.

from _____
closest major intersection street community

to _____
closest major intersection street community

NAME _____

ADDRESS _____

CITY _____ ZIP _____

Figure 2–4

SCHEDULE INFORMATION FOR HANDICAPPED RIDERS

ATTENTION HANDICAPPED RIDERS

THE NEW LIFT-EQUIPPED BUSES ARE NOW OPERATING ON THIS ROUTE. **ALL TRIPS** ON WEEKENDS AND DURING WEEKDAY OFF-PEAK HOURS & **MOST TRIPS** DURING WEEKDAY PEAK HOURS ON THIS ROUTE ARE OPERATED WITH THESE NEW DESIGN BUSES. PLEASE CALL THE CONNECTICUT TRANSIT INFORMATION CENTER TO FIND OUT THE SPECIFIC WEEKDAY PEAK HOUR TRIPS THAT ARE RUN WITH THE LIFT-EQUIPPED BUSES. REMEMBER THAT YOUR ATTENDANT RIDES FOR FREE.

SOURCE: Bus Route Schedule, Connecticut Transit, Department of Planning and Marketing, September 1980.

agencies promising attendance by at least 5 individuals are honored. Currently, Conn Transit conducts approximately one demonstration per month. When accessible service was initiated, Conn Transit ran demonstrations nearly every week. A total of approximately 20 demonstrations have been run since the initiation of service. If an individual requests a demonstration of the accessible service, he/she is encouraged to come to the local transit garage for an introduction to the lift.

The most recent public demonstration was "Love-a-Bus" Day in Connecticut on a Saturday in early September. On this Saturday handicapped persons were encouraged to congregate at a central point in each service area. If possible they were to use fixed-route accessible transit service to arrive.

Love-a-Bus Day was conceived and organized by the "Big Block," a handicapped persons organization based in Hartford. The Big Block coordinated with other handicapped organizations around the state to conduct this statewide demonstration of handicapped transportation. In cities where there is no fixed-route accessible transit service, such as Norwalk, the demonstrations focused on paratransit modes. In part because of the support of political and community leaders, the Love-a-Bus Day was a media event which served to publicize handicapped transportation in the state.

In Hartford 50 to 75 handicapped persons participated in the demonstration at the Old State House which is adjacent to the major downtown bus transfer terminal. Approximately two-thirds arrived on Conn Transit service. At the demonstration a gubernatorial proclamation was issued and Love-a-Bus t-shirts and buttons were sold. Box lunches were provided. A survey of demonstration attendees was conducted. However, response to the survey was poor and the data were not tabulated.

3

ACCESSIBLE BUS OPERATIONS

LIFT OPERATION

When not in use, the lift is stowed as the front steps of the bus. When handicapped passengers wish to use the lift, they approach the front of the bus. The operator then executes a complex sequence of operating steps which cause the steps to form a platform at the level of the coach floor, as shown in Figure 3-1. The platform is then lowered to street level and the passenger rolls aboard. The lift is then raised, the passenger wheels himself/herself into the bus and secures himself/herself at a special station equipped with wheelchair "tiedown" facilities. The platform is then collapsed back into steps.

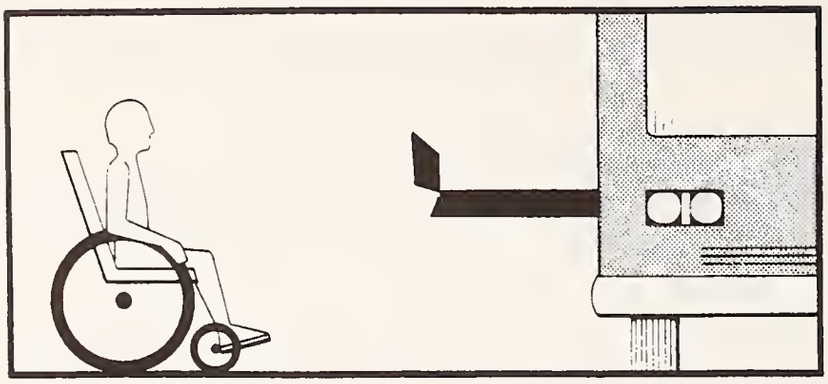
The lift is moved by three hydraulic motors powered by fluid diverted from the power steering mechanism. One motor forms the platform, another raises and lowers the platform, the third operates a small barrier flap on the outer edge of the lift. (This barrier flap helps keep the passenger from rolling off the lift.)

Lift operations are controlled from the operator's seat (see Figure 3-2). In addition to these controls, a number of automatic controls are attached to sensors in the lift mechanism.

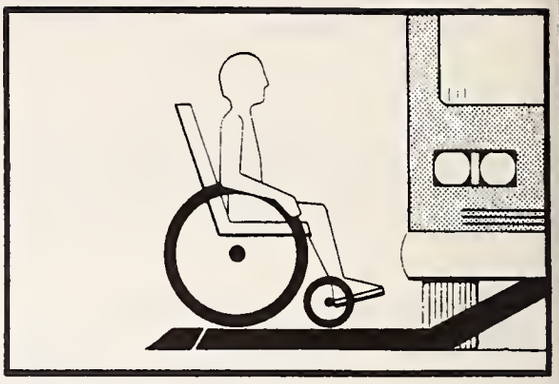
More detail on equipment operation is provided for the interested reader in Appendix A.

Figure 3–1

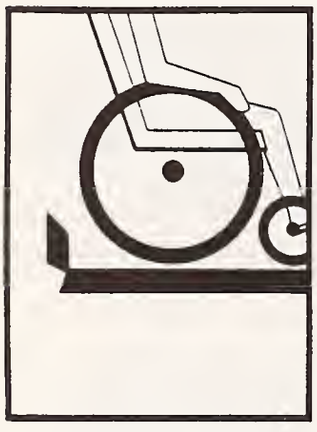
BASIC LIFT OPERATIONS SEQUENCE*



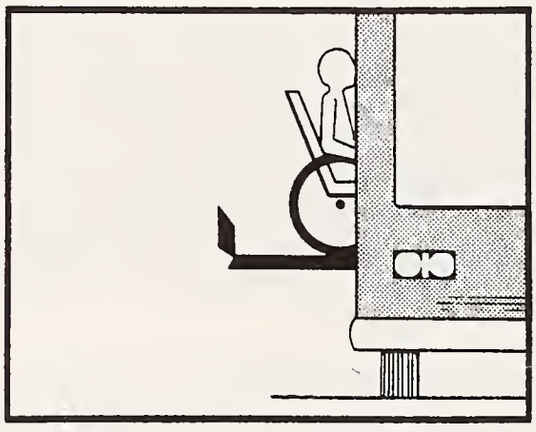
A. FORM PLATFORM



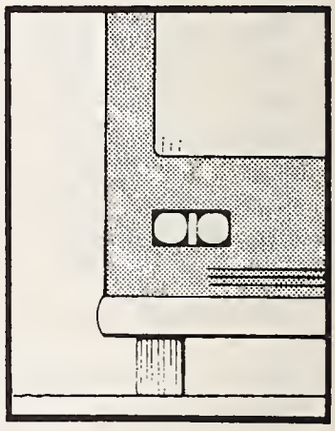
B. LOWER PLATFORM AND FLAP – BOARD PASSENGER



C. RAISE BARRIER FLAP



D. RAISE PLATFORM – BOARD PASSENGER



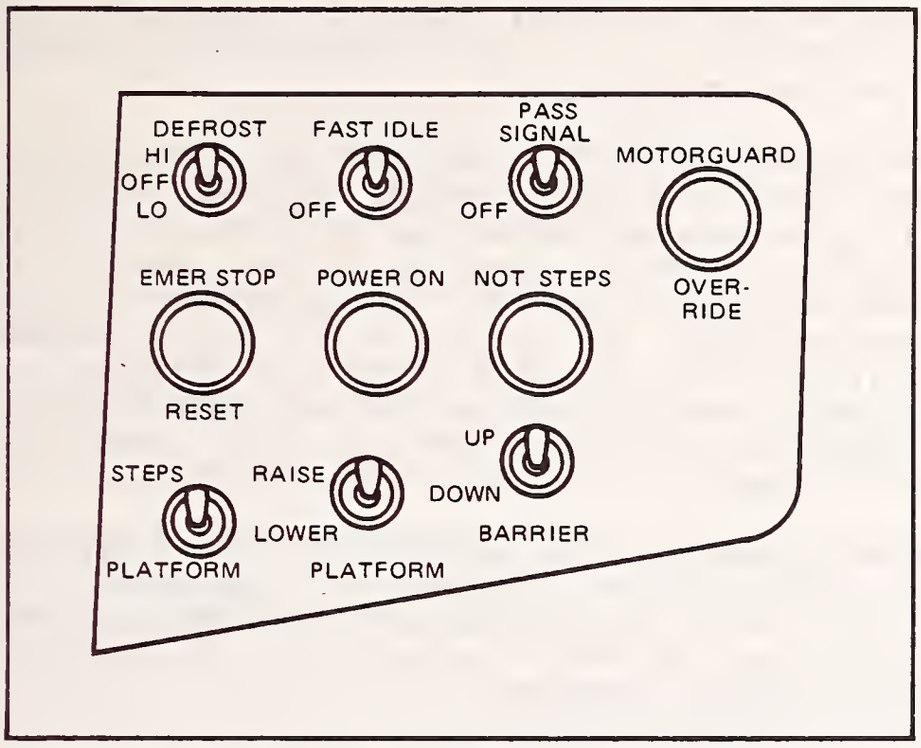
E. FORM STEPS – PROCEED TO NEXT STOP

* Diagram not to scale

SOURCE: Charles River Associates, 1980.

Figure 3–2

CONTROL PANEL



SOURCE: Grumman Flxible, *Wheelchair Lift Maintenance Handbook,* 1979.

EQUIPMENT RELIABILITY

Conn Transit has found the wheelchair lift equipment subject to frequent breakdowns and failures. Two major sources of service unreliability have been identified: equipment malfunction and operator error.

The lift equipment is a complex and delicate machine which also serves as the primary means of entrance and exit to the bus for all passengers. Consequently, it is subject to considerable wear and tear even when not in use as a wheelchair lift. The equipment is also subject to intermittent failures; loose connections and faulty relays can cause the lift to fail one time and then work the next. It is difficult and frustrating to try to identify and repair such problems.

Mechanical problems generally manifest themselves by a failure of the lift to properly complete its cycle and stow as steps. Failure to successfully complete the lift cycle prevents the bus from proceeding to the next step, since a brake interlock system is engaged at all times when the lift is not stowed. Lift breakdowns and failures are thus inconvenient for the transit agency and passengers. An analysis of lift repairs indicated that among classified repairs the most common problems were failures in the automatic sensers which regulate lift operation and difficulties with the barrier flap. Damaged doors and steps were also fairly common repairs. (More detail on lift repairs is provided in Chapter 6.)

The lift is complex to operate. The complete lift cycle requires the operator to successfully complete a sequence of 19 operations on the lift control panel in addition to properly positioning the bus and preparing the tiedown. Since lift boardings tend to be rare, few operators are extremely familiar with lift operation procedures.

The following section describes wheelchair lift policies and procedures which have been developed to help reduce the problem of service reliability.

WHEELCHAIR LIFT POLICIES AND PROCEDURES

Conn Transit's policies and procedures for the wheelchair lift have been developed and modified to respond to the problems of lift service, principally service unreliability due to mechanical malfunction and operator error.

LIFT USE POLICY

The lift is available to any person in a wheelchair. The operator is also given the discretion to offer lift service to individuals using walkers or

crutches who cannot negotiate the steps. Lift users, however, are predominantly persons in wheelchairs.

All elderly and handicapped patrons ride Conn Transit for 20 cents rather than the regular 50 cent fare. In order to qualify for the reduced fare, they need only present their Medicare Card or Conn Transit Elderly and Handicapped identification card to the operator. For lift patrons, especially the wheelchair passengers, Conn Transit also provides a free fare for any one escort or attendant the wheelchair rider may have.

DRIVER AWARENESS TRAINING PROGRAM

New drivers receive a total of four hours instruction on accessible bus wheelchair lift and kneeling features. Appendix B shows the syllabus for the short course in wheelchair and handicapped passenger operations. The essential features of the training program are:

- Classroom instruction in dealing with elderly and handicapped passenger;
- Practical exercises in equipment operation;
- Role playing as wheelchair passengers;
- Street operation of wheelchair lift and kneeling apparatus; and
- Introduction to emergency procedures.

Appendix C contains a copy of the bus operators handbook. This handbook contains information on assisting elderly and handicapped passengers.

DRIVER TESTING AND RETRAINING

Conn Transit has identified operator error as a major cause of unreliability in the wheelchair lift service. It is believed that operator error results, in part, from the infrequent use of lift equipment by most operators. Successful lift operation requires the driver to properly execute a sequence of 19 separate tasks (See Figure 3-3). Improper operation will result in a lift malfunction as the mechanism jams or is damaged.

In order to reduce operator error Conn Transit has introduced a program of quarterly testing and retraining for each operator. A training supervisor has been named for each division. The supervisor must check each operator every three months on wheelchair lift operations. Supervisors are tested and retrained annually.

Figure 3–3

CONN TRANSIT LIFT OPERATING INSTRUCTIONS

When operating lift controls, press only one button or one switch at any one time.

1. Pull bus within 18" to 24" of curb or suitable landing area.
2. Set parking brake.
3. Place transmission in the (N) neutral position.
4. Open door and check for lift clearance.
5. View landing area for obstructions such as rocks, sticks, etc. Barrier will not lock if in a soft grassy area.
6. Depress "POWER ON" white button.
7. Hold down toggle switch marked "STEPS/PLATFORM" in the platform position until cycle is completed and the platform is formed.
8. Hold down toggle switch marked "RAISE/LOWER PLATFORM" in the lower position until cycle is completed or the platform is in landing area.
9. Depress "EMER STOP/RESET" red button. Depress "NOT STEPS" yellow button until platform is relaxed in the landing area.
10. Depress "EMER STOP/RESET" red button. Depress "POWER ON" white button.
11. Pull out and hold down toggle switch marked "BARRIER" in the down position until cycle is completed and barrier is down.
12. Load passenger, instruct passenger to enter facing coach (if wheelchair - center on platform, lock wheelchair brake) and grasp handrail for added safety.
13. Press up toggle switch marked "BARRIER" in the up position until cycle is completed and barrier is raised and platform is earth level.
14. Press up toggle switch marked "RAISE/LOWER PLATFORM" in the raise position until cycle is completed and platform is raised to floor level.
15. After the platform is at the coach floor position, allow passenger to pay fare and proceed to the seating area.
16. Depress "EMER STOP/RESET" red button. Depress "NOT STEPS" yellow button until platform is relaxed about 2" to 3" below the floor level.
17. Depress "EMER STOP/RESET" red button. Depress "POWER ON" white button.
18. Press up toggle switch marked "STEPS/PLATFORM" in the steps position until cycle is completed and the yellow light goes out.
19. Depress "EMER STOP/RESET" twice to shut off lift power and restore coach power steering, close entrance door, place transmission in gear, release parking brake and proceed to next stop.

SOURCE: Conn Transit, September 1980.

OPERATOR AIDS

Also in an effort to reduce operator error, Conn Transit has developed two quick-reference information aids designed to help the operator follow the proper sequence of steps for lift operation. A decal has been installed on the driver's windshield visor of all Flxible buses symbolically showing the steps for lift operation (see Figure 3-4). Each driver is also issued a laminated wallet-sized card giving the same information. It is hoped that these recently developed aids will help reduce costly and embarrassing mistakes by operators who seldom operate the lift.

LIFT INSPECTION PROGRAM

In order to deal with the problem of service unreliability due to mechanical malfunctions in the wheelchair lifts, Conn Transit has recently instituted a new program of lift inspections at all three divisions.

Grumman Flxible and Environmental Equipment Corporation (EEC), the manufacturers of the lift, suggest that each lift should be cycled daily to ensure proper operation. This suggestion has been rejected by Conn Transit for two primary reasons. First, at the bus storage and maintenance facilities there is insufficient room to cycle the lift in the yard. This is especially true in Hartford and Stamford. A single disabled bus in the storage garage or yard could obstruct many bus movements at the facility. This led Conn Transit to reject the possibility of cycling the lift on each bus before it leaves on its run. Second, at the outset of the accessible service, lift reliability was poor; it was feared that many lifts would malfunction when tested. Since a lift malfunction often requires a mechanic to correct the problem, Conn Transit was reluctant to initiate a policy which could potentially generate many road calls. Drivers have not been encouraged to exercise the lift at layover points or other slack periods during their run. A lift malfunction resulting in a road call and a missed trip is feared.

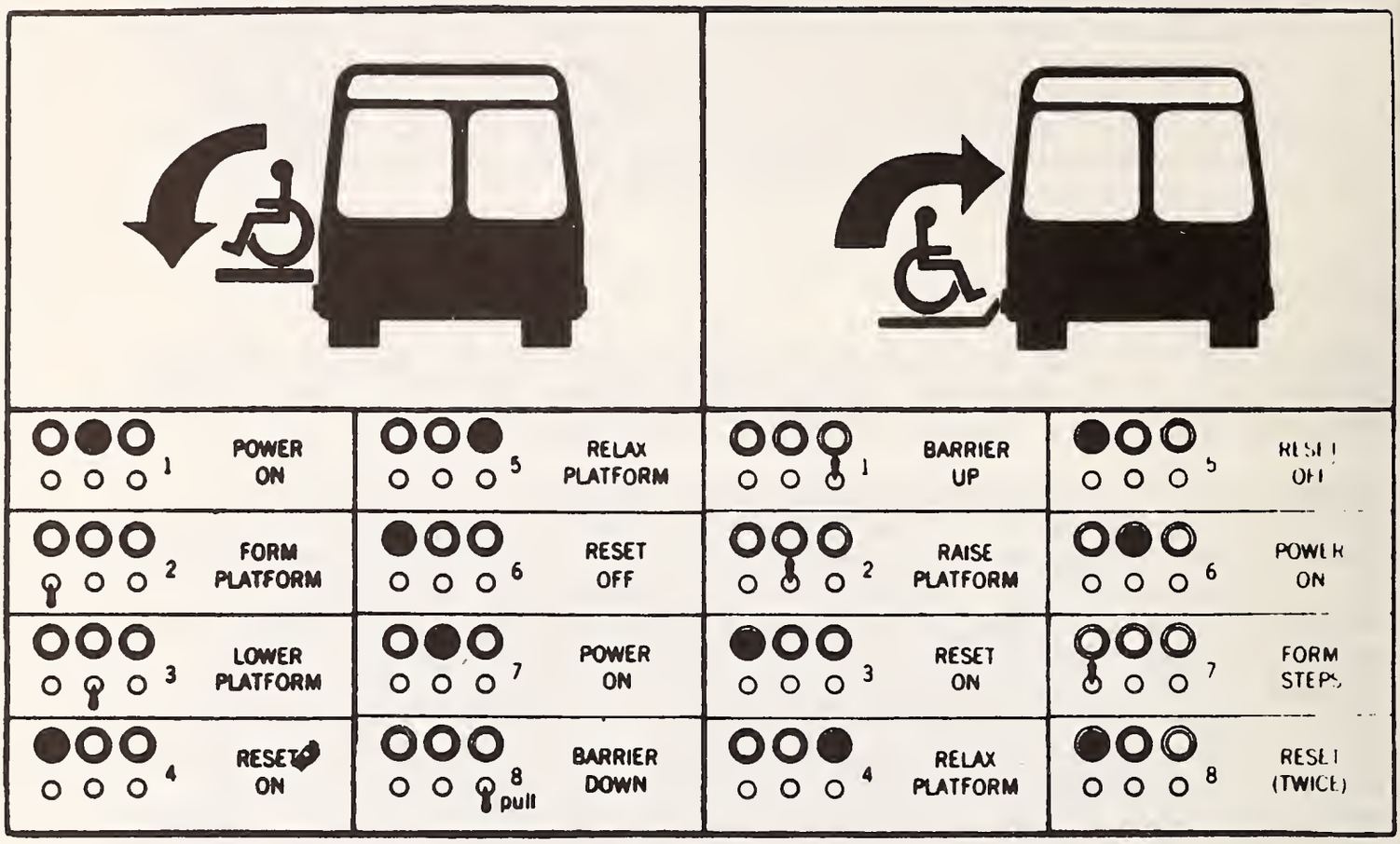
The result of these fears has been a policy which only requires an operator to use the lift when a wheelchair patron must board. Since wheelchair boardings are infrequent, operators seldom exercise the lift. This has contributed to both mechanical malfunctions due to lack of use and operator error due to lack of practice. This may increase the failure rate for wheelchair boarding attempts resulting in costly road calls and reduced confidence in the accessible service capabilities of the new Flxible fleet.

