# ***Fleet and Facility Maintenance***

The maintenance of vehicles and facilities at the MTA is under the direction of the Director of Equipment Services. The vehicles include the 150 fixed route buses, 36 handicapped service vans, vanpool vehicles, and a number of non-revenue and service vehicles. The facilities include the operating base at Nestor Street, the landports, the shelters, bus stop signs, and benches spread throughout the service area.

A comparison of the MTA's bus fleet statistics for 1995 and 2000 is shown on Table 19-1. We have attempted to identify industry norms or standard practice based on our experience where these exist. Where these standards or norms do not exist the table is noted NA for not applicable.

**Table 19-1**
**MTA Performance Audit**
**Fleet Characteristic, Fixed Route Vehicles**
**As Reported to NTD for FY 1995 and FY2000 (1)**

| Item | 1995 | 2000 | Standard (goals) |
|---|---|---|---|
| Active Fleet | 124 | 150 | NA |
| Wheel Chair Equipped | 24 | 61 | 100% of active |
| % Wheel Chair Equipped | 17.9% | 40.7% | 100% |
| Annual miles of operation | 4,227,000 | 4,702,000 | NA |
| Average miles per bus per year | 31,545 | 31,347 | 30-40,000 |
| Average life miles per bus | 303,754 | 335,907 | under 500,000 |
| Fleet life miles | 40,703,000 | 50,386,000 | NA |
| Years in services | 1,158 | 1,322 | 6 x fleet size |
| Average age | 8.6 | 8.8 | 6 |
| Coaches Over 12 Years | 36 | 43 | 0 |
| % Coaches Over 12 Years | 26.9% | 28.7% | 0% |
| Number of different models | 9 | 14 | NA |

(1) These data are for the year end for FY1995 and FY2000. The 1995 data are from the NTD reports, and the 2000 data are from the maintenance department's submission for use in the 2000 NTD report.

The basic statistics at the end of fiscal years 1995 and 2000 transit coach fleets are listed by type of bus on Exhibit 19-1. As these data show, there are 14 different subfleets in the transit coach fleet of 150 buses. The average age of the fleet is 8.8 years, and the average lifetime miles accumulated by the fleet is 335,907. The total number of miles on the fleet is over 50 million, and the total years of service by the fleet is 1,322. All three of these measures are higher than the 1995 numbers – in other words the fleet

is older, operates more miles each year, and accumulated more miles per bus in 2000 than it did in 1995.

The average bus at the MTA traveled 31,545 miles in 1995, and 31,347 in 2000. These figures are within the range of industry norms of 30,000 to 40,000 miles a year. Some systems with long periods of service during the day and frequent headways approach 60,000 miles a year.

The common standard used in planning transit fleets is an average age of 6 years old, a maximum lifetime mileage of 500,000, and a maximum age of 12 years. Both the 1995 fleet and the 2000 fleet exceed the FTA's age standards of 6 years on average and 12 years maximum age, but are well below the lifetime miles standard of 500,000. This variation from standards is a common pattern on many transit systems. Even with average maintenance practices, transit coaches tend to last beyond the 12-year life, and most transit systems do not approach the 500,000-mile standard for 15 to 20 years of operation. It is not uncommon to see average fleet ages approaching ten years without the fleet approaching 500,000 miles of use.

The peak period fleet requirement is 105 buses, plus trolleys, for the fixed route service. The active fleet size is 150 at the end of 2000. Although the MTA has 60 buses that will pass through the industry's 12 year life standard, only one fleet – the 17 General Motors buses – will exceed the 500,000 mile standard.

**Spares Ratio** - The size of any bus fleet is subject to constant change as new buses are delivered and old buses are retired, and as buses are out of service for extended periods due to body damage or lack of parts. A key measure of the correct fleet size is the ratio of active buses to the number of buses required for the maximum service period. The FTA standard for total fleet size is 120% of peak service requirements. This 20% allows for regular maintenance and repair during the peak periods. The spares ratio of the MTA transit fleet at month end February, 2001, was right at 20%, as shown on Table 19 –2.