In an attempt to monitor the mechanical condition of the wheelchair lifts, Conn Transit has recently instituted a lift inspection program. This program assigns two drivers at each division (one in Stamford) each weekday for two

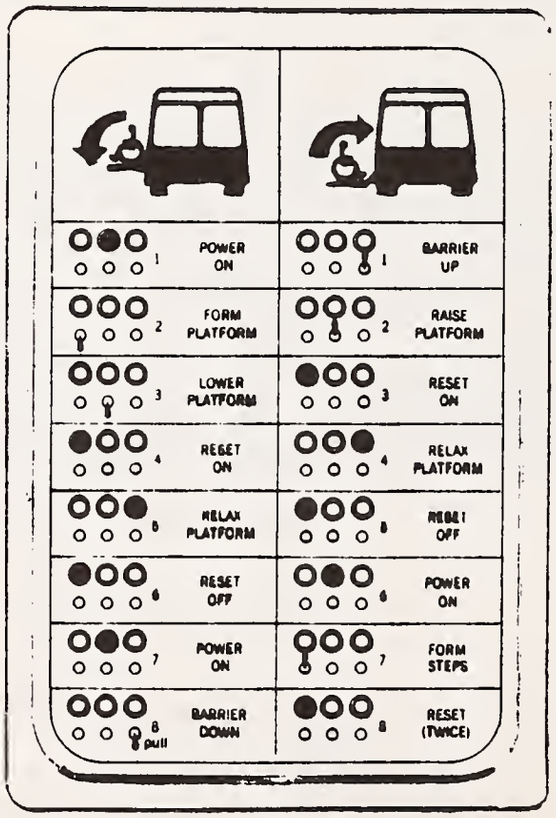
Figure 3–4

OPERATOR AIDS

Windshield Visor Decal



Wallet Card



SOURCE: Connecticut Transit, September 1980.

hours to the task of cycling and inspecting lifts on the Grumman buses. Together a team of two operators tests approximately ten lifts per day. One operates the lift, while the second provides weight. (In Stamford, sandbags are used for weight.) It is planned that each lift will be checked twice each month. Lift malfunctions are reported to the maintenance department.*

SCHEDULING POLICY

Conn Transit's scheduling philosophy for accessible service is simply to keep as many accessible buses on the road as possible. The rationale for this philosophy is that Conn Transit has sufficient equipment to provide almost full accessibility. Therefore it is believed that it is simply easier for consumers and the transit agency to use a full coverage approach to scheduling accessible service rather than providing a more limited service and maintaining more spares. For instance, in the Hartford division there are 155 lift equipped coaches. The local morning peak schedule requirement calls for 152 accessible coaches.** Consumers are simply told that all off-peak local service is accessible and most peak service is accessible as well. Those peak period local runs which are not scheduled to be served with accessible equipment are not noted on consumer service schedules. No lift equipped coaches are currently assigned to peak period commuter express service.

This approach to scheduling is only possible because of the large size of the Conn Transit accessible fleet. Table 3-1 shows the total peak and off-peak vehicle requirements and the vehicles available to meet those needs. As can be seen, the off-peak vehicle requirement can be generally met with the Flxible fleet if most vehicles are in working order. Subsequent sections of this chapter describe CRA's analysis of service schedules in more detail.

SCHEDULE OF ACCESSIBLE SERVICES

This section describes the scheduled supply of accessible bus service provided by Conn Transit. The section is divided into two parts. The first part lists and describes the sources used in developing the schedule

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*For more information on this program, see Chapter 6 on Road Calls, Repairs and Maintenance.

**In the Stamford division there are 25 accessible buses and a local route peak schedule requirement of 24 accessible buses. The New Haven division has 100 accessible buses available for assignment. Bus assignment sheets there call for 82 accessible buses on-peak on local routes.

Table 3-1

CONNECTICUT TRANSIT COMPANY ACCESSIBLE BUS SERVICE

	Hartford	New Haven	Stamford	Total
Scheduled Peak Buses*	239	110	28	377
Scheduled Off-Peak Buses**	93	56	22	171
Accessible Bus Fleet Size	155	100	25	280
Total Fleet Size	280	140	36	456
Accessible Buses as % of Total Fleet	55%	71%	69%	61%

*Includes Nonaccessible Express Commuter Runs.

**All off peak service is wheelchair accessible.

SOURCE: Interviews with Roger Sweeney, Director of Operations, Connecticut Transit Co. June 23, 1980, September 8, 1980.

information. It also outlines the technique used to calculate the numbers of accessible and non-accessible bus trips by route and provides some definitions. The second part describes CRA's findings.

METHODOLOGY

The availability of accessible services as well as the characteristics of its suppliers were measured using a variety of data on system operations. The data sources and their uses in this study are described below.

There is a single transit system map showing the bus route structure for each of the three metropolitan areas. These maps were used for general background and to identify corridors.

The headway sheet for each major route lists the driver's schedule for each bus "block." A "block" is a bus itinerary from the time it leaves the garage until it returns. When used in conjunction with the bus assignment sheets, the block number indicates the type of bus which should be assigned to a specific run.

Each major route is designated by a single letter. Each letter roughly corresponds to a radial corridor, although Connecticut Transit Systems have evolved in such a manner that there are a variety of outbound destinations for a single route letter. Most destination alternatives are subscripted within a route. For instance, the F route in Hartford is divided into two subroutes based on an outbound destination or a major artery traveled. These are F^1, which travels north out of the city of Hartford into the town of Bloomfield, and F^2, which travels south out of the city and into Wethersfield. Buses do not always travel the entire length of the route. There are three possible points of termination along the F^1 route (Bowles Park, Bloomfield Convalescent Home, Wedgewood Apartments), and two along the F^2 route (Jordan Lane, Ridge Road). The runs of most individual bus drivers are scheduled to include a variety of destinations within a route letter.

Peak hour commuter express service which operates between commuter parking lots and downtown Hartford is not listed on the headway sheets and is not included in these trip totals. No commuter express service is wheelchair accessible.

Individual route map/schedule pamphlets describe the route and schedule for each individual route. These are consumer marketing and information aids. Unfortunately, trips are not designated as accessible or non-accessible on the consumer pamphlets.

Bus assignment sheets are the connection between block numbers on the headway sheets and actual physical bus assignment. The master assignment sheet indicates which class of bus (accessible/non-accessible, long/short) is to be assigned to each route and block. This master sheet is used as a guide in making daily bus assignments.

Some buses in the Connecticut Transit System are used as "load levelers" and serve a variety of routes as they travel around town providing special peak demand services. These so-called "trippers" are scheduled using a different system from that used on regular routes. The tripper sheets give the itinerary for each individual tripper bus.

The headway sheets were used in conjunction with the individual route maps to differentiate between variations within a route. There is one set of headway sheets for each route letter. (Each route may actually involve from one to five subroutes.) Within these subroutes sometimes there are further route variations. For this analysis, trips were categorized and counted according to their actual destination.

A single trip was counted for each round trip from an origin to a particular destination and back again to the origin. Often a bus, particularly an early morning run, begins at the outbound point or, as in the case of many trippers, simply picks up a run going one way. These trips were counted as half trips.

In Hartford and New Haven, the block number or tripper number from the headway sheet was used in conjunction with the bus assignment sheets, to determine if a given trip was accessible or not. Stamford policy is to assign an accessible bus to each block if there is one available. If any of the older GMC buses are used in any particular day, they are most likely to be used as trippers. Therefore, all Stamford buses other than trippers were assumed to be scheduled accessible.

A further clarification of each bus trip involves the amount of time a particular bus spends out of the garage each day serving a particular mode. "Base" buses are those which are out all day on the same route. They leave the garage by 7:00 a.m. and do not return to the garage until after 5:00 p.m. "Peak" buses are those buses in service during high demand periods serving one particular route on a run. They average three to four hours out of the garage during the 5:00 to 10:30 a.m. period and/or three and one-half to four and one-half hours out of the garage during the 1:00 to 8:15 p.m. period. "Trippers" are those buses serving many routes on one run. Most individual routes have a few trippers serving them, generally for a half trip at a time.

SCHEDULED ACCESSIBILITY

According to the schedule information, Conn Transit bus assignment sheets call for a 95 percent accessibility in its total bus service.* Table 3-2 indicates that Stamford is scheduled as 99 percent accessible. The Stamford scheduling system assigns accessible buses as available, with priority given to base service followed by peak service. Trippers receive the lowest assignment priority.

In Hartford bus assignment sheets call for 96 percent accessible service with most of the non-accessible service confined to trippers. According to the assignment sheets, Hartford base service is expected to be 100 percent accessible while tripper service is only 50 percent accessible.

In the New Haven division, assignment sheets call for 94 percent accessible service. According to the master assignment sheets, New Haven base service is 99 percent accessible, peak service is 83 percent accessible and tripper service is only 26 percent accessible. Interestingly, although New Haven provides the least accessible service of the three divisions, it actually has the greatest percentage of accessible buses in its total fleet (Table 3-1). This raises the question of whether the accessible buses have been allocated to run as efficiently as may be possible.

Since first priority has been to guarantee a stable base period of accessible service, the accessible Flxible fleet is assigned to base runs first. Thirty-nine percent of the entire fleet remains non-accessible GMC buses. Conn Transit allocates these GMC buses to peak service only during high demand periods when the demand for buses exceeds the supply of the Flxible fleet. The figures for all divisions in Table 3-2 indicate that Conn Transit has been successful in its scheduling policy. Less than 1 percent of all base service is scheduled to use non-accessible equipment.

Appendix D gives route-by-route detail on accessible and non-accessible bus trips.

SCHEDULE RELIABILITY

Given Conn Transit's scheduling philosophy of assigning all available lift equipped buses to runs, it is virtually certain that the actual level of accessible service will be less than that scheduled by the master bus

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*Includes only the services reported on the headway sheets. Commuter express service which operates between commuter parking lots and downtown Hartford and New Haven is not included in these figures.

Table 3-2

CONNECTICUT TRANSIT SCHEDULED WEEKDAY BUS TRIPS[1]
BY DIVISION

	Base[2]		Peak[3]		Trippers[4]		Total Percent
	Accessible[6]	Non-Accessible[6]	Accessible	Non-Accessible	Accessible	Non-Accessible	Accessible
Hartford	1076.0	-	211.0	2.0	55.0	54.0	96
New Haven	947.5	7.0	227.5	46.5	10.0	28.0	94
Stamford	307.5	-	36.0	-	-	4.0	99
TOTAL	2331.0	7.0	474.5	48.5	65.0	86.0	95

Notes:

(1) Trip - Round trips only. Half trips are one-way trips.

(2) Base - Buses leave garage by 7:00 a.m. and do not return to garage until after 5:00 p.m.

(3) Peak - Buses in service during high demand periods. Averaging 3-4 hours out of garage during 5:00-10:30 a.m. period and/or 3 1/2 - 4 1/2 hours out of garage during 1:00-8:15 p.m. period.

(4) Tripper - Buses serving many routes on one run.

(5) Accessible - Flxible bus with wheelchair lift.

(6) Non-Accessible - Bus without wheelchair lift.

SOURCE: Transit System Map, Individual Route Maps/Schedules, Bus Assignment Sheets, Weekday Headway Sheets, Tripper Sheets, Run Assignment Sheets, Conversations with Bill Merton, Director of Scheduling, Connecticut Transit Co.

assignment sheets. This variance between the scheduled and actual levels of accessible service is caused by bus breakdowns. (The ratio of accessible buses scheduled to accessible buses owned approaches unity in Hartford and Stamford; see Table 3-3). If a less than full roster of accessible buses is available at the start of the workday, the dispatcher will assign an older non-accessible GMC bus to a scheduled accessible run. Generally, these changes in assignments will be made in peak service only. The daily bus assignment sheet then can be used to help measure the extent of actual accessibility. Also, if an accessible bus breaks down in the field, it must be replaced (or "changed-off") by another bus. Often this second bus is not lift equipped. Bus change-offs are reported on the daily road call summary reports. CRA used the daily bus assignment sheets and road call summaries for two random weeks in the study period to investigate the actual level of accessible service.

The results of the analysis are listed in Table 3-3. Based on the two-week sample, Hartford's actual accessibility differs from its schedule by 12 percent and New Haven and Stamford differ by 8 percent and 9 percent respectively. It is expected that with a large sample all three divisions would approach a 10 percent variation between scheduled and actual accessibility levels.

It is interesting to note that there was very little variation in the percentages of actual accessibility for the two random weeks studied. Particularly in New Haven and Stamford, the same runs were reassigned as non-accessible on almost a daily basis. This implies that the substitution process is rather structured and consistent.

Chapter 4 provides an analysis of wheelchair ridership. This analysis includes an appraisal of the relationship between actual levels of accessibility and ridership by routes.

Table 3-3
SCHEDULE RELIABILITY BY DIVISION

Division	Total Scheduled Weekday Bus Trips	Percent Scheduled Accessible	Percent Actually Accessible			Accessible Buses Scheduled on Peak	Total Accessible Buses Ever Available
			Week I	Week II	Average		
Hartford	1398.0	96	83	85	84	152	155
New Haven	1266.5	94	86	86	86	82	100
Stamford	347.5	99	88	91	90	24	25

SOURCE: Conn Transit Division Headway Sheets, Master Bus Assignment Sheets, Daily Bus Assignment Sheets (July 28-Aug. 1, Aug. 11-Aug. 15).

4

WHEELCHAIR RIDERSHIP

RIDERSHIP DATA COLLECTION METHOD

Since the initiation of accessible service, operators have been required to report wheelchair boarding on their bus daily fare box report cards. One card is turned in daily for each bus. Since many buses run on multiple routes, it was not possible to use these data to tabulate boardings by route or time of day. Operators also did not provide information on denied boardings.

For the purposes of this study, Conn Transit used the specially designed wheelchair boarding report card shown in Figure 4-1 to report contacts with lift-using passengers. Using data from this card CRA was able to tabulate boardings by route and time of day and provide an analysis of difficulties and boarding denials.

With both the daily fare box report card and the wheelchair boarding report card, there has been a tendency to underreport boardings and denials. CRA understands that Conn Transit adjusted some monthly boarding count reports upward to account for this phenomenon. Conn Transit made the adjustments to account for regular wheelchair riders who through informal reports were identified as daily bus commuters, but were not accounted for on a daily basis by the fare box report cards returned by the drivers. Conn Transit did not adjust boarding counts during the three-month study period.

Figure 4–1

WHEELCHAIR BOARDING REPORT CARD

CONNECTICUT TRANSIT
Wheel Chair Boarding Report

ATTENTION OPERATORS: Complete this card after each contact with a wheelchair passenger (boarding or denial).

Date _____

Time of Boarding (Denial) _____ ☐ am ☐ pm

Operator _____ Badge _____

Run No. _____ Bus No. _____

Route Letter _____ Block No. _____

Please check all boxes that apply.

☐ Boarding Completed – No Problems

☐ Boarding Completed – With Difficulty (Please Describe)

☐ Lift Malfunction – Boarding Denied

☐ Bus Crowded – Boarding Denied

☐ No Room at Curb – Boarding Denied

☐ All Tiedowns Occupied – Boarding Denied

☐ Other (Please Describe)

COMMENTS _____

_____

_____

_____

Completed card must be returned to the dispatcher after run is completed.

All unused cards must also be returned to the dispatcher.

BOARDINGS AND DENIALS

During the summer of 1980 the systemwide ridership average was 285 riders per month. Wheelchair lift ridership has increased since the early months of the service. Figure 4-2 shows the monthly reported ridership by division. Although it is too early to tell for certain, there may be seasonality in wheelchair ridership with patronage peaking in the summer and declining during the winter. The total number of reported wheelchair lift boardings since service began was 2,654 as reported in Table 4-1.

Table 4-2 shows the results from wheelchair boarding report cards from the period of July 17, 1980 to September 27, 1980, a period of approximately 10 weeks. Overall, 68 percent of the attempted boardings are reported as occurring with no problems. Another 24 percent of the attempted boardings were completed with some problems, most of them platform-related. Either the platform would not lift weight, would not relax, or the barrier would not function properly. Another common problem was that the lift would not stow after the boarding.

Eight percent of all reported boarding attempts were unsuccessful. In nearly all cases, these denials were due to lift malfunctions. No boardings were denied because there was no room at the curb (e.g., a car parked in the bus stop). Only 10 boardings were denied because the bus was too crowded. As would be expected, the crowded bus reports tended to be on high-volume routes. In no cases were boardings denied because both tiedowns were already occupied by wheelchair users.

LIFT BOARDINGS BY ROUTE

The pattern of successful and denied boardings is similar in Hartford and New Haven. In Stamford, difficulties are more common. Tables 4-3 through 4-5 report the total number of scheduled weekday bus trips for each major route, the percent scheduled accessible, and the percent CRA found to be actually accessible. This is the supply of accessible services by route. On the demand side, the table reports wheelchair boardings and denials by route and August morning peak hour ridership count for the route as reported by Conn Transit.

These tables indicate a number of interesting points about the relationship between supply and demand for accessible service. Demand for accessible service tends to be concentrated on a few routes. For instance, in Hartford 75 percent of the reported attempted boardings* were found on 4 of 21 routes. Seven routes had no boarding attempts. In general, there is no difference in

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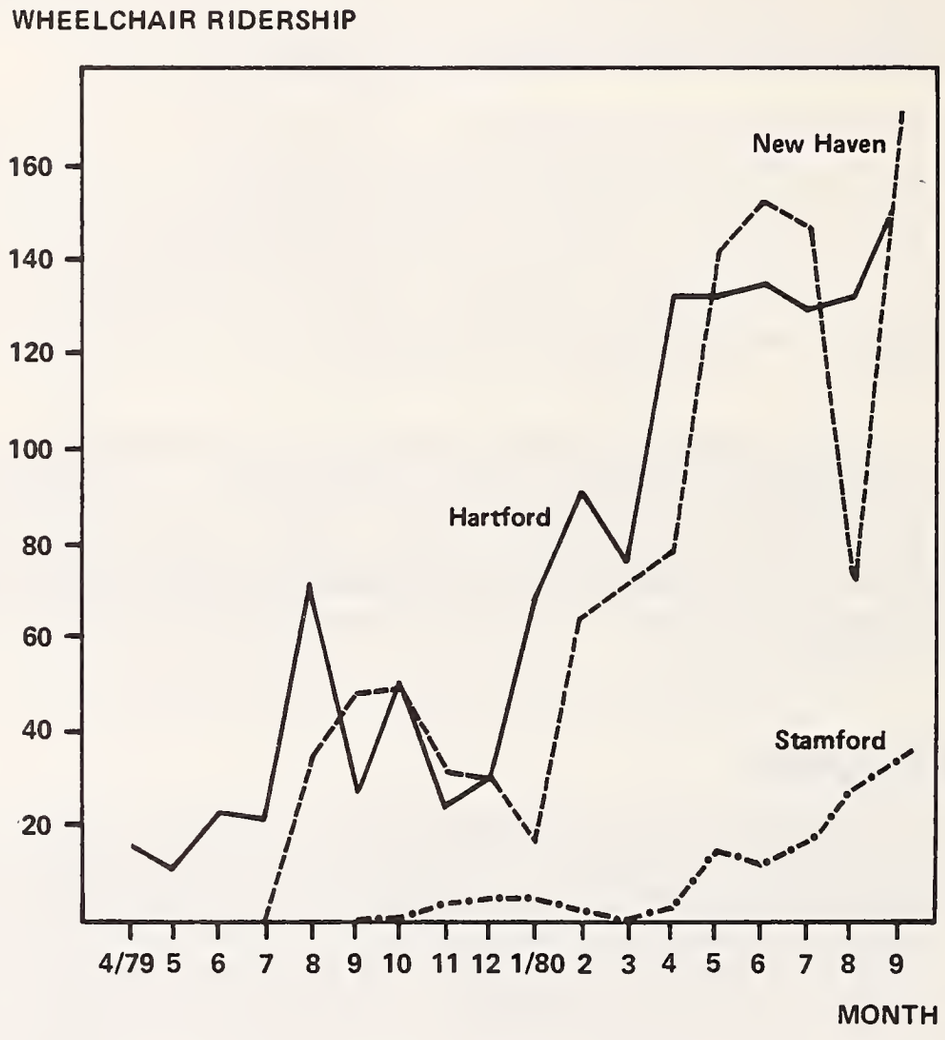
*Attempted boardings include both successful boardings and denials.

Figure 4–2

REPORTED MONTHLY WHEELCHAIR RIDERSHIP BY DIVISION



SOURCE: Connecticut Transit, Monthly Reports.

Table 4-1

WHEELCHAIR RIDERSHIP BY MONTH BY DIVISION

1979	Hartford	New Haven	Stamford	Total
April	16	*	*	16
May	11	*	*	11
June	23	*	*	23
July	22	0**	*	22
August	74	36	*	110
September	28	50	0	78
October	52	51	0	103
November	25	33	4	62
December	31	31	5	67
1980				
January	71	17	5	93
February	94	66	2	162
March	89	74	0	163
April	137	81	3	221
May	137	146	15	298
June	140	158	12	310
July	135	152	18	305
August	137	75	28	240
September	157	178	35	370
TOTAL	1,379	1,148	127	2,654

*Accessible buses not yet in service.

**Service on three routes only.

Sources on following page.

Table 4-1 (Continued)

WHEELCHAIR RIDERSHIP BY MONTH BY DIVISION

SOURCES: Abell, Charles W. Memorandum to T. A. Hauer, May 8, 1979

Crowley James E., Manager, Stamford Division of Connecticut Transit. Letter to Ray Clark, Division Manager, Hartford Division of Connecticut Transit, August 5, 1980.

Sweeney, Roger, Director of Operations, Connecticut Transit, Letters to James C. Moran, Director of Transit Operations, Bureau of Public Transportation, Wethersfield, Connecticut, June 12, 1979, July 2, 1979, August 3, 1979, September 4, 1979, October 2, 1979, November 2, 1979 and December 5, 1979.

Williams, John J., General Manager, Connecticut Transit, Letter to Allen W. Wamester, Elderly and Handicapped Transportation Coordinator, Department of Transportation, Wethersfield, Connecticut, February 26, 1990.

Interview with Roger Sweeney, Director of Operations, Connecticut Transit, September 19, 1980.

Table 4-2

REPORTED WHEELCHAIR BOARDINGS BY DIVISION
(July 16, 1980 to September 27, 1980)

Boarding Condition	Division			
	Hartford	New Haven	Stamford	Total
Boarding Completed - No Problems	67* (227)**	71 228	54 (42)	68 (497)
Boarding Completed - With Difficulty	26 (88)	21 (66)	29 (23)	24 (177)
Lift Malfunction - Boarding Denied	5 (16)	7 (21)	17 (13)	7 (50)
Bus Crowded - Boarding Denied	2 (6)	1 (4)	0 (0)	1 (10)
TOTAL	100 (337)	100 (319)	100 (78)	100 734

*Percent of total attempted boardings in the division.

**Number of reported wheelchair boardings appears in parentheses.

SOURCE: Charles River Associates Incorporated, October 1980.

SERVICE RELIABILITY AND RIDERSHIP BY ROUTE: HARTFORD

Route	Total Scheduled Weekday Bus Trips	Percent Scheduled Accessible	Percent Actually Accessible	Reported Wheelchair Boardings 7/16-9/27					A.M.* Peak Hour Ridership
				Boarding Completed		Boarding Denied			
				No Problems	With Difficulty	Lift Malfunction	Bus Crowded	Percent of Total Boardings	
A	81	100	100	35	8	3		14	353
B	37	89	85	9	5	1	1	5	234
E	130	96	74	64	31	7	3	31	462
F	134.5	98	92	12	3	1		5	463
G	66.5	100	100	1	2			1	42
H	21	95	90						130
J	17	76	71						65
K	198	99	79	10	3	1		4	793
M	18.5	100	92						139
N	83.5	94	85		1				516
O	34.5	84	78	34	18	1	1	16	223
P	19	100	99		1				136
Q	125	97	74	39	7	1	1	14	612
R	9	89	89				✓		61
T	156.5	93	76	3	3			2	819
U	94	96	87	9	2	1		4	497
W	33	91	65						240
X	31	100	100						110
YM	43	100	94	4	1			1	234
YS	37.5	97	94	3	3			2	137
Z	28.5	91	87	4				1	123
All Routes	1,398	96	84	227	88	16	6		6,389

Note: Blanks indicate no reported boardings.
* A.M. Peak as defined by Conn Transit is 6:30-8:30.

SOURCE: Total Scheduled Weekday Bus Trips obtained from Headway sheets. Percent Scheduled Accessible obtained from Master Assignment Sheets, Percent Actually Accessible obtained from Daily Bus Assignment Sheets (7/28-8/1,8/11-8/15), Wheelchair Boardings obtained from Wheelchair Boarding Report Cards, A.M. Peak Ridership obtained from Title VI report as of August 1980

Table 4-4

SERVICE RELIABILITY AND RIDERSHIP BY ROUTE: NEW HAVEN

Route	Total Scheduled Weekday Bus Trips	Percent Scheduled Accessible	Percent Actually Accessible	Reported Wheelchair Boardings 7/16 - 9/27					A.M. Peak Hour* Ridership
				Boarding Completed		Boarding Denied			
				No Problems	With Difficulty	Lift Malfunction	Bus Crowded	Percent of Total Boardings	
A	134.0	100	97	1					331
B	162.5	86	72	58	13	3	2	24	474
C	21.0	100	78						88
D	167.5	95	95	54	15	4	2	24	556
F	101.5	100	100	18	7	3		9	242
G	94.0	90	70	2				1	174
J	88.5	76	68	11	1	2		4	276
L	6.5	0	0						35
M	63.5	100	99	3	1	1		2	112
N	24.0	100	97	41	9	2		16	86
O	81.0	98	95	1	2			1	165
P	48.0	100	100						46
Q	80.0	100	68		1				243
S	7.5	100	95	7	1	3		3	34
T	28.0	75	75	1					26
U	54.5	91	79	19	11	3		10	160
Y	33.5	100	100						179
Z	71.0	100	99	12	5			5	181
All Routes	1,266.5	94	86	228	66	21	4		3,408

NOTE: Blanks indicate no reported boardings.
*A.M. Peak Hour is defined by Conn Transit as 6:30 a.m. to 8:30 a.m.

SOURCE: Total scheduled weekday Bus Trips obtained from Headway sheets. Percent Scheduled Accessible obtained from Master Assignment Sheets, Percent Actually Accessible obtained from Daily Bus Assignment Sheets (7/28-8/1, 8/11-8/15), Wheelchair Boardings obtained from Wheelchair Boarding Report Cards, A.M. Peak Ridership obtained from Title VI report as of July 1980.

Table 4-5

SERVICE RELIABILITY AND RIDERSHIP BY ROUTE: STAMFORD

Route	Total Scheduled Weekday Bus Trips	Percent Scheduled Accessible	Percent Actually Accessible	Reported Wheelchair Boardings 7/16-9/27			Percent of Total Boardings	A.M. Peak Hour* Ridership
				Boarding Completed		Boarding Denied		
				No Problems	With Difficulty	Lift Malfunction		
A	70	100	82					134
BE	57.5	93	86	30	15	7	67	121
F	27	100	68	2	2	1	6	54
G	20	100	99					45
H	67	100	94	6	5	4	19	135
JS	82	100	99	4	1		6	122
L	11	100	82					10
O	13	100	98			1	1	9
All Routes	347.5	99	90	42	23	13		630

Note: Blanks indicate no reported boardings
* A.M. Peak Hours as defined by Conn Transit is 6:30-8:30.

SOURCE: Total Scheduled Weekday Bus Trips obtained from Headway sheets. Percent Scheduled Accessible obtained from Master Assignment Sheets, Percent Actually Accessible obtained from Daily Bus Assignment Sheets (7/28-8/1,8/11-8/15), Wheelchair Boardings obtained from Wheelchair Boarding Report Cards, A.M. Peak Ridership obtained from Title VI report as of July 1980.

accessibility between the high volume and zero volume wheelchair routes. This pattern holds true for New Haven, where four routes carried 74 percent of the wheelchair patronage. It also holds true for Stamford, where two routes carried 86 percent of the patronage. This finding suggests that it may be more efficient to target accessible services to particular routes where ridership may be higher. It is also noteworthy that wheelchair ridership tends to occur principally on high volume routes.*

Route ridership is reported for approximately a 10-week period from mid-July to late September 1980. During this period a transit commuter would have made 50 round trips (100 one-way trips) to and from the job.** On only one route in the Conn Transit system were more than 100 lift boardings attempted during the study period. This suggests that only one handicapped individual could be using transit to travel both to and from work on a regular basis.+ This does not necessarily mean that some other wheelchair users do not commute regularly by bus on a more limited basis. For instance, they may only use the bus a few days a week, or take the bus to a regular activity but not return on the bus.

The pattern of denied boardings suggests a hypothesis that equipment malfunctions may be responsible for more reliability problems than operator error. If equipment malfunction were the principal culprit in poor reliability, one would expect to find no relationship between operator experience with lift operation and denied boardings due to equipment failure. Although the data on lift malfunctions by operator have not been statistically analyzed, an informal review suggests that inexperienced drivers are not responsible for a disproportionate share of denied boardings.

LIFT BOARDINGS AND ACCESSIBILITY

It might be expected that routes with particularly high substitution of non-accessible for accessible buses would be those found to have lower wheelchair ridership. This was not the case in Hartford. Although the

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*However, there are exceptions to this general rule. For example, Route N in New Haven is an exception with a peak load of only 86 passengers. Also, Route T in Hartford is an exception with the highest able-bodied patronage and only 6 handicapped boardings.

**This assumes 10 one-way trips per week.

+Data on boardings by time of day, presented later in this chapter, also tend to support the conclusion that few, if any, wheelchair lift users ride the bus to work on a regular basis.

greatest difference between actual and scheduled accessibility occurred on the W route which reported no boardings for the period studied, two of the routes used most frequently by handicapped riders were also two of the routes most plagued by missed trips. The actual accessibility of the E route was 22 percent less than its scheduled accessibility even though almost one-third of all attempted boardings in Hartford took place on the E route. Similarly, the Q route was 23 percent less accessible than scheduled, though 14 percent of the reported boardings took place on its buses.

The New Haven data show a distinct pattern in the accessible buses being replaced by non-accessibles on a day-to-day basis. The greatest differences in accessibility were found on the B, C, G, and Q routes. Boardings were highest on the B, D, N, and U routes.

Stamford also had a few routes which seemed to be most likely to miss accessible trips (A, F, and L.) The figures for reported wheelchair boardings indicate no boardings on either route A or L during the period studied; only 6 percent of total boardings took place on route F.

LIFT BOARDINGS BY HOUR OF THE DAY

Figure 4-3 shows the pattern of attempted lift boardings by hour of day for each division. In Hartford, lift boardings tend to peak during the midday period between 11:00 a.m. and 3:00 p.m. Systemwide, boardings during the early morning hours (before 10 a.m.) account for only 12.2 percent of all boardings. This suggests that the majority of handicapped lift riders are not using the lift for commuting purposes. The pattern of boardings for New Haven is similar to that for Hartford. In Stamford the shoulders of the "peak period" for lift ridership are more broad. Yet all attempted boardings were reported between 9:00 a.m. and 7:00 p.m. In general, it is notable that evening lift ridership levels are low.

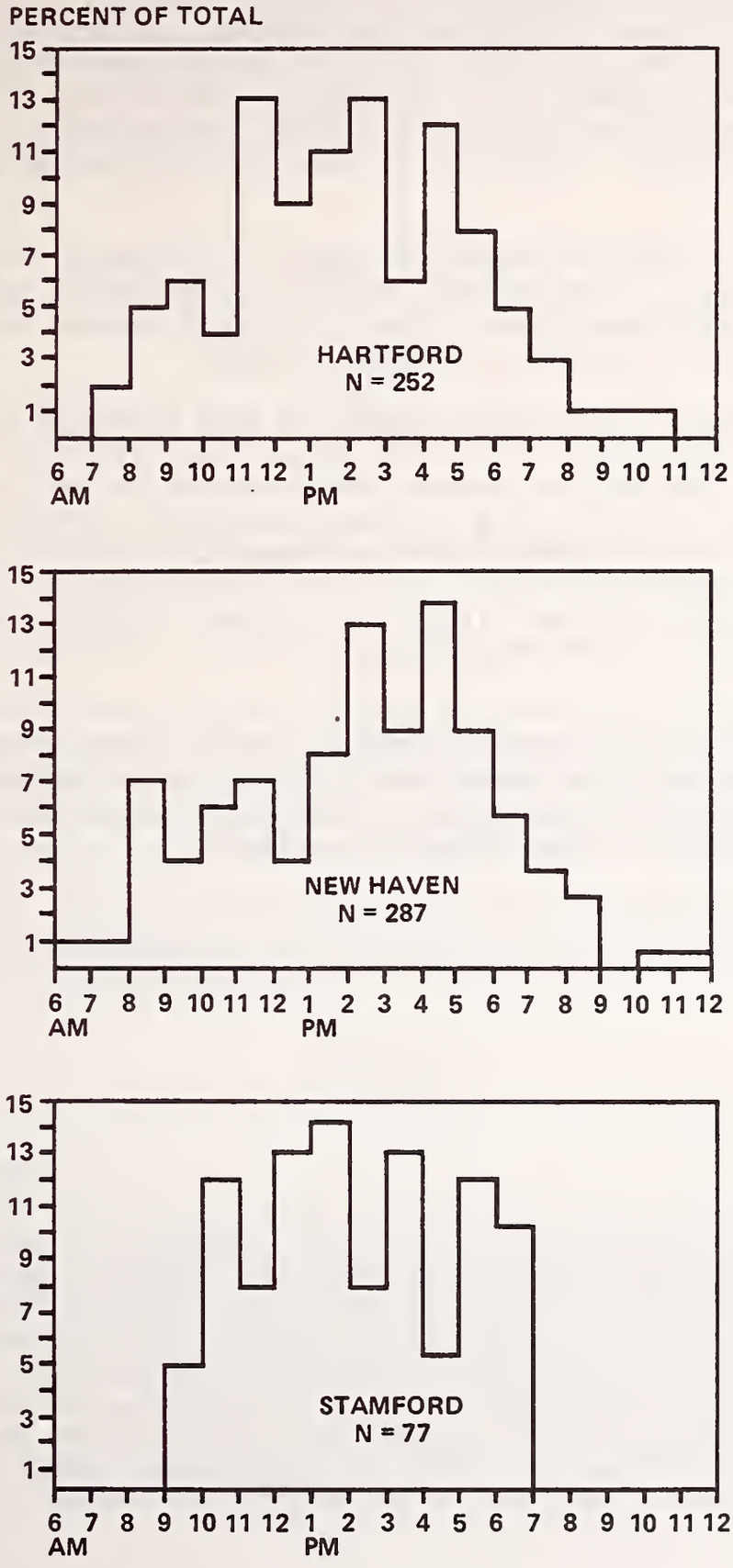
ALTERNATIVE SERVICES

The low level of demand reported above almost certainly reflects the superior transportation alternatives available to many wheelchair handicapped in Connecticut. It may also be partially attributable to the relatively low level of promotion given the wheelchair service by Conn Transit. Many adults confined to wheelchairs can drive their own specially equipped automobiles.

Moreover, there are substantial door to door dial-a-ride services for the handicapped in each area. Virtually every town in the Hartford division service area has a wheelchair lift equipped municipal dial-a-ride service.

Figure 4–3

WHEELCHAIR BOARDINGS BY HOUR OF DAY AS A PERCENT OF TOTAL WHEELCHAIR BOARDINGS BY THE DIVISION*



NOTE: Some cards did not indicate the time of boarding. These cards were not included in the figure.

SOURCE: Charles River Associates Incorporated, October 1980.

* Boardings include both successful and denied boardings.

This service is coordinated by the Greater Hartford Transit District (GHTD).* Service includes, but is not limited to, trips for purposes of employment, medical appointments, grocery shopping, and personal business for the elderly and handicapped. However, the level of service varies considerably from town to town depending on the needs of the community. The service is basically a many-origins-to-many-destinations dial-a-ride with door-to-door service and limited driver assistance. Generally, 24-hour advance reservations are required.

The service generally operated Monday through Friday between the hours of 9:00 a.m. and 4:00 p.m., although some vehicles may begin or end service prior to or later than those times. There is limited weekend service within the City of Hartford and occasional evening service.

Of the 56 vehicles used in the GHTD program, 24 were purchased by the GHTD with assistance of the federal funds from UMTA. Also, of the 56 vehicles, 27 are lift equipped. The District leases these vehicles to the community for operation. The other vehicles were purchased through a variety of sources including Section 16(B)2 of the Urban Mass Transportation Administration Act, Title III of the Older Americans Act, and local contributions. The operating expenses for the service are paid from local coffers. Similar programs are run by towns and cities in the New Haven and Stamford divisions.