**Table 19-2**
**MTA Performance Audit**
**Peak Vehicle Requirement and Fleet Size, February 2001**

| Fleet | Active | Peak Needs | Spares Ratio |
|---|---|---|---|
| **Motor Bus** | **128** | **104** | **23%** |
| **Trolleys** | **13** | **13** | **0%** |
| **Combined** | **141** | **117** | **20.5%** |

The introduction of more complicated specifications, the increased number of fleet types and component variations, the introduction of electronics, wheel chair lifts, and the need to operate several different kinds of services, have all contributed to the doubling of the FTA standard for acceptable spares ratio from 10% to the current guideline of 20%.

The actual spares ratio of a transit fleet changes periodically as new buses are purchased, old buses are retired, and buses are placed on the reserve list. At the same time, the peak bus requirements change seasonally, with each change in the public timetable.

**Demand Responsive Fleet**

A comparison of the paratransit fleet profile is shown on Exhibit 19-2. The demand responsive fleet is a much simpler maintenance problem than the fixed route fleet in a number of ways. The vehicles are all virtually the same, they are less complex mechanically, and they get much less arduous use from their riders.

The 1995 fleet and the 2000 fleet are similar in most respects, except that the annual miles per van was higher in 2000 that it was in 1995, at 30,167 miles versus 24,293 miles, respectively. This suggests a better fleet utilization in 2000 than in 1995. A summary of these data is provided on Table 19-3.

**Table 19-3**
**MTA Performance Audit**
**Demand responsive Paratransit Fleet Comparison**
**1995:2000**

| Item | 1995 | 2000 |
|---|---|---|
| Fleet size | 41 | 36 |
| Active Fleet | 39 | 36 |
| Wheel Chair Equipped | 21 | 35 |
| % Wheel Chair Equipped | 51.2% | 97.2% |
| Annual miles of operation | 996,000 | 1,086,000 |
| Average miles per bus per year | 24,293 | 30,167 |
| Average life miles per bus | 177,463 | 210,111 |
| Fleet life miles | 7,276,000 | 7,564,000 |
| Years in services | 244 | 232 |
| Average age | 6.0 | 6.4 |
| Coaches Over 8 years old | 10 | 17 |
| % Coaches Over 8 years old | 24.4% | 47.2% |
| Number of different models | 1 | 1 |

(While all of the vans were Fords in both fleets, there were small differences in the models from year to year.)

As these data show, the 2000 demand responsive fleet was generally older than the 1995 fleet, had accumulated more lifetime mileage, and operated more miles per year than did the 1995 fleet. In addition, all but one of the vans were lift equipped in the 2000 fleet, while only 21 of the 41 1995 fleet were lift equipped.

Of the 2000 fleet, 17 had accumulated more than 250,000 miles, and were older than 6 years. In 1995 none of the vehicles had even accumulated more than 230,000 miles, much less 250,000 miles.

**Maintenance Expense**

The trends in the major elements of maintenance expense over the past five years are illustrated on Table 19-4. As these data show, there was a major increase in 1998 and 1999 in the expense for wages, materials and supplies.

**Table 19-4**
**MTA Performance Audit**
**Maintenance Expense Trends 1995-1999**

| | 1995 | 1996 | 1997 | 1998 | 1999 | '99/'95 % |
|---|---|---|---|---|---|---|
| Wages | $1,756,612 | $1,785,246 | $1,968,835 | $1,795,942 | $2,256,572 | 28.5% |
| Services* | 127,273 | 127,429 | 102,101 | 116,679 | 100,005 | -21.4% |
| Materials | 859,925 | 763,234 | 712,679 | 2,073,924 | 2,859,819 | 232.6% |
| | 2,743,810 | 2,675,909 | 2,783,615 | 3,986,545 | 5,216,396 | 239.6% |

*Services represents work performed by contractors

The maintenance department is coming to the end of a major effort to catch-up on a substantial amount of deferred maintenance and to improve the appearance and condition of the fleet. A review of a selection of maintenance "swing sheets" for June 1997 and January 2001 illustrates the dividend from these expenses on the mechanical condition of the fleet. These "swings sheets" show the status of the maintenance backlog on each vehicle in the fleet, including any deferred maintenance.

The costs of maintenance should decline markedly as the MTA recovers from the elimination of the deferred maintenance program.