Many private nonprofit social service agencies also provide handicapped transportation services on a demand-responsive basis. Many of these services are provided in vans purchased under Section 16(B)2 of the UMTA Act. The acquisition of these vans is sponsored by Conn DOT. Approximately 35 lift equipped vans have been provided under this program.

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*Information in this section is drawn from the Greater Hartford Transit District, Transition Plan, January 1980 (revised 5/27/80). The GHTD is a special purpose district with 13 member municipalities established for the purpose of providing public transportation services in the Hartford area. The principal activities of the GHTD include the funding of local paratransit services; the regulation of taxis, private motor coaches, and livery services; and the rehabilitiation of Hartford's Union Station as a multimodal transportation center. GHTD does not fund or direct Conn Transit. Conn Transit is funded by and directly responsible to Conn DOT.

5

WHEELCHAIR INCIDENTS AND CLAIMS

INTRODUCTION

One concern about increased carriage of the handicapped on public transit is increased exposure to liability for personal injury by the transit operator. Conn Transit's experience with claims by wheelchair passengers does not indicate that claims from wheelchair passengers will be a major problem.

Since wheelchair incidents are relatively rare, CRA investigated all such incidents since the advent of accessible service. There have been seven wheelchair-related incidents.

FINDINGS

STRANDED PASSENGER

The first incident occurred on July 17, 1979, although the driver did not fill out an accident report and states he never saw the claimant fall.

The situation as described by the bus driver was that he lowered the wheelchair lift to pick up a passenger, a female paraplegic, aged 30. The barrier would not go down flat and a few passengers lifted the woman in her

chair onto the platform which was then raised so she could wheel herself onto the bus. The driver was then unable to stow the lift and continue on his route. A second bus arrived on the scene after the driver of the first bus had unsuccessfully tried to stow the lift. It was decided that the passengers would use the rear door to disembark and transfer to the second bus. Meanwhile, the first driver went to use a pay phone to call the dispatcher for a mechanic. After his call, the driver returned to find three people lifting the woman in her wheelchair off of the still-raised platform to set her on the ground. He reboarded his bus to find the lift in working order and cancelled the call for a mechanic.

However, the woman subsequently filed a claim against Conn Transit which is at variance with the bus driver's report. Her amended claim report indicates that she had other passengers help her and her wheelchair out of the bus by way of the the defective ramp. But the ramp gave way on one side causing her wheelchair to topple over and send her sprawling to the cement pavement.

The claim requests $20,000 for hospital bills, surgery, medical and doctors' bills. The plaintiff's lawyer claims she suffered from ischial ulcers requiring complicated surgery, received other bruises and lacerations and further requested damages for mental humiliation and psychological damages.

Conn Transit is contesting this claim which it expects to settle in court.

DAMAGED FOOTREST

The second incident occurred on October 6, 1979 when a rented wheelchair was damaged by the lift mechanism. Apparently the chair's footrest jammed in the lift and part of the device was broken off. The cost of the settlement was the price of a replacement part for the chair, $39.50.

COLLAPSED LIFT

The third incident was an accident which occurred on November 13, 1979 when the wheelchair lift of a bus collapsed two-thirds of the way to the ground causing a quadriplegic passenger to topple out of his chair to the ground. The claimant was taken to the hospital with lower back and neck pain, abrasion of the knee and a swollen foot. The bus was checked by Conn Transit maintenance that evening. They were not able to determine the cause of the accident. A leak was found in the hydraulic line that operates the safety barrier, but this would have no effect on the platform on which the wheelchair rested.

In addition to his claim the claimant also sent a viewer inquiry to the consumer reporter for a local television channel. He expressed concern for his safety and the safety of the public that supports mass transportation

systems. He felt that Conn Transit had not satisfactorily responded to his inquiries about the causes of the mishap.

Conn Transit's settlement with the claimant cost a total of $357.30 to cover the hospital, x-ray, doctor and ambulance costs he incurred as a result of the accident.

DAMAGED WHEELCHAIR

The fourth incident took place on June 17, 1980. The supervisor's report indicates that the bus driver drove off before a wheelchair passenger had settled, causing her to fend for herself and damaging her brake. Also, the driver reports that a passenger refused to move for the wheelchair to pass and got her foot caught in it. No claim has been made by either of the parties.

SCRAPED HAND

In an incident on August 30, 1980, a wheelchair passenger scraped her hand against the door while the lift was in the process of lowering her to the ground. She allegedly suffered abrasions on the index and third fingers. This incident may result in a claim.

CAPSIZED WHEELCHAIR

The most recent incident occurred on September 13, 1980. A wheelchair passenger tipped over while attempting to wheel himself off of the lift before the driver had relaxed it. The driver's report indicates that the passenger "jumped back" into his chair, and "he was all right" and "hurried away" before his name and address could be obtained.

FRUSTRATED PASSENGER

On a hot day in September, a regular wheelchair lift patron was passed up by several Conn Transit buses and denied boarding. This woman passenger, a handicapped activist, in the heat of frustration rolled herself in front of an on-coming bus, stopped it, and clung to its bumper until she was forcibly removed by the police. Curiously, after the incident the woman generally praised the efforts of Conn Transit on behalf of the handicapped. She was an organizer of the "Love-A-Bus" day described earlier. This incident did not result in an incident report or a claim.

CONCLUSIONS

Since the advent of accessible service, Conn Transit has served 2,654 wheelchair riders, yet there have been only seven reported incidents. This averages out to one incident for every 379 boardings. Although this is probably much higher than for the general ridership population, CRA does not see it as a cause for great alarm about the safety of wheelchair patrons.

6

ROAD CALLS, REPAIRS, AND MAINTENANCE

INTRODUCTION

One major issue in the evaluation of wheelchair lift service is the mechanical reliability of the lift equipment and the costs of repairing and maintaining the lifts. This chapter describes CRA's findings and the experience of Conn Transit in repairing and maintaining the lifts. CRA's investigation of repair and maintenance requirements focused on three activities of the Maintenance Department:

- Road Calls;
- Repairs; and
- Maintenance and Inspections.

Since mechanic time represents a significant cost to operators of wheelchair lift equipped fleets, this section also outlines CRA's efforts to estimate the labor and parts costs of maintaining the wheelchair lift equipment.

Road calls require the attention of mechanics to mechanical problems encountered in the field. Actual repairs represent a more obvious cost -- the parts and labor requirements of correcting a lift malfunction. Maintenance and inspection procedures are the more routine duties of mechanics.

ROAD CALLS

Mechanics make road calls in response to service calls from drivers in the field. In response to a service call from the driver of a disabled bus, the maintenance department dispatches a mechanic to the inoperative bus. The mechanic then repairs the bus in the field or brings it back to the garage.

An inoperative wheelchair lift can often prevent the bus from moving by simply preventing the front doors from closing. (A brake interlock safety device prevents the bus from operating with the doors open.) For this reason, many lift malfunctions in the field necessitate road calls.

METHODOLOGY

Road calls are tallied by the bus dispatcher. Complete records of daily road calls recorded by the dispatcher are maintained by Conn Transit.

June road calls were tabulated by CRA by coding the information in the "trouble reported" column of the dispatchers' records as either lift-related or non-lift-related. During July and August, Conn Transit recorded wheelchair lift-related road calls. Wheelchair lift and accessible bus road call data were then tabulated with all road calls to determine the proportion of all road calls that were lift-related (see Appendix E).

ROAD CALLS

Table 6-1 shows the distribution of road calls for all Conn Transit buses for the summer of 1980. It is noteworthy that lift-related road calls generally account for less than 10 percent of all road calls for the new accessible buses. They account for only 6.3 percent of all road calls for all buses. However, in relating lift-related road calls to lift boardings during the study period, we find that there were 197 lift-related road calls and 855 lift boardings. This implies one lift-related road call for every 4.3 lift boardings reported.

It is also interesting to note that Conn Transit averaged over 1,000 road calls per month. This implies at least 2 road calls per month for every one of the 457 buses owned by the system. The 280 accessible coaches average over 3 road calls per coach each month. The air conditioning equipment on the new Grumman Flxible buses posed a significant problem during the summer of 1980. Since these vehicles cannot be operated in hot weather without air conditioning, this may explain the large number of road calls in the accessible fleet. (Appendix E contains tables showing road calls by month.)

Table 6-1

ACCESSIBLE BUS ROAD CALLS BY DIVISION
June 1 - August 23, 1980

	Lift-Related	Other	Total
Hartford	110 (6.6)	1,563 (93.4)	1,673 (100.0)
New Haven	59 (7.8)	694 (92.2)	753 (100.0)
Stamford	28 (11.2)	223 (88.8)	251 (100.0)
Total	197 (7.4)	2,480 (92.6)	2,677 (100.0)

NOTE: Numbers in parentheses are row percentages.

SOURCE: Conn Transit, Dispatchers Daily Report of Road Calls and Pull Ins, June 1 - August 23, 1980.

ROAD CALL LABOR HOURS

Based on comparisons between the number of lift-related road calls and wheelchair lift repair orders for the summer of 1980, it is obvious that not all calls correspond to repairs. There are simply more road calls than repairs. CRA understands there are several reasons for this. First, although it is standard procedure for all road calls to be accompanied by a repair order, this custom has broken down recently due to the illness of a key individual responsible for maintenance records. Second, a large proportion of all lift-related road calls do not result from mechanical malfunctions or do not require repairs. In many instances, the operator has jammed the lift mechanism due to improper operation, is unable to stow the lift, and cannot continue on his run. The mechanic simply helps the driver finish the lift cycle procedure. Mechanics are loathe to generate paperwork for such a trivial task. In fact, it is not uncommon for the mechanic to find the operator has corrected the problem himself by the time he arrives.

In most cases a mechanic is dispatched from the garage on all road calls. Time spent responding to road calls is underrepresented for mechanics on repair order reports to the extent that road calls do not generate repair orders. The following section describes CRA's method of estimating mechanic hours spent responding to road calls.

CRA selected a random sample of wheelchair lift road calls from the July and August lists provided by Conn Transit, representing approximately 38 percent of the lift-related road calls in those months. CRA was able to locate repair orders for only approximately 16 percent of these road calls.

If only 16 percent of the 197 lift-related road calls in the summer of 1980 were recorded in the repair orders, 122 cases remain unattributed. At 60 mechanic-minutes per call, this represents an additional cost of 122 hours of mechanic time.

In order to account for the costs of road calls, CRA added 120 mechanic hours to the total labor time spent repairing and maintaining lifts. This represents 60 minutes of road time for each of the approximately 120 road calls without repair orders. This solution is a conservative estimate of the true labor cost since the average road call may occupy a mechanic for well over an hour.

REPAIRS

INTRODUCTION

In general, Conn Transit's experience with the EEC lifts has shown them to be sugject to frequent breakdowns and failures. The mechanism is characterized by erratic performance and can be damaged by misuse. The operator controls,

Flxible, are complicated and unforgiving to the inexperienced operator. This section reports CRA's findings on the repairs of lifts from analysis of records provided by Conn Transit and from discussions with Conn Transit bus maintenance personnel. Despite the faulty mechanical aspects of the lift, only a small proportion of total mechanic time each month is devoted to lift repair. It is possible that the amount of lift maintenance provided by Conn Transit was not sufficient to ensure proper performance of the lifts. However, it was beyond the scope of this study to make such a determination. The findings include an estimate of labor and parts costs for lift repairs.

When a bus is repaired by a mechanic in the Conn Transit system, the mechanic fills out a repair order report form. The repair order includes the service division, bus number, any parts used (and their costs), the date, a brief description of the problem and repair, starting and completion times of the repair, and the mechanic's name. For the purposes of this study, Conn Transit set aside repair orders pertaining to the wheelchair lift and made them available to CRA. From these repair orders, CRA derived and tabulated repair type, elapsed time, division, date, and parts costs.

Wheelchair lift repairs can be coded into eight categories. These include seven primary classes of repairs and an unclassified category encompassing other mechanic activities. The labor time required to perform the various types of repairs, as well as the cost associated with various types of parts, was developed from the repair orders.

It should be noted that indirectly attributable breakdowns may not be entirely accounted for. For instance, doors can be damaged by improper lift operation; these may not be coded as lift repairs. For this reason, mechanic time spent repairing lifts is a large portion, but not all, of the total mechanic time that is truly a function of lift service. The lift repairs provided by Conn Transit and coded by CRA only include repairs to the lift mechanism proper. Repairs on doors or other features that may have been damaged by lift operation are not coded as lift repairs.

TYPES OF REPAIRS

As indicated above, seven primary classes of bus repairs can be coded from Conn Transit repair orders. Each of the classes is described below. Table 6-2 shows the incidence, labor hours, and parts required for each class of repair over the period from June 1, 1980 through August 23, 1980. The eight categories include main platform repairs, repairs to automatic sensors, problems with the door and steps, fluid leaks, barrier flap malfunctions, failure of the controls, broken handrails, and an unclassified category containing many "nonrepairs." (Appendix F contains monthly details on repairs by division.)

Table 6-2

WHEELCHAIR LIFT REPAIRS BY TYPE
June 1-August 23, 1980

Repair	Number of Occurrences	City			Labor (Minutes)				Parts		
		New Haven	Hartford	Stamford	Average	Minimum	Maximum	Total	Average Cost Parts (if nec.)	Percent of Repairs Requiring Parts	Total Cost of Parts
Platform	18	6	10	2	155	31	384	2,794	$ 404	67	$ 4,852
Sensors	41	16	24	1	113	20	337	4,639	223	41	3,783
Door, Steps	31	19	10	2	121	25	565	3,751	167	35	1,842
Leaks	21	8	13	0	150	22	334	3,151	6	14	18
Barrier	54	11	41	2	109	14	418	5,883	85	28	1,282
Controls	25	6	17	2	168	22	540	4,203	715	48	8,576
Handrail	22	12	10	0	69	32	185	1,527	4	5	4
Unclassified	127	97	28	2	67	9	570	8,459	$ 145	6	$ 872
Total	339	175	153	11				34,407			$21,229

SOURCE: Conn Transit, Repair Orders, June 1 - August 23, 1980.

PLATFORM, MANEUVERING CYLINDERS

Problems of this variety leave the lift inoperable. In many cases, the difficulty is caused by failure of the hydraulic system to supply the necessary pressure to maneuver the lift. Troubles with the main arm and the platform itself also fall into this category. A variety of other problems, particularly those involving sensors or any part of the secondary hydraulic systems, may be related and can cause the same symptoms. Problems of these types often require major repairs. Fortunately, they occur infrequently.

New risers, cylinders, arms, and sensors were responsible for most parts expenses in this repair category. After some repairs in this category, it is necessary to adjust or replace sensors. (As indicated below, sensor repairs can be an expensive process.) Platform repairs were not very common over the three months studied, but were generally the most time-consuming and expensive repairs.

SENSORS

At several points in the lift operation sequence, switches are automatically activated to ensure various functions and levels of safety. "Switches" can refer to two types of lift part. Switches at the control panel refer to buttons or other devices used by the driver to activate the equipment. Repairs to these switches are coded as "controls." In the lift mechanism itself, switches such as the down limit switch or barrier up limit switch also control the equipment. The important distinction is that these switches function automatically as the lift operates. Repairs to these automatic, internal switches are coded as "sensors."

Limit switches stop functions of the lift when continued functioning is undesirable. For instance, the dock limit switch turns off the main hydraulics when the platform reaches the docked position. The down limit switch stops the platform from lowering past the curb. If the lift were to continue to "push" down, the bus would be forced up, and the lift would be damaged. The barrier up limit switch acts in a similar manner, shutting off the secondary hydraulic system when the barrier is fully raised.

Sensors ensure safe lift operations. The level sensor works off a photo-sensitive system and ensures that the platform is level during raising and lowering of passengers. The passenger sensor locks the barrier in the up (safe) position whenever a passenger is on the lift.

Sensor repairs are relatively frequent and expensive. The location of the sensors makes repairs time consuming. Also, the cause of the problem may not be immediately clear. The greatest costs involve expensive parts (a new level sensor costs $840). Sensor repairs were frequent enough to make this class of repair the second largest in mechanic time consumed.

DOOR, STEPS

Many lift malfunctions can impede successful stowing of the lift and closing of the front door. When the front door will not close, the bus cannot be operated and must be "changed off" for another one. Failures of sensors, controls, platform, hydraulics, and the barrier may block the doorway. Also, broken doors can simply be a function of a poorly operated functional lift. As far as is possible, these problems were coded with the category of the true cause. However, "Door, Steps" remains a varied category of repairs.

In many cases, the lift is functional, but will not stow properly after operation. Often, adjustment of the step guides is necessary. Replacement of step guides, bolts, cables, related switches, and cylinders contributed to parts costs in this category. Occasionally, jammed doors damaged the barrier flap and additional work was required. Simple recycling of the lift led to successful stowing in a few cases. The principal mechanic's problem can be finding the cause of the failure to stow. More than one minor adjustment may be necessary, and the lift failure may be intermittent.

LEAKS

Because the lift is operated by hydraulic systems, leaks and low levels of oil or air can prevent the lift from functioning. If the level of oil is low in the power steering mechanism, or if insufficient fluid is diverted by the solenoid valve, the hydraulic system may not supply the pressure necessary to operate the lift. Unfortunately, insufficient fluid can cause problems with almost every step of the lift operation. Valve adjustment, when necessary to ensure fluid flow, was coded in the repair data with "leaks."

Parts costs here were virtually zero. Replacing oil in the power steering mechanism and hydraulic systems is routine maintenance procedure. Mechanics who added oil to the hydraulics did not include any cost of parts used. Labor minutes in this category were among the highest, averaging 2.5 hours per repair. Many repair orders indicated several possible repairs being attempted (e.g., sensor adjustment, wiring traces, and examination, etc.) before the leak was sealed or the fluid replaced. Difficulty in locating the leak appears to contribute significantly to repair time.

FLAP OR BARRIER

The barrier flap serves a variety of functions: it is a flap, exposed outside the bus doors, when the lift is stowed in the steps position; it is a ramp when the lift is curbside and a passenger is boarding or deboarding;

and it is a barrier, preventing wheelchairs from rolling over the platform while the lift is operating or docked. A variety of causes can be responsible for barrier flap malfunctions.

Faulty wiring to the flap prevents the driver from operating it, and incapacitates the lift. Finding a break in the wiring can take as long as fixing it. Insufficient fluid in the barrier pump will prevent both the barrier up and barrier down steps of operation. Because of the flap's exposed position, physical damage can also occur. Occasionally, the flap simply breaks off. The variety of difficulties the barrier is subject to make it the most frequent repair and the largest consumer of mechanic time.

Barrier operations can also be blocked by problems with the barrier up limit switch. These repairs are coded as switch repairs. This illustrates how separate aspects of the lift mechanism repair are interrelated.

Because the barrier has so many functions and so many possible causes of malfunction, trouble shooting is necessary and contributes to repair time and cost. The lift will not perform any function without the flap in the proper position, so barrier malfunctions can block the doors from closing and cause bus change-offs. Parts costs, unless the flap is physically broken off, are minor.

CONTROLS

The controls allow step-by-step operation of the lift by the driver, without the driver being required to leave his seat. The control box is the center of wiring connections between the controls and the functional parts of the lift. "Commands" from various sensors are also transmitted to the lift through relays in the control box.