A summary of the change in the deferred maintenance backlog for June 1997 and January 2001 is illustrated in Table 19-5. By January 2001, the backlog of deferred mechanical work had virtually disappeared.

**Table 19-5**
**MTA Performance Audit**
**Comparison of Backlogs: 1997 to 2001**

| Defect Type | June 1997 | January, 2001 |
|---|---|---|
| Coach engine | 17 | 2 |
| Van engine | 4 | 1 |
| HVAC defects | 20 | 2 |
| Brakes | 28 | 5 |
| Oil leaks | 27 | 1 |
| Exhaust | 5 | 0 |
| Low power | 8 | 0 |
| Motor mounts | 7 | 0 |
| Transmission oil leak | 4 | 0 |
| Wheel seals | 3 | 0 |
| Electrical malfunctions | 5 | 0 |
| Air leaks | 18 | 0 |
| Speedometer | 10 | 0 |

For a further discussion of Maintenance see the Bus Maintenance item in the *Peer Group Assessment*.

**Appearance of the Fleet**

While the reliability and air conditioning of the fleet has improved substantially due to the initiative of the department management team over the past two years, the body and paint problems of the fleet have been given a lower priority. The elimination of the backlog of mechanical problems has enabled the maintenance department to begin to shift its attention to working on the appearance of the fleet, while keeping after the mechanical work to prevent another build up of deferred maintenance.

The large number of buses with body damage, window and windshield damage, roof leaks, and seats in disrepair was greater in 2000 than in 1997. The April 1997 swing sheet reported 42 vehicles with body damage. The November, 2000 report showed an increase to 52 vehicles with paint and body damage. In 1997, 34 buses had damage to seats, and in 2000 the number was virtually the same.

**Cleaning Standards** - The MTA strives to do a thorough external cleaning of every bus every day, when buses are serviced and refueled – usually at the end of each day of service. The general cleanliness of the fleet is typical of the industry, and is adequate on most days, except when there is rain for a few days.

The MTA has committed to a complete interior 'scrub down" every 45 days to every bus. They are currently achieving about a 35-day cycle. The interiors are generally clean and free from physical damage, except for some damaged seats and some cracked window glass.

These standards for cleaning are typical of transit systems of this size that operate in a climate like Nashville.

**Maintenance Operations**

At least one crew of the vehicle maintenance department staff at the MTA is at work virtually every hour of the day, seven days a week. Like most transit systems, the bulk of the scheduled maintenance and running repair work is performed on the day shift on weekdays. A profile of the work shifts is illustrated on Table 19-6. This maintenance work shift pattern is typical for the industry.

Most of the vehicle fueling, cleaning, and servicing takes place at night from before the evening pull-ins start until the early morning hours. Some minor cleaning is done at midday at the shops or at a landport. Overnight maintenance personnel make sure that the fleet is ready for the morning service.

**Table 19-6**
**MTA Performance Audit**
**Vehicle Maintenance Work Shifts**

| Shift | Sun | Mon | Tue | Wed | Thu | Fri | Sat |
|---|---|---|---|---|---|---|---|
| 8AM –4PM | 6 | 36 | 45 | 45 | 44 | 41 | 3 |
| 4PM-12Mid | 4 | 6 | 9 | 8 | 8 | 5 | 4 |
| 6PM- 2AM | 1 | 9 | 9 | 9 | 9 | 9 | 5 |
| 7PM-3AM | 2 | 7 | 9 | 9 | 9 | 7 | 2 |
| 11PM-7AM | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 12Mid – 8 AM | 3 | 4 | 7 | 7 | 7 | 5 | 4 |
| Total | 17 | 63 | 80 | 79 | 78 | 68 | 18 |

The maintenance work force is a relatively junior staff. Of the maintenance staff members who were on the seniority roster at the time of the site visits, 49 were hired since 1990, 15 were hired in the 1980's, and 16 were hired before 1980. The staff includes 11 sweepers and general helpers, three janitors, three storeroom clerks, six body and paint staff, and one fare box mechanic. Thirty (30) members of the staff are certified air conditioning technicians.