Control repairs centered around the control box and the wiring associated with it. Actual control panel switches (buttons) were inexpensive to replace. Control boxes, however, were the most expensive single part and made up much of the cost in this category. The time required to change a control box or locate faulty wiring gives this repair category the longest average repair time.

HANDRAIL, GRABRAIL, AND TIEDOWN

The handrail is a nonmoving passenger assistance device. Breakdowns in this area are not due to any moving parts, and part replacement costs are minimal. Costs stem from repair time, much of which is spent extracting broken bolts, as well as installing new ones. Latches, used to hold the jump seat and tiedown, were often found to be faulty during August maintenance and inspection.

The brief descriptions provided by the repair orders imply wear-and-tear-caused problems (bolts breaking off, rails giving way, loosening, etc.) The handrail is in a position to aid all passengers while boarding. It is used by all classes of passengers and receives more use than the number of wheelchair boardings would indicate. It is designed to secure the position of a wheelchair passenger on a level lift, not to aid a walking person in using the steps. The small base of the grabrail is bolted to the platform. The height of the grabrail (relative to the base) may be providing leverage that compounds the strain on the base when able-bodied passengers use the rail as a bannister.

UNCLASSIFIED

Several types of repairs typify the unclassified category. Large numbers of maintenance procedures in New Haven (particularly in June and August) were coded as unclassified. (These were a result of a lift maintenance and repair campaign primarily using mechanics working the "graveyard" shift.) These "repairs" were performed on an operative lift, required no parts, and took less than an hour of mechanic time. Lifts that were examined but not repaired (no trouble found) also constitute a large portion of the unclassified category. These "repairs" (often road calls) averaged somewhat more than half an hour each. Also coded as unclassified were some multiple breakdowns, lift-caused problems (such as failures in the brake interlock system), and repair orders containing insufficient data for accurate coding.

The low average time per repair in this category reflects the large number of "nonrepairs" coded as unclassified. Approximately 80 percent of unclassified repairs were checking or servicing a functional lift, and might be best described as "nonrepairs." About 20 percent of these nonrepairs included road calls or cycling of lifts, and many others were routine maintenance procedures (e.g., lubrications and cleaning.) In June and August there were special wheelchair maintenance campaigns. These are reflected in the unclassified repairs.

The actual repairs that were coded unclassified included the brake interlock system, illegible repair orders, and multiple repairs that could not be attributed to a particular class. These repairs are the cause of the large mechanic time and parts costs in this category.

LABOR AND PARTS

From the bottom line of Table 6-2 it can be seen that a total of 573 mechanic hours were devoted to lift repairs (and special maintenance campaigns) during the study period. This is an average of nearly 200 hours per month or approximately 40 minutes of repair time per bus per month.

The total costs of parts included several very expensive control boxes replaced under warranty with the Grumman Flxible. (In fact, many major repairs to the buses are still covered under warranty.) The costs of parts averages out to approximately $7,000 a month. This is an average of $25 per bus per month.

MAINTENANCE AND INSPECTIONS

Lift maintenance and inspection is part of the routine bus maintenance program. Every 6,000 miles each bus and lift is checked for malfunctions and provided with routine lubrication. (Buses are also inspected every 3,000 miles, but the 3,000 mile inspection does not have a lift component.)

In addition to routine maintenance, there are occasional special programs for lift inspection and repair. For instance, during June the New Haven division conducted a special service program. These special programs are reflected in the unclassified category of the repair orders analysis above and are not counted here.

The routine 6,000 mile inspections known as "B inspections" require 30 minutes of mechanic time for lift operation and checking. B inspections are recorded for each vehicle as inspections. CRA used lists of B inspections provided by Conn Transit to determine the number of regular monthly inspections.

Table 6-3 shows the number of mechanic hours each calender month by division for regular wheelchair maintenance and inspection. A total of 175 regular inspections were conducted during the three-month interval. This implies that 700 inspections are conducted annually. At this rate a lift is expected to receive routine maintenance and inspection once every four or five months. This would imply that Conn Transit buses are driven only 14,000 to 18,000 miles per year. This rate is less than half the national average rate for transit bus use. Perhaps Conn Transit is falling behind in its scheduled maintenance.

One factor which may have contributed to the frequent lift breakdowns and failures may be the quality of maintenance given to the lift equipment. However, it is beyond the scope of this report to assess the quality of the Conn Transit lift maintenance program.

During August, Conn Transit initiated a special lift inspection program to deal with the problem of service unreliability due to mechanical malfunctions.

Table 6-3

"B" INSPECTION WHEELCHAIR LIFT HOURS* BY CALENDAR MONTH AND DIVISION

DIVISION	June	July	August	Total
Hartford	15.5	15.0	19.5	50.0
New Haven	16.0	12.0	6.0	34.0
Stamford	1.0	2.0	0.5	3.5
Total	32.5	29.0	26.0	87.5

*30 minutes of wheelchair lift maintainance per "B" inspection assumed.

SOURCE: Conn Transit, Monthly B Inspection Lists, June - August 1980.

The lift inspection program assigns two drivers in each division (one in Stamford) each weekday for two hours to the task of cycling and inspecting lifts on the Grumman buses. Together a team of two operators tests approximately ten lifts per day. One operates the lift while the second provides weight. (In Stamford, sandbags are used for weight.) It is planned that each lift will be checked twice each month. This is a significant increase over the former program described above, where lifts were inspected twice each year. Lift malfunctions are reported to the maintenance department. The initial impact of this program when started during the summer of 1980 was to increase the backlog of lift repairs for the maintenance department.

This program will probably help alleviate the problem of lift unreliability due to undetected mechanical failures, but it does not serve to increase most operators' familiarity with lift operation. A periodic driver testing and training program has been initiated. It should be recognized, however, that neither the lift inspection program nor the quarterly operator test provides the level of usage and familiarity that would result from daily lift cycling by each driver as he initiated or finished his run.

CONCLUSIONS

Mechanic hours devoted to the lift stem from three sources:

- Road calls;
- Repairs; and
- Maintenance and inspection.

Mechanic time spent on these activities was estimated for each activity. Table 6-4 shows mechanic hours by task for each division for the study period. Also included on the table, for the purpose of comparison, are the total mechanic hours worked over the same period. It should be noted that mechanic time devoted to lift maintenance and repair is roughly equivalent to having 1.5 extra full-time lift mechanics, an average of 63.7 hours per week. (Appendix G shows these data in monthly detail.)

Over the course of the three months studied, approximately 1.5 percent of all mechanic time was spent servicing lifts. There are some differences between months and divisions. Many of these differences may represent normal fluctuations in the data. The new lift inspection programs may somewhat increase the amount of mechanic time spent on lifts in the future.

Table 6-4

MECHANIC HOURS BY DIVISION AND TASK
June 1-August 23, 1980

Division	Lift Repairs* and Road Calls	Lift Inspection**	Total Lift-Related	Total Hours	Percent Lift-Related
New Haven	202.9	34.0	236.9	17,554	1.35
Hartford	311.4	50.0	361.4	26,981	1.34
Stamford	42.6	3.5	46.1	4,253	1.08
Total	556.9	87.5	644.4	48,788	1.32
Adjusted Total†	676.9	87.5	764.4	48,788	1.50

*Includes New Haven maintenance activities coded as "unclassified" repairs.

**30 minutes per accesible bus "B" inspection.

†60 minutes per estimated unaccounted Road Call added.

SOURCE: Conn Transit, Dispatcher's Daily Report at Road Calls and Pull Ins, Repair Orders, June 1 - August 23, 1980; Conn Transit Weekly Payroll Report and B Inspection List, June, July and August 1980.

LIMITS OF THE DATA

August repairs reflect the new inspection program and a high level of preparation for a special handicapped "Love-A-Bus" day promotion. The higher level of actual repairs indicates that stepped up lift maintenance and examination will uncover more problems. The lack of an increase in lift-related road calls during the same period shows that these increases in repairs were not due to any increase in on-road breakdowns. The high number of unclassified repair orders reflects the high level of preparation that did not yield actual repairs.

June repair orders were categorized with a few repairs inadvertently included from earlier months. Also, June road calls were tallied by a method slightly different from July and August road call tallies.

It should also be noted that the month-by-month groupings of the data are not precise to the day. Repair orders and road calls were grouped into three, four-week periods that began on June 1, June 29, and July 27, respectively. B inspection counts were grouped by calendar month and are not precise representations of these four-week periods. Total mechanic hours were also grouped in four-week periods, but those periods began and ended one day earlier than the repair order and road call periods. Lift breakdowns can reflect the level of lift activity (i.e., maintenance and driver training programs) as well as the rate of malfunction. These problems, combined with a lack of figures on seasonal variation, may make precise interpretations of month-to-month differences untenable. The stability of repair time statistics is evident from Table 6-5.

PROSPECTS FOR THE FUTURE

The future prospects for lift repairs are unclear. On one hand there is reason to believe that mechanic time spent on the lifts may decrease in the future. A large portion of lift-related road calls leads to no repair. Operators more familiar with the lift should make fewer of these "fruitless" road calls and thereby reduce mechanic time associated with the lift. Driver training and experience can bring about increased familiarity. Also, the increased level of lift inspection and maintenance in August and beyond may reduce the rate of future breakdowns. Nevertheless, lifts will continue to breakdown. It is uncertain if Conn Transit will be able to improve lift performance. Maintenance and repairs will remain a large part of the overall accessibility cost. Driver training and familiarity can reduce these costs, but some mechanical malfunctions will remain. Also as the lift equipment grows older, the rates of mechanical failure may increase.

Table 6-5

LIFT REPAIR TIME BY MONTH AND TYPE
(in minutes)

Month	Average Time of All Repairs	Average Time of Classified* Repairs
June	96	119
July	102	115
August	99	117

*Repairs coded in one of the 7 repair classes.

SOURCE: Conn Transit, Repair Orders, 1980.

As James Hodges and Mark MacKenzie of Conn Transit Maintenance point out, the lift is required to serve a variety of users. The relatively delicate sensor and hydraulic devices are trampled and jostled by the hundreds of able-bodied passengers each day that use the steps. The occurrences of grabrail break-offs illustrate the wear and tear able-bodied passengers can exert on the lift. Other parts of the lift, such as the barrier and step guides, also can be strained by this usage. This wear and tear may grow worse as the equipment grows older. Thus, while the proportion of lift-attributable costs is substantial, not all of this cost is due to use by wheelchair passengers. Certain failures appear to be simply functions of having lifts that convert to steps. Increases in lift use may actually lead to lower rates of increases in mechanic costs as drivers become more familiar with lift operation.

7

COSTS OF ACCESSIBLE SERVICE

INTRODUCTION

The wheelchair lift service has imposed a variety of costs on Conn Transit. These costs range from capital costs for the lift equipment to costs of maintaining the lifts and insuring them against damage. This chapter reports CRA's estimates of costs of the accessible service based on analysis of Conn Transit experience.

The costs of handicapped accessible service, include capital costs of lift equipment, start-up costs of initiating service and operating costs of providing accessible service. Operating costs include maintenance and repair of lifts, training, marketing and advertising, planning, insurance and claims paid. Each of these costs will be considered separately. In some cases there are costs imposed which cannot be conservatively valued in a dollars-and-cents fashion. In these cases, we have chosen not to quantify the costs but to include them as other nonquantified considerations.

CAPITAL COSTS

Bids from Grumman Flxible for the fleet of 280 coaches indicated that wheelchair lifts and tiedowns added $8,000 to the total cost of each coach; the total fleet cost for lifts and related equipment was $2.24 million (see Table 7-1). CRA understands that no other special equipment or facilities

Table 7-1

CONNECTICUT DEPARTMENT OF TRANSPORTATION
GRUMMAN FLXIBLE FLEET
CAPITAL COSTS BY TYPE OF COACH

	Type of Coach		
	35-Foot	40-Foot	
Basic Coach	$ 82,568	$ 84,568	
Wheelchair Features	8,000	8,000	
Delivery Charge	572	572	
Weight Incentive	1,890	1,500	
Total Cost per Coach	93,030	94,640	
Coaches Purchased	118	162	
Total Cost	10,977,540	15,333,300	26,310,840

SOURCE: John Spaulding, Connecticut Department of Transportation, September 9, 1980.

were required for the lift service (e.g., no special maintenance or repair facilities were necessary). Based on this data the wheelchair lifts added 8.7 percent to total capital costs of 35-foot buses and 8.5 percent to the cost of 40-foot buses.

We can annualize this cost using the capital recovery factor approach assuming a discount rate of 10 percent, a service life of ten years, and a scrap value of zero.* Based on these assumptions the annual capital cost of the lifts is approximately $1,300, or $364,000 for the fleet. On a monthly basis the capital cost is $105.72 per unit or approximately $29,600 for the fleet.

START-UP COSTS

At the time of initiating service Conn Transit incurred a number of one-time costs associated with embarking on the new service. These start-up costs include initial inspection and preparation of the new accessible equipment, service planning, initial marketing and promotion, initial training for drivers and mechanics and administrative oversight. Since this study was a three month "slice-in-time" assessment of an ongoing program, many start-up costs were not measured. However, some start-up costs could be estimated. Specific start-up cost categories are described below.

INITIAL INSPECTION AND PREPARATION

As the new bases were received from Grumman Flxible, Conn Transit inspected each bus and made it ready for over-the-road service. CRA did not collect data on the nature, extent, or costs of this activity.

SERVICE PLANNING AND SCHEDULE MODIFICATIONS

It will be recalled from Chapter 2 that planning for the accessible service was limited to a survey of potential ridership. This was a one-time survey that was estimated to have cost no more than $15,000.

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*Annual Capital Cost $= \left(\frac{i}{1-(1+i)^{-n}} \right) cc$

where:

i = discount rate (.10 annually or .00833 monthly;
n = service life (10 years or 120 months); and
cc = capital cost ($8,000).

It also will be recalled that since the advent of accessible service, the planning department has made some marginal changes (route deviations) on approximately 8 to 10 routes to provide improved service to major traffic generators in the mobility-impaired market segment. The costs of these marginal changes, however, are generally negligible.

The introduction of the new buses has precipitated some other schedule changes on selected high-volume routes. These changes have been prompted by three related circumstances:

- First, the new buses have somewhat less seating capacity than the older GMC buses;
- Second, on short headway/high volume routes schedule adherence is a problem; and
- Third, dwell times for wheelchair patrons are longer than for other passengers.

These considerations have led Conn Transit to schedule additional buses on several high density (7.5- to 10-minute headway) routes in Hartford and New Haven.

Conn Transit's general scheduling philosophy with respect to dwell times and schedule adherence for wheelchair service, however, has been to take a "wait and see" attitude. Due to the generally low level of wheelchair ridership, no changes to specifically adjust for this service have been required. Most route and service changes have taken place in response to overcrowding or changes in the pattern of demand (e.g., the opening of a new apartment complex).

In light of these circumstances, we feel it would be conservative and justified at this time to include the costs of additional buses, added to maintain original seating capacity, only as an unquantified consideration. This would not be the case if wheelchair patronage reached higher levels, resulting in noticeably slowed service, increased dwell times and crowding, which required the insertion of additional buses into the schedule. In short, there is a marginal cost to additional wheelchair patronage. However, for Conn Transit this cost is almost negligible at current levels of demand.

INITIAL MARKETING AND PROMOTION

When the new accessible buses arrived, Conn Transit spent nearly $20,000 on newspaper ads that described the new buses and the lift service. (See Figures 2-2 and 2-3). Now that the service is established these ads are seldom run. Also at the start of accessible service, Conn Transit expended

substantial marketing and promotional resources in developing information aids for handicapped users on how to ride the bus and on developing lift demonstrations for potential handicapped users. CRA did not determine the cost of developing these information aids and marketing devices.

INITIAL DRIVER AND MECHANIC TRAINING

When the new equipment arrived, both drivers and mechanics were trained in those facets of lift operating maintenance and repairs, which were necessary for their jobs. Drivers were also trained in handling handicapped passengers. Initial training for each driver required four hours in a small group setting. Staff time for initial training of drivers and instructors probably cost no more than $40,000. CRA did not determine the extent or costs of mechanic training.

CONCLUSIONS

The start-up costs for the new accessible service appear to be relatively modest. The total costs for which CRA was able to develop quantified estimates are in the neighborhood of $75,000. However, this estimate does not cover the substantial costs of initial equipment inspection and preparation, marketing materials development, mechanic training, and administration. Consequently the total start-up costs could have been considerably higher.

Since start-up costs are not expected to represent recurring expenses nor do they represent the purchase of an asset which will eventually deteriorate and need to be replaced, CRA conservatively chose not to include these costs in the estimation of monthly costs for accessible service.

OPERATING COST

CRA investigated a number of factors affected by the wheelchair lift operation. Each of these factors is described in earlier chapters. In this section, where possible, we assign costs to these impacts of accessible service. These categories of cost include the following:

- Marketing and Promotional Costs;
- Training Costs;
- Insurance Costs;

- Claims Costs;
- Road Calls, Repairs and Maintenance Costs;
- Inspection Costs;

In some cases there is no conservative way to assign a dollar-and-cents value to some operating impacts.* In these instances the costs are included as unquantified costs of service. Each of the categories of operating costs are discussed below. They include only those categories of cost which represent an ongoing monthly expense of providing accessible service.

MARKETING AND PROMOTION

Marketing and promotion for the wheelchair lift service is generally embedded in Conn Transit's line item budget. All service schedules and information aids produced and distributed by Conn Transit describe the wheelchair service.

Most Conn Transit radio ads are run from a "cart" of 12 standard 60-second messages about Conn Transit services. One of the 12 is specifically targeted to the wheelchair market. Since one-twelfth of the standard radio ads are wheelchair oriented and approximately $100,000 are spent annually on radio ads, it is conservative to estimate $8,000 as the annual cost of promoting accessible service. This comes to approximately $666 per month.

Connecticut Transit also distributes a pamphlet entitled "How-To-Ride the Bus." Among other things, this booklet describes how to use the wheelchair lift and tiedown facilities. The annual cost of producing this pamphlet is approximately $4,500. This comes to approximately $375 monthly.

In addition to these promotional items, Conn Transit generally participates in one lift demonstration per month. Each demonstration requires a driver (usually from the spare board), a marketing representative or planner, and often a supervisor. Conn Transit estimates that each demonstration costs approximately $216 for labor.

Based on the above data, it is very conservative to assign $1,257 as the monthly cost of promoting and marketing wheelchair service. Of course, this represents only a fraction of the lift service information disseminated by Conn Transit. However, most of this information is on general use pamphlets, maps, and schedules. Consequently, the marginal cost of providing this information is negligible.

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*This is especially true for aspects of the marketing and promotional program.

TRAINING COSTS

Each new operator receives 4 hours of initial training in handling the lift and handicapped passengers. A training instructor spends approximately 2 hours per new operator in initial training sessions. Conn Transit expects to hire approximately 70 new operators during 1980. Operators and training instructors both entail a resource cost of approximately $12 hourly.* Based on these figures provided by Conn Transit, the annual cost of providing initial handicapped lift training for new operators is approximately 420 operator and instructor hours, or $5,040. This is equivalent to $420 per month.

In addition to initial training, each operator is checked quarterly on his/her proficiency in using the lift. If he/she should fail, deficiencies are corrected with minor retraining. Conn Transit employs 620 operators. Each quarterly test, and retraining if necessary, requires an average of 30 minutes from both an operator and a training instructor. The annual total labor requirement for the testing program is therefore 1,240 operator hours and 1,240 training instructor hours for a total of 2,480 hours. This represents an annual cost of approximately $29,760, or $2,480 per month.

The total annual cost of the initial training program for new operators and the quarterly tests for call operators is approximately $34,800, or $2,900 per month.

INSURANCE

Conn Transit is self-insured against liability for personal injuries and damage to the property of others. The accessible service, therefore, had no impact on liability insurance premiums.

However, Conn Transit insures its own property against damage at $.23/$1,000 annually. The marginal cost of insuring the accessible equipment against damage is .00023 times the capital cost of the lifts. The lifts for 280 accessible buses cost $8,000 each or a total of $2,240,000. Therefore, the marginal insurance cost equals $515.20 for the fleet (or $1.84 per bus) annually. On a monthly basis this is equal to a monthly payment of approximately $43 for the fleet.

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*This figure, provided by Lloyd Schaffhauser, Conn Transit Director of Finance, reflects the basic hourly wage for operators/instructors plus an adjustment for fringe benefits and overtime.

CLAIMS

There have been 7 reported incidents and claims involving wheelchair passengers since nearly full service began during the summer of 1979. In this period, the total claims paid were $39.50 for a damaged footrest and $357.30 for a passenger injured by a collapsed lift for a total cost of $396.80. There is also an outstanding claim for $20,000 being contested by Conn Transit. This unsettled claim is not included in our cost calculations because it is not certain that the claim will be awarded by the courts.

Approximately 15 months' worth of full, or nearly full, operating experience is reflected in the claims files. Since the initiation of service, 2,654 wheelchair passengers have been served. Therefore the cost of claims paid is approximately $26 per month or 15 cents per wheelchair passenger.* There is approximately one incident or claim reported for every 379 wheelchair passengers.

ROAD CALLS, REPAIRS AND MAINTENANCE

Based on our analysis, this cost consideration is the most significant operating cost of accessible service at Conn Transit. New programs for driver training and lift inspection may help reduce these costs in the future for the equipment at Conn Transit. Improved lift design to facilitate ease of operation and improve the durability of mechanism could reduce these costs for other accessible bus programs.

It will be recalled from Chapter 6 that lift-related road calls, repairs and maintenance were estimated to require 254.8 mechanic hours per month (63.7 hours per week). Including the costs of fringe benefits and overtime, a Conn Transit mechanic costs approximately $13.25 per hour. This yields a monthly labor cost for road calls, repairs and maintenance over the 3-month study period of approximately $3,375 per month.

It should also be recalled from Chapter 6 that parts cost for the 3-month study were reported to be $21,229. This is an average of $7,076 per month. CRA understands that many of these parts (and some labor) costs are covered under warranty.

Based on our analysis, the estimated monthly cost of labor and parts for lift-related roadcalls, maintenance and repairs equals $10,451 per month. This is equivalent to approximately $37 per bus per month.

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*This figure does not include the $20,000 claim which is being contested.

INSPECTION COSTS

The new on-going lift inspection program, which uses operators to inspect lifts for 50 hours each week, costs approximately 200 operator hours monthly. Including fringe benefits and overtime, Conn Transit operators cost approximately $12 per hour. Thus, the monthly cost of the new inspection program is approximately $2,400.

SUMMARY

Table 7-2 shows a summary of estimated monthly service costs based on the three-month study period. It should be noted that the training and inspection programs have been recently initiated. Both of these programs are designed to increase service reliability. Improvements in service reliability are likely to reduce expenditures on road calls and repairs. Therefore one would expect the monthly cost of road calls and repairs to decline somewhat in the coming months.

Despite the caveat above, the costs of providing accessible service remain very high. CRA estimates the monthly capital and operating cost of the accessible service at $46,677. During the study period Conn Transit reported an average monthly ridership of 285 patrons. Based on this ridership level the cost of service is approximately $164 per wheelchair rider. Each handicapped patron pays a 20-cent fare for this service.

Of course many of these costs are not sensitive to ridership levels. (That is, increases in ridership will only marginally affect measured operating costs; capital costs will not be affected at all.) Therefore, increases in ridership should result in reduced unit costs per patron. However, at current levels of ridership the average cost of $164 per ride would imply an annual service cost of $82,000 for any wheelchair commuter (based on 500 worktrips per year).

Table 7-2

ESTIMATED MONTHLY COSTS AND REVENUES OF WHEELCHAIR LIFT SERVICE

AVERAGE MONTHLY COSTS	
CAPITAL COSTS	$ 29,600
OPERATING COSTS	
Marketing and Promotion	1,257
Training	2,900
Insurance	43
Claims	26
ROAD CALLS, REPAIRS AND MAINTENANCE	
Labor	3,375
Parts	7,076
Inspections	2,400
Subtotal	17,077
TOTAL AVERAGE MONTHLY COSTS	46,677
AVERAGE MONTHLY REVENUES	
285 PASSENGERS AT .20 EACH	57
NET COST	
	46,620

SOURCE: Charles River Associates Incorporated, October 1980.

8

TRANSFERABILITY AND UNANSWERED QUESTIONS

TRANSFERABILITY

For other transit agencies acquiring lift-equipped coaches, there are three basic lessons to be learned from the Conn Transit experience. First, although the emerging technology of transit wheelchair lift equipment will hopefully improve with time and operators with other equipment may experience different patterns of breakdown and repairs, its appears that some level of lift repairs will be inevitable. Operators setting up new accessible services should adequately plan for breakdowns, maintenance and repairs.

Second, the pattern of ridership in the first months of accessible service in Connecticut does not indicate that ubiquitous lift accessible service stimulates high demand on all routes. On some routes substantial levels of wheelchair ridership have been observed. However, many others reported no ridership during the study period. For those operators with significantly less lift capacity than would be necessary for full accessiblity, this suggests that a selective strategy would be preferred to a minimal coverage approach for scheduling lift vehicles. If possible, service planners at such agencies should devise techniques to target specific routes for accessible service and eliminate lifts on other routes with more limited ridership potential.

Finally, to ensure service reliability, driver familiarity with lift operation is important. This is especially true if the lift controls are complex. Familiarity can be cultivated by frequent driver testing or daily lift operation by bus drivers.

UNANSWERED QUESTIONS

With respect to further research on the Conn Transit experience, CRA suggests that it would be worthwhile to examine the following issues which were outside the scope of this study but could be easily investigated without extensive data collection. First, what impacts will the new inspection and training programs have on lift reliability and operating costs? Second, how often do the wheelchair handicapped use alternative services to the fixed route accessible transit, such as private autos and dial-a-ride paratransit? Third, what impacts will a severe winter have on ridership and repairs?

The new Conn Transit inspection and training programs were designed to overcome the two major obstacles to service reliability; lift malfunctions and operator error. If these programs are successful, the costs of lift repairs and road calls will be reduced. More important, with improved reliability the level of service offered to the handicapped will improve, presumably stimulating increases in ridership and reductions in unit costs. These important impacts of the new program could be analyzed at low cost by tracking road calls, repairs, and ridership.

It is apparent from the data on wheelchair ridership that the handicapped in Connecticut have mobility alternatives which they use more often than fixed route transit. These alternatives include, but are not confined to, private automobiles and existing paratransit services. A study of the mobility of the wheelchair handicapped in Hartford, New Haven, and Stamford would shed light on the attributes of and competition between these alternatives. Of particular importance in view of possible congressional action in this area would be consideration of the patterns of ridership on dial-a-ride paratransit systems for comparison with the fixed route alternative.

This report has reported the operating experience of Conn Transit's accessible fleet in terms of ridership, reliability, and repairs under relatively favorable summer conditions. New England winters are often harsh and could have a dramatic impact on both ridership and equipment performance. Ridership data since the initiation of service indicate a possible seasonality in patronage, but this is not clear. No data on the relationship of cold, ice, and snow to reliability and repairs have been collected or analyzed.

Appendix A

WHEELCHAIR LIFT EQUIPMENT OPERATION

This appendix describes the basic operation of the wheelchair lift device installed in Conn Transit's fleet of Grumman Flxible buses. The appendix is divided into separate sections on terminology, lift description, operation, operator control and automatic sensors and switches. It is designed to familiarize the reader with the lift mechanism sufficiently to understand descriptions of mechanical problems and repairs encountered in the Conn Transit case study. It is optional for readers who are primarily interested in the policy-related findings of this report. Appendix C is largely based on Grumman's wheelchair lift maintenance handbook.

TERMINOLOGY

- Lift -- Wheelchair lift unit.
- Mode -- A position the wheelchair lift is in at the time.
- Steps -- Wheelchair lift formed down into steps.
- Platform -- When the wheelchair lift is positioned in the form of a flat surface.
- Docked -- When the edge of the platform nearest the operator is tight and level with the coach floor.

- Loading -- Process of moving a passenger from the street to the interior of the coach.

- Off-Loading -- Process of moving a passenger from the coach to the street.

- Loading Zone -- Where the wheelchair lift is formed into a platform and lowered down into position to load or unload a passenger on the street.

DESCRIPTION

The lift mechanism is manufactured by the Environmental Equipment Corporation. The unit is designed to fit into the front entrance door of the coach. It is normally stowed in a step position to enable the boarding of passengers by means of standard steps.

When loading or unloading a wheelchair passenger, the lift can be deployed into a platform capable of both raising and lowering a wheelchair and its occupant between ground level and coach floor height (See Figure 3-1). Its operation is remote controlled, allowing the coach driver to remain in his seat and retain complete control of the coach during the operation.

The lift is capable of lifting a 600-pound load.

OPERATION

The lift is powered by three hydraulic motors. The basic power source is the coach power-steering hydraulic system. The power-steering fluid is pumped from the engine compartment to the front of the coach through a solenoid valve to a main and secondary hydraulic motor. The secondary hydraulic motor drives a pump which in turn provides power to extend and retract the cylinders used to position the lift from steps to platform. The coach power-steering fluid provided to the secondary motor is also diverted through a control valve to the main motor. The main motor drives a gear drive through a chain and jack shaft. An arm is mounted to the output shaft on the gear drive which moves the platform from the coach floor to the boarding position.

The third hydraulic system is powered by a 12-volt electric motor coupled to a hydraulic pump. The hydraulic force developed by the pump is directed to a cylinder that is used to raise and lower the outer barrier. The outer barrier is a narrow flap at the outer edge of the platform which lowers to allow wheelchairs to board and is then raised to prevent them from rolling off the platform.

Control of the three hydraulic systems is provided by a series of electrical safeguards that require certain conditions before an operator actuated switch command can be fulfilled.

OPERATOR CONTROL

The operator control panel, shown in Figure 3-2, is located in the instrument panel to the right of the steering column in the operator's compartment.

The following section describes the normal sequence of operations required to load a wheelchair passenger. Off-loading is a similar operation, and it is not separately described.

- Stop the coach in position to allow the wheelchair lift to land in the desired spot, an 18" minimum and a 24" maximum clearance from coach to curb must be observed.

- If the curb is too high, too close, or too far relative to the bus, the down limit switch may not function properly. Obstructions in the loading zone (e.g., rocks or sticks) can also be a problem.

- Set parking brake. Open the entrance door.

- Instruct patrons waiting to board to stand clear and check the landing area for obstructions.

- Depress "Power On" switch. (If button fails to light and "Emergency Stop" button is lit, depress "Emergency Stop" button and then depress "Power On" button.)

  In this step, oil is diverted from the power steering mechanism to the lift by the control solenoid valve. Leaks or low fluid levels may inhibit this operation, and block subsequent hydraulic operations. The emergency stop switch (really a "power off" switch) must not be activated for power to come on.

- Hold toggle switch marked "Steps/Platform" in the platform position until platform is formed in the fully up position.

  In this step, the secondary hydraulic system drives the hinged lower steps and risers into a rigid platform position at the level of the coach floor.

- Hold toggle switch marked "Raise/Lower Platform" in the lower position until lift comes to rest on the street or curb.

  In this step, the main hydraulic motor moves the platform from the coach floor level on an arm out and down to the boarding position. The main motor drives the platform down until the toggle switch is released, or the down limit switch is tripped.*

- Pull toggle switch marked "Barrier Down" to the down position.

  In this step, the barrier flap is lowered to allow the wheelchair to roll onto the platform. The third hydraulic system raises and lowers the barrier.

- Load passenger. Instruct passenger to enter facing coach, center wheelchair on platform, lock wheelchair brake, and grasp handrail for added safety. The weight of the passenger activates the passenger sensor switch.

- Raise barrier by pushing barrier toggle switch in "Up" position until barrier is fully up and platform is level.

  Problems with barrier operation can show up in this step. Platform level is automatically controlled by the level sensor. The level sensor is activated at this step.

- Raise platform by pushing "Raise" side of platform toggle switch until platform is at the coach floor position. Operator must observe operation carefully to be sure the safety of the passenger is maintained.

  In this step, the main hydraulic motor raises the platform up and toward the bus on the arm. The step is terminated automatically by the dock limit switch on the inner edge of the platform.

- After the platform is at the coach floor position, the passenger may then unlock his wheelchair brake and proceed to the seating area. There are two seating areas for wheelchair passengers near the front of the

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*In order to get the leading edge of the platform flush with the ground, Conn Transit has found it necessary to add two steps to the normal operation sequence. Once the platform is lowered, the operator shuts off power to the lift by pushing the "Emergency Step/Reset" button and then depresses the "Not Steps" button. This relieves pressure on the platform allowing it to "relax." When relaxed the platform pitches away from the bus until leading edge touches the pavement. Then he redirects power to the lift and proceeds to the next step.

bus. Each seating area is equipped with a harness and locking device to prevent the wheelchair from rolling. When not in use, both wheelchair stations are concealed beneath ordinary passenger seats which must be empty and raised to accommodate wheelchair passengers.

- The operator then returns the lift to the step mode by pushing the toggle switch to the steps position until the lift is fully returned to the steps and the "Not Step" light is out. At this stage, the passenger sensor is often "fooled" by hydraulic pressures into "believing" the passenger is still on the platform. Thus, it will not allow the lift to be stowed. A special procedure has been devised to relax this hydraulic pressure by momentarily shutting off the lift mechanism, foiling the passenger sensor.

  If the lift does not completely stow, the front doors will not shut and the bus will not operate.

- Close entrance door, release the parking brake and proceed to the next stop.

AUTOMATIC SENSORS AND SWITCHES

As described above, the lift is equipped with a number of automatic sensors and switches to safeguard operations. Each of these is briefly described below.

LEVEL SENSOR

The level sensor is mounted on an arm at the right hand side behind the top riser. The lift platform maintains a level horizontal position by means of the level sensor.

The level sensor works off a photo-sensitive light system and is self-contained. A failure of the platform to erect could be due to a faulty light in the leveling sensor. Both sides of the sensor contain a transparent viewport and may be visually inspected for a failure, equal brightness should be displayed at each port. A malfunction in the sensor will initiate a stop and hold action. The lift can then be returned to a step configuration with the existing lift control.

PASSENGER SENSOR SWITCH

The passenger sensor switch contains a two-switch system activated by hydraulic pressure in the secondary pump output to the steps/platform

cylinder. The passenger sensor switch is designed to prevent the operator from inadvertently relaxing the platform into steps mode with a passenger aboard. A malfunction in this switch will not allow the platform to be stowed in steps mode.

DOWN LIMIT SWITCH

The down limit switch is mounted near the pivot point of the arm assembly and is activated by the downward movement depressing the switch plunger. This switch stops the travel of the lift at the street level.

BARRIER UP LIMIT SWITCH

The barrier up switch is used to sense the barrier cylinder in the extended position. A slide bar holds the switch in open position until the barrier is extended, then the switch roller runs off the slide bar allowing the switch to return to its normal closed position. After the switch is closed, power is transmitted to a relay which closes the platform raise and lower circuits. A malfunction in the barrier uplimit switch freezes the lift in the down position.

DOCK LIMIT SWITCH

The open dock limit switch is actuated by the gear drive pitman arm when the lift is docked. When activated, the contacts are closed providing a circuit for the electrical signal from the "steps" toggle switch to the secondary hydraulic pump solenoids. The switch must be actuated at the same time the lift reaches the mechanical stop. Malfunction of this switch prevents the operator from stowing the platform.

MANUAL OPERATION

The lift is provided with a manual back-up system in the event of power failure. The manual pump system is designed to be used when the power steering pump is inoperative (but the hydraulic system is intact and will hold pressure) or the electrical power has failed.

Should the lift's normal power source fail and it becomes necessary to use the lift, the operator must leave his seat and open an access panel on the exterior front of the bus. The operator uses a manual pump to provide hydraulic power. This procedure is useful for off-loading passengers from a disabled vehicle. Portions of the technique can be used to perform other wheelchair lift functions as required to fulfill the need.

Appendix B

CONNECTICUT TRANSIT
NEW OPERATOR AWARENESS TRAINING PROGRAM

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTA-MA-06-0049-81-5	PB82-105115	

4. Title and Subtitle	5. Report Date
Fixed Route Accessible Bus Service in Connecticut: A Case Study.	July 1981
	6. Performing Organization Code: DTS-243
7. Author(s): David Nelson, Marcia Spano, and Seth Shepetin	8. Performing Organization Report No.: DOT-TSC-UMTA-81-38
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Cambridge, Massachusetts 02142

16. Abstract

U.S. Department of Transportation regulations implementing Section 504 of the Rehabilitation Act of 1973, require transit agencies to provide wheelchair accessibility on fixed-route bus service. Since transit agencies have little experience with the emerging technology of transit wheelchair lifts, the Transportation Systems Center is performing a series of evaluations funded by the Urban Mass Transportation Administration to examine recent experience in providing fixed-route lift service for handicapped persons.

This study is part of the series which included studies in Seattle, Washington and Washington, D.C. The objectives are to report on Connecticut Transit's (Conn Transit) experience with the new service in order to provide information to other systems developing accessible service, and to estimate the costs of providing this service.

This document reports on the operating experience of Conn Transit's fleet of 280 Flxible buses equipped with wheelchair lifts. This fleet, purchased in 1979, provides service in the Hartford, New Haven, and Stamford areas. The study analyzes operating data on wheelchair lift boardings and denials; accessible and non-accessible bus schedules; road calls and repairs for all problems and for lifts; lift-related accidents, injuries, and claims; wheelchair lift marketing and promotional activities; service planning and development; and marginal operating and capital costs of accessible service for a three-month period in each of the three operating areas.

17. Key Words	18. Distribution Statement
Accessible Buses; Buses; Connecticut; Elderly; Handicapped; Lifts; Wheelchair Lifts; Fixed-Route Buses	Available to the public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	148	A07

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CONNECTICUT TRANSIT"S AWARENESS TRAINING PROGRAM

FOR OPERATION OF THE NEW ACCESSIBLE BUSES

Lesson Title: Accessible Buses Total Hours: 4 (Minimum)

Instructors: As assigned by the Director of Operations

Training Aids and Equipment: Narrated slides, wheelchairs , accessible bus with wheelchair lift and kneeling mechanism, Awareness Training brochure, Connecticut Transit Bus Operators Handbook on Assisting the Elderly and Handicapped, Grumman-Flxible Operators Handbook and the "How To Ride The Special Lift Buses" pamphlet.