The maintenance staff selects their work and their shifts by seniority from a roster of available shifts and work assignments that is prepared by management. Work shifts are posted by type of work and by shift, and personnel who are qualified for each type of work chose their work by seniority. Generally, a mechanic is restricted by work rules to doing work assigned to the shop that he has chosen for a given work schedule period.

For example, a mechanic who has picked a shift in the air conditioning shop will not be able to be assigned to work in another shop. Most transit system are eliminating these shops and allowing the qualified work force to work as assigned during their shifts. This flexibility in the work rules allows

management to allocate people on a tactical basis to meet short term needs like AC fixes in hot days in the summer, or open work for a given shift.

The daytime mechanical work is divided into a typical arrangement of scheduled and unscheduled activities. Some of the maintenance activities are scheduled at predictable thresholds. For example, inspections are based on miles operated, and cleaning and servicing is performed daily for all pullouts. The personnel requirements for this work can be predicted ahead of time – even annually at the time of budget preparation.

Most of the rest of maintenance work is based on less predictable requirements. This includes

- Daily running repair work that arises out of in-service problems
- Road calls
- Accident repair work

The volume of this work on any given day can only be anticipated in general levels of effort, and depend on the problems that arise during the operation of service.

Most of this less predictable work is assigned by the foreman at the beginning of each shift, based on the personnel available and the list of maintenance jobs to be done that arise out of defects reported by drivers, scheduled maintenance, and inspections. This unscheduled work is selected on a triage basis, with one objective being to keep as many buses available for service as possible.

**Preventive Maintenance (PM)**

The MTA has three levels of scheduled inspections beginning at 6,000 miles, with more extensive inspections due at intervals of 12,000, 36,000, and 48,000 miles. These inspections must be conducted within 600 miles or 30 days of their scheduled time. A review of the PM report dated November 2, 2000, showed bus inspection intervals that were almost random, and many showed no relationship to the reported odometer reading and the anticipated inspection intervals of 6,000, 12,000, 36,000 or 48,000 miles.

The MIS maintains a complete summary of the inspection status of each vehicle, including the date and miles of the last inspection for each interval. The report also notes the mileage at which the next inspection is to be conducted, and shows the miles or days remaining until the next inspection. On the day of one site visit, eight buses were overdue for inspections – a fairly normal degree of variance.

The inspection work force works on the 6PM to 2AM shift. This is after the evening peak period. The staff includes both inspectors and follow-up mechanics who perform repairs on items found to be deficient by the inspectors.

**The Operating and Maintenance Facility**

The MTA fleet maintenance is performed in a large former aircraft manufacturing plant that has been retrofitted for its current purpose. About 50%of the total square footage is dedicated to fleet maintenance and repair, and the rest is used for storage, a full sized basketball court, and a work out gym for employees. A significant amount of space away from the primary maintenance areas is underutilized and could possibly be used for other activity.

There are several buildings in the facility, each with a specific use: administration, transit bus maintenance, bus cleaning and servicing, small bus maintenance, small bus parking, and storage for benches, signs, and shelters.

The administrative offices are adjacent to and connected to the major maintenance building. The layout of the first floor of this area allows the maintenance and transportation staffs to be located with easy access to the drivers' and the mechanics' areas. The remaining administrative offices and the boardroom are on the second floor. The layout of these spaces is adequate. Each employee has either an enclosed office or a cubicle for workspace. Public access to the second floor of the administrative offices is necessary because the boardroom and the personnel assistant are on that floor. There is handicapped access to the offices, including an elevator to the second floor.

The interior layout of the shops that are dedicated to bus maintenance and repair was arranged and installed by the MTA staff, and is adequate to the tasks assigned to it. The maintenance work areas are well lighted and have adequate space for normal work activities. There are no inspection pits in the shop, and many of the lifts are portable lifts. The buses pull in and back out of the berths, with no movement conflicts. The tools and bench areas are easily accessible, and both the passive and active ventilation appears to be good. Hoses for consumable and power connections are handy to the work areas.

The major problem with the internal layout of the bus maintenance area has to do with parts storage and disbursing. To begin, the storage area is at a distance from the maintenance bays that are used for repair work. Second, there is a substantial amount of major parts stored in unsecured and open areas. The location and manner of this storage gives this part of the facility an unkempt and disorganized appearance. Due to the nature and size of the parts in question, however, there is little risk of loss.