Presentation: Introduction lecture, narrated slides and practical exercise (2 hours)

Introduction (classroom)

1. Lecture (taped) (6 minutes)
   "Dealing with the Elderly and Handicapped Passengers"
2. Narrated slides (14 minutes)
   "Pertaining to Wheelchair Passengers and Handicapped Passengers"
3. Question and Answer period (12 minutes)

Practical Exercise (1½ hour minimum)

Instructions given in Division yard on board a training bus

Operating Wheelchair Lift: Instructor will explain and demonstrate the wheelchair lift controls, wheelchair retention devices and the purpose of the devices.

Each operator will operate the wheelchair lift and each operator

will board and alight from the bus using a wheelchair and will lock and release a wheelchair using the locking device.

Instructor will also explain and demonstrate the emergency operation of the wheelchair lift. Each operator will operate the lift manually.

Instructor will review the operation of the wheelchair lift with the students to make sure each of them understands the location of the switches and what function they perform.

Instructor will ask questions, answer questions and reviews the "DO'S" and "DON'T'S".

Instructor will discuss what to look for when wheelchair is on the lift: Make sure the brakes are set on the wheelchair before moving the lift; Make sure the legs, arms, hands and wheelchair are clear when lift is in motion; When wheelchair is onboard the bus operator must not move bus until the wheelchair is properly secured.

Operating Kneeling Unit: Instructor will explain the switches and purpose of the kneeling unit and under what conditions it is to be used.

Instructor will have each operator operate the kneeling unit until they understand its use.

Instructor will review the "DO'S" AND "DON'T'S" concerning the use of the kneeling unit, answer and ask questions of the operators until each operator fully understands the operation of the unit.

Street Operation: (2 hours minimum) Maximum of 4 operators per instructor.

Under the direction and guidance of an instructor each operator will actually operate the bus in simulated passenger service.

Each operator will operate the bus in simulated passenger service pulling into and away from stops, loading and unloading handicapped passengers in wheelchairs by using the lift and kneeling device.

Instructor must caution operators on the hazards of allowing the right front of the bus to hang over the curb (damage to lift and kneeling unit).

Instructor will also explain and demonstrate the use of the emergency push-out windows, the roof escape hatch, and explain the use and location of the fire extinguisher and other emergency equipment.

Instructor will also review the use of all the standard operating controls of this new vehicle including the power steering unit.

Appendix C

CONNECTICUT TRANSIT
BUS OPERATORS HANDBOOK

THE BUS OPERATORS HANDBOOK

THE INFORMATION YOU NEED
TO ASSIST OUR
ELDERLY AND HANDICAPPED
PASSENGERS

1978

TABLE OF CONTENTS

INTRODUCTION

Connecticut Transit is entering a new phase in its program of providing improved bus service to the residents of the Hartford, New Haven, and Stamford regions. Our new Flxible "870" transit vehicles are equipped with a kneeling feature, a level change device, and other amenities that will make our transit services accessible for both the elderly and handicapped.

The state of Connecticut's commitment to purchase wheelchair lift-equipped buses has achieved our goal of totally accessible bus service. Learning to operate the kneeling feature and the new lift-equipped buses, however, is only part of our concern.

We also face the challenge of adapting many aspects of our operations to make our service more convenient to our new passengers, many of whom have never travelled on a bus or may have been unable to ride for years.

What follows is information that can aid you in providing the courteous and high-quality service that we are striving to achieve.

GENERAL PHYSICAL LIMITATIONS

Many people and especially some elderly people who have not been able to ride with Connecticut Transit before will now be able to because of the special design features of our new buses. People with physical limitations usually are slower moving and may have difficulty with their balance making it more difficult for them to board, be seated, and step down from our buses.

YOU SHOULD ASSIST THESE PASSENGERS BY:

- Using the kneeling feature whenever you cannot pull to the curb;
- Allowing extra time for the passenger to board and pay the fare;
- Making absolutely certain that the passenger has been seated before starting the bus in motion;
- Watching to see that the aisle is free of canes, crutches, packages and other items that might present a hazard to passengers.

WHEELCHAIR RELATED LIMITATIONS

It is very important that you understand how to best serve our new passengers who are confined to a wheelchair and will be using the bus lift for the first time. Please be patient and remember that this is a new experience not only for you but your passenger also.

YOU CAN ASSIST THESE PASSENGERS BY:

- Pulling the bus to within 12-18 inches of the curb;
- If any passengers are seated on the fold-up seat reserved for the handicapped, ask them to move to another location on the bus;
- Preparing for the wheelchair passenger by securing the fold-up seat in the "UP" position and releasing the padded restraining arm. (you should always utilize the wheelchair position directly behind the entrance first);
- The lift may be used only by a person in a wheelchair. Never permit anyone to stand on the moving lift, except individuals using walkers or crutches who cannot negotiate the steps;
- You are not expected to physically assist the wheelchair passenger in boarding or alighting unless you are so requested. Don't assume that such a passenger is aware of the proper procedure. Instruct them on the operation of the lift if required;
- In case of medical emergency or a mechanical failure in the lift, you should contact the dispatcher. As a safety precaution, never attempt to remove a person from an inoperable lift:

- In an emergency, when the safety of your passenger is threatened, take whatever action you feel is necessary;
- Make certain that the passenger is properly secured. Request that the person lock the wheelchair brakes and use the safety mechanisms provided on the bus;
- Upon boarding, ask the wheelchair passenger where he or she wishes to alight so that you can make the proper approach for that stop;
- Due to the additional time required and the apprehension many wheelchair passengers may experience, you will need to be especially patient in serving these passengers.

VISUAL LIMITATIONS

You probably have already had some experience with helping a person who is blind, partially blind, or has some other visual limitation ride your bus.

YOU CAN ASSIST THESE PASSENGERS BY:

- Trying to make boarding convenient for blind persons (sometimes identified by a white cane or a guide dog) by pulling up to the stop as close as possible;

- Permitting the person to use your voice as a guide in locating the bus door. This can be accomplished by simply greeting the passenger;
- Cautioning them about the presence of a rear view mirror or any other obstacle;
- Don't expect persons with visual limitations to be aware of information signs posted in or on the bus. Tell them the fare and any other information they require;
- These passengers may need help in locating the farebox. Encourage them to follow the handrail to the farebox. If he or she accidentally drops the fare on the floor, pick up the money and deposit it in the farebox in full view of other passengers. Tell the person what you are doing;
- Directing the passenger to the nearest vacant seat by giving specific instructions;
- Calling out stops and major transfer points. It is one of the most appreciated services you can perform. Ask where he or she wants to get off so that the person can be notified as the bus approaches that location;
- When this passenger alights, help the person to gain a sense of direction by indicating where he or she is, in relation to any obstructions that exist either on or off the bus.

HEARING LIMITATIONS

Hearing limitations and/or deafness are most likely to occur as a person grows older, although the handicap may exist in some people of any age. One problem that you may have already experienced with a passenger who had a hearing limitation is that the problem is not as obvious as other handicaps that you might encounter. What may appear to be rudeness or inattention could be inability to hear. Many deaf persons use sign language in order to communicate.

One innovation our new buses have is a light that is activated by the bus stop indicator tape device. (Instead of a pull cord). This light indicates that you, the driver, have been notified by the buzzer (which a deaf person cannot hear) that the passenger wishes to get off the bus at the next stop.

YOU CAN ASSIST THESE PASSENGERS BY:

- Speaking a little louder and slower; take care not to yell, because this may only embarrass and upset the passenger;
- If possible, face the passenger when you speak so that he or she may be able to read your lips, a fairly common ability among the deaf;
- If you are unable to understand what a deaf person is saying (a deaf person may not be aware of the volume or clarity of his voice) ask him or her to repeat the statement.

CONNECTICUT TRANSIT

MENTAL LIMITATIONS

Many mentally handicapped persons have no readily recognizable physical symptoms; nevertheless they may be very dependent on you for assistance. Many such persons have limited ability to comprehend what is being said to them or to communicate their needs.

YOU CAN ASSIST THESE PASSENGERS BY:

- Being patient;
- Speaking in a calm voice so that the person does not become upset;
- Encouraging the person to sit near to you, if possible;
- Though special care and consideration may be needed for this person, he or she should be treated with the same concern due other passengers on board your vehicle;
- Asking the passenger to repeat himself if you are unable to understand him;
- Providing whatever route and fare information the passenger may need. A schedule may not be sufficient; you may need to offer a detailed explanation;
- Asking where they want to go so that you can notify them when you reach that location.

OTHER SPECIAL PROBLEMS

Seizures and other medical problems suffered by passengers aboard your bus can present situations that call for an immediate and careful response. A seizure might be accompanied by uncontrollable thrashing or drooling on the part of the person affected. Such individuals usually present no danger to other passengers but can do harm to themselves. Other types of attacks may cause a person to lapse into unconsciousness.

YOU CAN ASSIST THESE PASSENGERS BY:

- Stopping your vehicle and asking other passengers to move away from the area, allowing the affected person plenty of room for movement and breathing;
- Immediately calling the dispatcher, who will contact the proper authorities for assistance.

SUMMARY REMINDERS

A few other points to remember when serving elderly or handicapped persons:

- Encourage elderly and handicapped passengers to sit in the front of the bus, if possible, so that you will easily be able to provide them with any special assistance or information they may need;

- Call out all major streets, intersections, and transfer points as you approach them. For many of your passengers, especially the blind (as well as the able-bodied riders who are unfamiliar with the particular route), this will be especially helpful and appreciated;
- Most elderly and handicapped persons are aware of their own limitations, many are extremely capable of dealing with their infirmities and are quite independent. The best way to help is by asking how you can be of assistance;
- If a passenger presents an elderly/handicapped identification card and you suspect that person is not entitled to the card, you may question him but do not refuse him service;
- Most important of all, remember this: no rules or regulations can cover every situation. Be guided by your natural concern for those less physically and mentally able. Try to be especially patient and understanding, offering your assistance but never pressuring or hurrying these passengers.

Appendix D

SCHEDULE OF ACCESSIBLE
SERVICES BY DIVISION

Table D-1

CONNECTICUT TRANSIT SCHEDULED WEEKDAY BUS TRIPS[1]

HARTFORD DIVISION

Route	Destination	Base[2]		Peak[3]		Trippers[4]		Total Percent
		Accessible[5]	Non-Accessible[6]	Accessible	Non-Accessible	Accessible	Non-Accessible	Accessible
A[1]	Simsbury Road	15.0		5.0				100
A[2]	Fern Street	10.0		10.0		0.5		100
A[3]	Hillside Avenue	24.0		15.0		1.5		100
B	Manch. Ind. Park	28.0		4.0		1.0	4.0	89
E	West Hartford Center	15.0				5.5	2.0	91
E[1]	Westgate	6.0						100
	Health Center	21.0				2.0		100
E[2]	Unionville	15.0					2.0	88
E[3]	Bishops Corner	29.0					0.5	98
E[4]	Webster Hill	4.5						100
	Corbins Corner	14.0				1.5	1.0	94
	Elmwood	11.0						100
F[1]	Bowles Park	30.0		12.0		1.0		100
	Bloomfield Conv.	13.0		3.0				100
	Wedgewood Apts.	14.0		3.0				100
F[2]	Jordan Lane	30.0					0.5	98
	Ridge Road	25.5					2.5	91
G[1]	Weston St. P. O.	13.0		7.0		6.0		100
G[2]	Brainard Ind. Park	10.0		9.0				100
G[3]	Smith Tower	12.5		6.0		3.0		100
H	East Windsor Hill	7.0		2.0				100
	Long Hill Road	4.0		3.0		1.0	1.0	89
	So. Windsor Terminus	2.0				1.0		100

Table continued on following page.

Table D-1 (Continued)

CONNECTICUT TRANSIT SCHEDULED WEEKDAY BUS TRIPS[1]

HARTFORD DIVISION

Route	Destination	Base[2]		Peak[3]		Trippers[4]		Total Percent Accessible
		Accessible[5]	Non-Accessible[6]	Accessible	Non-Accessible	Accessible	Non-Accessible	
J	Forest and Oak	12.0					1.0	92
	Hillstown					1.0	3.0	25
K[1]	Barbour Street	45.0		5.0				100
K[2]	North Main Street	47.0		3.0		0.5		100
K[3]	New Park Avenue	43.5		2.5		2.0	1.0	98
K[4]	Sampson + Randall	21.5				0.5		100
K[5]	Sedgwick Road	21.5						100
	Quaker Lane	5.0						100
M	Rocky Hill Center	1.0						100
	Union Park	3.0		0.5				100
	Ct. Valley Hosp.	10.0		4.0				100
N[1]	Windsor Center	3.0		8.0		4.0	5.0	75
	Community Center	11.0		2.0		1.0		100
	Rainbow + High	13.0		1.0				100
N[2]	Dept. of Labor	9.5		3.0				100
	Fairway Drive	16.0		7.0				100
O[1]	Hills + Oak	3.0		1.0		1.0	0.5	91
	Forest + Oak	5.0		1.0				100
O[2]	Knox Lane	6.0		1.0				100
	S. Glastonbury					1.0	4.0	20
	Glastonbury Center	5.0		4.0		1.0	1.0	91

Table continued on following page.

Table D-1 (Continued)

CONNECTICUT TRANSIT SCHEDULED WEEKDAY BUS TRIPS[1]

HARTFORD DIVISION

Route	Destination	Base[2]		Peak[3]		Trippers[4]		Total Percent Accessible
		Accessible[5]	Non-Accessible[6]	Accessible	Non-Accessible	Accessible	Non-Accessible	
P	New Britain	18.0				1.0		100
Q[1]	Vine Street	51.0		4.0		1.0		100
Q[2]	Charter Oak Terrace	15.5		5.0		2.5		100
Q[3]	Newington Center	6.0						100
	Vet Hospital	8.5		2.0			1.0	91
Q[4]	Elmwood Center	10.5		0.5		0.5	1.0	92
	Corbins Corner	12.5		1.5			2.0	88
R	Fairfield Avenue			8.0			1.0	89
T[1]	City Line	21.5				1.0	10.0	69
	Cottage Grove	20.5				1.0	1.0	96
	Rockwells Corner	20.0				0.5		100
	Wedgwood Apartments	6.0		2.0				100
T[2]	Jordan Lane	31.5		3.0		0.5	0.5	99
	Nott Street	14.5						100
	Griswoldville	1.5		1.0				100
	Rose Hill	18.5		1.0		1.0		100
U[1]	Bishops Corner	20.0		3.0		1.0	0.5	98
U[2]	Bloomfield	2.0		3.0		2.0	1.5	82
	U. of Hartford	8.0		4.0		1.0		100
U[3]	Wethersfield	38.0		8.0			2.0	96
W	Oakwood Avenue	2.5		4.0		1.0	2.5	75
	Corbins Corner	10.5		12.0			0.5	98

Table continued on following page.

Table D-1 (Continued)

CONNECTICUT TRANSIT SCHEDULED WEEKDAY BUS TRIPS

HARTFORD DIVISION

Route	Destination	Base[2]		Peak[3]		Trippers[4]		Total Percent Accessible
		Accessible[5]	Non-Accessible[6]	Accessible	Non-Accessible	Accessible	Non-Accessible	
X	Garden Street	12.0		5.0				100
	Founders Plaza	11.0		3.0				100
Y^M	Via Center	11.5		10.0		2.0		100
	Via Middle Tnpk.	19.0				0.5		100
Y^S	Sunset Hills	25.0		9.0		2.5	1.0	97
Z	Rockville	26.0			2.0		0.5	91
TOTAL		1076.0	0	211.0	2.0	55.0	54.0	96

Notes:

(1) Trip - Round trips only. Half trips are one-way trips.

(2) Base - Buses leave garage by 7:00 a.m. and do not return to garage until after 5:00 p.m.

(3) Peak - Buses in service during high demand periods. Averaging 3-4 hours out of garage during 5:00-10:30 a.m. period and/or 3 1/2 - 4 1/2 hours out of garage during 1:00-8:15 p.m. period.

(4) Tripper - Buses serving many routes on one run.

(5) Accessible - Flxible bus with wheelchair lift.

(6) Non-Accessible - Bus without wheelchair lift.

SOURCE: Transit System Map, Individual Route Maps/Schedules, Bus Assignment Sheets, Weekday Headway Sheets, Tripper Sheets, Run Assignment Sheets, Conversations with Bill Merton, Director of Scheduling, Connecticut Transit Co.

Table D-2

CONNECTICUT TRANSIT SCHEDULE WEEKDAY BUS TRIPS[1]

NEW HAVEN DIVISION

Route	Destination	Base[2]		Peak[3]		Trippers		Total Percent
		Accessible[5]	Non-Accessible[6]	Accessible	Non-Accessible	Accessible	Non-Accessible	Accessible
A[1]	Mitchell Drive	67.0						100
A[2]	Liberty Street	67.0						100
B[1]	Amity Road	28.0		3.0	5.0			86
	Brookside Terminus	29.0		4.0	3.0			92
	Whalley Avenue	2.0			2.0			50
B[2]	West Haven Center	37.0		5.0	6.0			88
	Jones Hill Road	24.0		3.0	2.0	2.0	3.5	84
B[3]	First Avenue			3.0	1.0			75
C	North Haven			2.0				100
	Montowese	3.0		8.0				100
	Wallingford	5.0		3.0				100
D[1]	Oxford St.	21.5		11.5				100
	Lenox St.	2.5		1.5			0.5	89
	Bella Vista	30.0		9.0				100
D[2]	Putnam & Dixwell			1.0		1.5	1.5	63
	Pine Rock						6.5	0
	Benham St.	19.5		12.0				100
	Hamden Plaza	34.0						100
	Centerville	6.0		9.0				100
F[1]	Momauguin	17.0		5.0				100
	Short Beach Rd.	6.5		3.0				100
	Branford	17.0		3.0				100
F[2]	West Chapel	39.0		11.0				100

Table continued on following page.

Table D-2 (Continued)

CONNECTICUT TRANSIT SCHEDULED WEEKDAY BUS TRIPS[1]

NEW HAVEN DIVISION

Route	Destination	Base[2]		Peak[3]		Trippers[4]		Total Percent
		Accessible[5]	Non-Accessible[6]	Accessible	Non-Accessible	Accessible	Non-Accessible	Accessible
G[1]	Lighthouse Park	42.0				1.0	1.0	98
G[2]	Airport						5.0	0
G[3]	Shelton Ave.	41.0				1.0	3.0	93
J[1]	Centerville	24.0		5.0	11.0	0.5		73
J[2]	Savin Rock	32.0		5.0	10.0	1.0		79
L	Totoket Terminus				6.5			0
M[1]	State St.	19.5		12.0				100
M[2]	Washington Ave.	21.0		11.0				100
N	Seymour	15.5		8.5				100
O[1]	Newbury St.	11.0						100
	Millrock Ave.	14.5		13.5				100
O[2]	Miller St.	26.0		14.0				100
	Winchester Shop						2.0	0
P	Bull Hill Lane	24.0						100
	Veteran's Hospital	24.0						100
Q[1]	Lombard Loop	26.0		13.5				100
Q[2]	Beverly Hills	27.5		13.0				100
S	Clinton	3.5		4.0				100

Table continued on following page.

Table D-2 (Continued)

CONNECTICUT TRANSIT SCHEDULED WEEKDAY BUS TRIPS[1]

NEW HAVEN DIVISION

Route	Destination	Base[1]		Peak[2]		Trippers[3]		Total Percent
		Accessible[5]	Non-Accessible[6]	Accessible	Non-Accessible	Accessible	Non-Accessible	Accessible
T	Pine Rock	10.0						100
	Northside	11.0						100
	Woodin & Dixwell		7.0					0
U[1]	Waterbury	12.5						100
	Chesire	1.0						100
	Mt. Carmel	2.0		4.0			3.0	67
U[2]	Union RR	1.0		1.0				100
	Oyster River			1.0			2.0	33
	Woodmont	5.0						100
	Milford	15.0		6.0		1.0		100
Y	Yale Shuttle	33.5						100
Z[1]	West Hills	25.0		9.0				100
Z[2]	Savin Rock	25.0		10.0		2.0		100
		947.5	7.0	227.5	46.5	10.0	28.0	94

Footnotes and source on following page.

Table D-2 (Continued)

CONNECTICUT TRANSIT SCHEDULED WEEKDAY BUS TRIPS[1]

NEW HAVEN DIVISION

Notes:

(1) Trip - Round trips only. Half trips are one-way trips.

(2) Base - Buses leave garage by 7:00 a.m. and do not return to garage until after 5:00 p.m.

(3) Peak - Buses in service during high demand periods. Averaging 3-4 hours out of garage during 5:00-10:30 a.m. period and/or 3 1/2 - 4 1/2 hours out of garage during 1:00-8:15 p.m. period.

(4) Tripper - Buses serving many routes on one run.

(5) Accessible - Flxible bus with wheelchair lift.

(6) Non-Accessible - Bus without wheelchair lift.

SOURCE: Transit System Map, Individual Route Maps/Schedules, Bus Assignment Sheets, Weekday Headway Sheets, Tripper Sheets, Run Assignment Sheets, Conversations with Bill Merton, Director of Scheduling, Connecticut Transit Co.

Table D-3

CONNECTICUT TRANSIT SCHEDULED WEEKDAY BUS TRIPS[1]

STAMFORD DIVISION

ute	Destination	Base[2] Accessible[5]	Peak[3] Accessible	Trippers[4] Non-Accessible[6]	Total Percent Accessible
A1	Springdale	29.0	6.0		100
A2	Cove Road	28.0	7.0		100
B	Waterside	26.5			100
	Stamford Museum			4.0	0
E	U Conn	13.0			100
	Trinity Pass	14.0			100
F	Norwalk	27.0			100
G	White Bridge	12.0	8.0		100
H1	Southfield	26.0	8.0		100
H2	South End	26.0	7.0		100
J1	Strawberry Hill	27.0			100
J2	Connecticut Ave.	28.0			100
L	Long Ridge	11.0			100
O	Old Greenwich	13.0			100
S	Shippan	27.0			100
	TOTAL	307.5	36.0	4.0	99

Footnotes and source on following page.

Table D-3 (Continued)

CONNECTICUT TRANSIT SCHEDULED WEEKDAY BUS TRIPS[1]

STAMFORD DIVISION

Notes:

(1) Trip - Round trips only. Half trips are one-way trips.

(2) Base - Buses leave garage by 7:00 a.m. and do not return to garage until after 5:00 p.m.

(3) Peak - Buses in service during high demand periods. Averaging 3-4 hours out of garage during 5:00-10:30 a.m. period and/or 3 1/2 - 4 1/2 hours out of garage during 1:00-8:15 p.m. period.

(4) Tripper - Buses serving many routes on one run.

(5) Accessible - Flxible bus with wheelchair lift.

(6) Non-Accessible - Bus without wheelchair lift.

SOURCE: Transit System Map, Individual Route Maps/Schedules, Bus Assignment Sheets, Weekday Headway Sheets, Tripper Sheets, Run Assignment Sheets, Conversations with Bill Merton, Director of Scheduling, Connecticut Transit Co.

Appendix E

MONTHLY ROAD CALLS
BY DIVISION AND TYPE OF BUS

Table E-1

ROAD CALLS

By Division and Type of Bus: June 1 - June 28, 1980

	Accessible Buses			Nonaccessible Buses	
	Lift-Related*	Other	Total	Total	TOTAL
Hartford	70 (12.0)**	511 (88.0)**	581 (87.9)†	80 (12.1)†	661
New Haven	28 (10.5)	239 (89.5)	267 (90.8)	27 (9.2)	294
Stamford	10 (10.3)	87 (89.7)	97 (80.8)	23 (19.2)	120
Total	108 (11.4)	837 (88.6)	945 (87.9)	130 (12.1)	1075

NOTE: Numbers in parentheses are in percent.

*Lift-related road calls in June are the total of road calls made for front door, steps, handrail and lift malfunctions.

**Percent of Total Accessible Bus Road Calls.

†Percent of all Road Calls.

SOURCE: Conn Transit, Dispatcher's Daily Report of Road Calls and Pull Ins, June 1 - 28, 1980

Table E-2

ROAD CALLS

By Division and Type of Bus: June 29 - July 26, 1980

	Accessible Buses			Nonaccessible Buses	
	Lift-Related	Other	Total	Total	TOTAL
Hartford	21 (4.0)*	509 (96.0)*	530 (83.1)**	108 (16.9)**	638
New Haven	13 (5.3)	230 (94.7)	243 (90.0)	27 (10.0)	270
Stamford	9 (13.2)	59 (86.8)	68 (76.4)	21 (23.6)	89
Total	43 (5.1)	798 (94.9)	841 (84.4)	156 (15.6)	997

NOTE: Numbers in parentheses are in percent.

*Percent of Total Accessible Road Calls.

**Percent of all Road Calls.

SOURCE: Conn Transit, Dispatcher's Daily Report of Road Calls and Pull Ins, June 29 - July 26, 1980.

Table E-3

ROAD CALLS

By Division and Type of Bus: July 27 - August 23, 1980

	Accessible Buses			Nonaccessible Buses	
	Lift-Related	Other	Total	Total	TOTAL
Hartford	19 (3.4)*	543 (96.6)*	562 (81.7)**	126 (18.3)**	688
New Haven	18 (7.4)	225 (92.6)	243 (92.0)	21 (8.0)	264
Stamford	9 (10.5)	77 (89.5)	86 (88.7)	11 (11.3)	97
Total	46 (5.2)	845 (94.8)	891 (84.9)	158 (15.1)	1049

NOTE: Numbers in parentheses are in percent.

*Percent of Total Accessible Bus Road Calls.

**Percent of All Road Calls.

SOURCE: Conn Transit, Dispatchers' Daily Report of Road Calls and Pull Ins, July 27 - August 23, 1980..

Appendix F

WHEELCHAIR LIFT REPAIRS
BY TYPE, DIVISION, AND MONTH

Table F-1

WHEELCHAIR LIFT REPAIRS BY TYPE

June 1 - 28, 1980

Repair	Number of Occurrences	City			Labor (Minutes)				Parts		
		New Haven	Hartford	Stamford	Average	Minimum	Maximum	Total	Avg. Cost of Parts (if nec.)	Percent of Repairs Requiring Parts	Total Cost of Parts
Platform	6	3	3	0	154	31	384	923	$475	67	$1,899
Sensors	10	5	4	1	145	30	300	1,454	295	60	1,767
Door, Steps	13	11	2	0	153	26	565	1,988	302	38	1,510
Leaks	6	3	3	0	174	34	330	1,045	1	17	1
Barrier	8	4	3	1	123	21	390	985	38	38	114
Controls	3	2	1	0	59	22	105	177	1,124	33	1,124
Handrail	6	6	0	0	111	44	185	666	--	0	0
Unclassified	54	50	4	0	54	12	570	3,940	416	4	832
Total	106	84	20	2				10,178			$7,247

SOURCE: Conn Transit, Repair Orders, June 1 - 28, 1980.

Table F-2

WHEELCHAIR LIFT REPAIRS BY TYPE

June 29 - July 26, 1980

Repair	Number of Occurrences	City			Labor (Minutes)				Parts		
		New Haven	Hartford	Stamford	Average	Minimum	Maximum	Total	Avg. Cost of Parts (if nec.)	Percent of Repairs Requiring Parts	Total Cost of Parts
Platform	5	1	3	1	165	105	300	824	$302	40	$603
Sensors	6	4	2	0	79	22	142	474	2	17	2
Door, Steps	5	5	0	0	148	53	334	738	9	20	9
Leaks	2	1	1	0	43	40	45	85	-	0	0
Barrier	4	3	0	1	87	55	165	346	3	25	3
Controls	4	2	1	1	162	75	240	646	1,269	75	3,806
Handrail	2	2	0	0	55	32	77	109	-	0	0
Unclassified	8	5	2	1	65	20	95	455	-	0	0
TOTAL	36	23	9	4				3,677			4,423

SOURCE: Conn Transit, Repair Orders, June 29 - July 26, 1980.

Table F-3

WHEELCHAIR LIFT REPAIRS BY TYPE
July 27-August 23, 1980

Repair	Number of Occurrences	City			Labor (Minutes)				Parts		
		New Haven	Hartford	Stamford	Average	Minimum	Maximum	Total	Parts (if nec.)	Percent of Repairs Requiring Parts	Total Cost of Parts
Platform	7	2	4	1	150	60	252	1,047	392	86	$ 2,350
Sensors	25	7	18	0	113	20	337	2,711	201	40	2,014
Door, Steps	13	3	8	2	79	25	138	1,025	65	38	323
Leaks	13	4	9	0	155	22	334	2,021	8	15	17
Barrier	42	4	38	0	108	14	418	4,552	107	26	1,165
Controls	18	2	15	1	188	30	540	3,380	456	44	3,646
Handrail	14	4	10	0	54	28	134	752	4	7	4
Unclassified	65	42	22	1	64	9	336	4,064	10	6	40
Total	197	68	124	5				19,552			$ 9,559

SOURCE: Conn Transit, Repair Orders, July 27 - August 23, 1980.

Table F-4

WHEELCHAIR LIFT REPAIRS BY TYPE AND DIVISION
June 1-28, 1980

Repairs	Occurrences	Labor (Minutes) Average	Minimum	Maximum	Total	Avg. Cost of Parts (if nec.)	Percent of Repairs Requiring Parts	Total Cost of Parts
New Haven:								
Platform	3	128	31	384	506	$ 295	67	$ 589
Sensors	5	114	40	176	569	840	20	840
Door, Steps	11	119	26	467	1,308	456	27	1,368
Leaks	3	177	77	302	531	1	33	1
Barrier	4	49	21	93	195	27	25	27
Controls	2	36	22	50	72	1,124	50	1,124
Handrail	6	111	44	185	666	--	0	0
Unclassified	50	68	12	176	2,040	--	0	0
Total	84				5,887			3,949
Hartford:								
Platform	3	139	102	180	417	655	67	1,310
Sensors	4	173	30	300	690	22	100	87
Door, Steps	2	340	115	565	680	71	100	142
Leaks	3	171	34	330	514	--	0	0
Barrier	3	133	70	240	400	3	33	3
Control	1	105	105	105	105	--	0	0
Unclassified	4	225	60	510	900	416	50	832
Total	20				3,706			2,374
Stamford:								
Sensors	1	195	195	195	195	840	100	840
Barrier	1	390	390	390	390	84	100	84
Total	2				585			924
TOTAL	106				10,178			7,247

SOURCE: Conn Transit, Repair Orders, June 1 - 28, 1980.

Table F-5

WHEELCHAIR LIFT REPAIRS BY TYPE AND DIVISION
June 29 - July 26, 1980

Repairs	Occurrences	Labor (Minutes)				Parts		
		Average	Minimum	Maximum	Total	Avg. Cost of Parts (if nec.)	Percent of Repairs Requiring Parts	Total Cost of Parts
New Haven:								
Platform	1	137	137	137	137	-	0	0
Sensors	4	89	22	142	354	2	25	2
Door, Steps	5	148	53	334	738	9	20	9
Leaks	1	40	40	40	40	-	0	0
Barrier	3	60	55	68	181	-	0	0
Controls	2	166	132	199	331	1,269	100	2,537
Handrail	2	55	32	77	109	-	0	0
Unclassified	5	61	20	95	306	-	0	0
Total	23				2,196			2,548
Hartford:								
Platform	3	172	105	300	515	142	33	142
Sensors	2	60	30	90	120	-	0	0
Leaks	1	45	45	45	45	-	0	0
Controls	1	75	75	75	75	-	0	0
Unclassified	2	90	90	90	90	-	0	0
Total	9				845			142
Stamford:								
Platform	1	172	172	172	172	461	100	461
Barrier	1	165	165	165	165	3	100	3
Controls	1	240	240	240	240	1,269	100	1,269
Unclassified	1	59	59	59	59	-	0	0
Total	4				636			1,733
TOTAL	36				3,677			4,423

SOURCE: Conn Transit, Repair Orders, June 29 - July 26, 1980.

Table F-6

WHEELCHAIR LIFT REPAIRS BY TYPE AND CITY
July 27-August 23, 1980

Repairs	Occurrences	Labor (Minutes)				Parts		
		Average	Minimum	Maximum	Total	Avg. Cost of Parts (if nec.)	Percent of Repairs Requiring Parts	Total Cost of Parts
New Haven:								
Platform	2	165	135	195	330	461	50	461
Sensors	7	87	42	138	611	28	29	55
Door, Steps	3	68	43	105	204	55	33	55
Leaks	4	97	34	262	386	15	25	15
Barrier	4	48	14	90	190	66	25	66
Controls	2	119	100	138	238	24	50	24
Handrail	4	77	28	134	308	--	0	0
Unclassified	42	43	21	107	1,826	2	2	2
Total	68				4,093			678
Hartford:								
Platform	4	116	60	165	465	350	100	1,401
Sensors	18	124	20	337	2,100	245	44	1,959
Door, Steps	8	77	25	120	619	60	25	121
Leaks	9	182	22	334	1,635	2	11	2
Barrier	38	115	22	418	4,362	111	26	1,097
Control	15	173	30	480	2,602	415	40	2,491
Handrail	10	44	30	89	444	4	10	4
Unclassified	22	91	9	300	1,902	13	14	38
Total	124				14,129			7,113
Stamford:								
Platform	1	252	252	252	252	489	100	489
Door, Steps	2	101	64	138	202	74	100	147
Controls	1	540	540	540	540	1,131	100	1,131
Unclassified	1	336	336	336	336	--	0	0
Total	5				1,330			1,767
TOTAL	197				19,552			9,558

SOURCE: Conn Transit, Repair Orders, July 27 - August 23, 1980.

WHEELCHAIR LIFT REPAIRS BY TYPE AND CITY
June 1-August 23, 1980

Repairs	Occurrences	Labor (Minutes)				Parts		
		Average	Minimum	Maximum	Total	Avg. Cost of Parts (if nec.)	Percent of Repairs Requiring Parts	Total Cost of Parts
New Haven:								
Platform	6	162	31	384	973	350	50	1,050
Sensors	16	96	22	176	1,534	224	25	897
Door, Steps	19	118	26	467	2,250	286	26	1,432
Leaks	8	120	34	302	957	8	25	16
Barrier	11	51	14	93	566	47	18	93
Controls	6	107	22	199	641	921	67	3,685
Handrail	12	90	28	185	1,083	--	0	0
Unclassified	97	43	12	176	4,172	2	1	2
Total	175				12,176			7,175
Hartford:								
Platform	10	140	60	300	1,397	408	70	2,853
Sensors	24	121	20	337	2,910	171	50	2,046
Door, Steps	10	130	25	565	1,299	66	40	263
Leaks	13	169	22	334	2,194	2	8	2
Barrier	41	116	22	418	4,762	100	27	1,100
Controls	17	164	30	480	2,782	415	35	2,491
Handrail	10	44	30	89	444	4	10	4
Unclassified	28	103	9	510	2,892	174	18	870
Total	153				18,680			9,629
Stamford:								
Platform	2	212	172	252	424	475	100	950
Sensors	1	195	195	195	195	840	100	840
Door, Steps	2	101	64	138	202	74	100	147
Barrier	2	278	165	390	555	44	100	87
Controls	2	390	240	540	780	1,200	100	2,400
Unclassified	2	198	59	336	395	--	0	0
Total	11				2,551			4,424
TOTAL	339				33,407			21,228

SOURCE: Conn Transit, Repair Orders, June 1 - August 23, 1980.

Appendix G

MECHANIC HOURS
BY DIVISION, TASK, AND MONTH

Table G-1

MECHANIC HOURS BY DIVISION
June 1-June 28, 1980

	Lift Repairs* and Road Calls	Lift Inspection**	Total Lift-Related	Total Hours	Percent Lift-Related
New Haven	98.1	16.0	114.1	5,890	1.94
Hartford	61.8	15.5	77.3	9,026	0.86
Stamford	9.8	1.0	10.8	1,396	0.77
Total	169.7	32.5	202.2	16,312	1.24
Adjusted Total†	235.7	32.5	268.2	16,312	1.64

*Includes New Haven maintenance activities coded as "unclassified" repairs.

**30 minutes per accessible bus "B" inspection.

†60 minutes per estimated unaccounted Road CAll added.

SOURCE: Conn Transit, Dispatcher's Daily Report of Road Calls and Pull Ins, Repair Orders, June 1 - 28, 1980; Conn Transit Weekly Payroll Report and B Inspection List, June 1980.

Table G-2

MECHANIC HOURS BY DIVISION
June 29-July 26, 1980

	Lift Repairs* and Road Calls	Lift Inspection**	Total Lift-Related	Total Hours	Percent Lift-Related
New Haven	36.6	12.0	48.6	5,915	0.82
Hartford	14.1	15.0	29.1	8,985	0.32
Stamford	10.6	2.0	12.6	1,421	0.89
Total	61.3	29.0	90.3	16,321	0.55
Adjusted Total†	67.3	29.0	116.3	16,321	0.71

*Includes New Haven maintenance activities coded as "unclassified" repairs.

**30 minutes per accessible bus "B" inspection.

†60 minutes per estimated unaccounted Road Call added.

SOURCE: Conn Transit, Dispatcher's Daily Report at Road Calls and Pull Ins, Repair Orders, June 29 - July 26 1980; Conn Transit Weekly Payroll Report and B Inspection List, July 1980.

Table G-3

MECHANIC HOURS BY CITY
July 27-August 23, 1980

	Lift Repairs* and Road Calls	Lift Inspection**	Total Lift-Related	Total Hours	Percent Lift-Related
New Haven	68.2	6.0	74.2	5,749	1.29
Hartford	235.5	19.5	255.0	8,970	2.84
Stamford	22.2	0.5	22.7	1,436	1.58
Total	325.9	26.0	351.9	16,155	2.18
Adjusted Total†	353.9	26.0	379.9	16,155	2.35

*Includes New Haven maintenance activities coded as "unclassified" repairs.

**30 minutes per accessible bus "B" inspection.

†60 minutes per estimated unaccounted Road Call added.

SOURCE: Conn Transit, Dispatcher's Daily Report at Road Calls and Pull Ins, Repair Orders, July 27 - August 23, 1980; Conn Transit Weekly Payroll Report and B Inspection List, June 1980.

Appendix H

REPORT OF INVENTIONS

The work performed under this contract led to no new inventions. The work did, to some extent, involve an evaluation of a wheelchair lift device installed in buses operated by Connecticut Transit.

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