The body and paint shop are somewhat remote and separate from the area dedicated to general repair, as is appropriate to this kind of work. There is an enclosed paint shop equipped for painting buses that has been built onto the large open area in the building.

The remaining space is a large, "L" shaped area that is used for a number of functions. This space is largely underutilized. Among the activities that take place in this space are van maintenance and storage, trolley storage, and storage for signs, shelters, and benches.

The buildings compound separates two parking areas for employee vehicles. The area for driver parking is almost always full to overflowing. These areas are fenced in, and are covered by outside cameras.

There is little or no space on the site for expansion beyond the limits of the present structure without taking some of the current parking spaces, of which there are already too few. As noted above, there is a significant amount of space available in the enclosed areas for other activities that might be undertaken.

**Maintenance MIS**

The current MIS system includes a vehicle history that contains all job order entries. The data for all work orders is recorded in each vehicle history. The vehicle histories are thorough records of all work done on the vehicle. The entries include the date of the work, the work order number, the odometer reading, the description of the work, the costs of parts and labor for the job, the hours worked, and the mechanic's identification number.

The maintenance system (Turley) is not being used to generate a number of reports which would normally be used to manage the maintenance function effectively, e.g., a list of buses overdue for inspections. It is unclear whether this is a deficiency of the system or lack of report writing expertise. The maintenance director maintains a number of special reports on Excel on his desktop computer. Much of this data are hand entered rather than being transferred electronically from the Maintenance MIS.

**Conclusions**

The rapid and substantial increase in maintenance expenses over the past three years has enabled the department to eliminate a major backlog of deferred maintenance.

The department has gone through a period of transition under the new Director over the past two years. The achievements over this period include a substantial rapprochement with the maintenance employees, and the virtual elimination of the backlog of mechanical problems with the fleet. This performance is to be commended.

While the mechanical condition of the fleet has improved over this period, the extent of body and paint damage has worsened. The number of buses on the "swing sheet" with such problems has increased by 25% since 1997.

Scheduled preventive maintenance is being performed according to periodic mileage or hours intervals. Eight buses were overdue for inspection on the date of our fieldwork review.

As currently used, the Turley maintenance software is not providing adequate management information.

The ability of the department to sustain the current mechanical condition of the fleet, to continue to improve reliability, and to carry out the needed campaign on the body and paint damage will require a new financial strategy to take the place of the capitalization of maintenance expenses.

There is no documented long term strategy for fleet management and maintenance that incorporates an adopted fleet replacement program, a supporting capital budget, and a fleet utilization plan that levels fleet use in a manner that increases the predictability of more maintenance work.

**Recommendations**

The Maintenance Director should develop a maintenance management plan that brings the fleet age and condition up to standards, and prevents the accumulation of the type of backlog that he inherited when he came to the MTA. Additionally, maintenance schedules should be established which correspond to periodic mileage intervals. This schedule should be adhered to rigorously.

The plan should incorporate a fleet operations strategy that lays out the use and maintenance strategy for each subfleet.

The plan should develop mileage thresholds for major component rebuild and replacement thresholds, and estimate of the work hours and materials necessary to support that level of maintenance, and personnel strategies that provide the staff necessary to carry out the plan.

The Maintenance Director should do a complete evaluation of the body damage repairs and paint work necessary and prepare a program budget that restores the fleet damage as a part of the maintenance budget for the coming fiscal year.

The budget for the coming year should specify the maintenance campaigns to be undertaken, the costs of each maintenance element, and the expected changes in fleet performance as a result of that investment.

If the work hours and facility capacity that are necessary to complete the body and paintwork in a year are not available at the MTA, the maintenance Director should seek proposals from the private sector to accomplish the work.

The report writing capacity of the Turley maintenance software should be examined.

MTA should strive to change the provision of the labor agreement that limits management's flexibility to contract work, and increases management flexibility in assigning work, within the overall collective bargaining strategy of the MTA.

**Cost Implications**

Once the body and paint backlogs are worked down through fiscal year 2001, maintenance expense should return to more normal ("average") levels. This could result in year over year reductions of $1 million or more from savings in materials and supplies.