

**INDIANA DEPARTMENT OF TRANSPORTATION**

**RURAL AND SPECIALIZED TRANSIT**

**GUIDE TO PREVENTIVE MAINTENANCE**



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## I. INTRODUCTION

Preventive maintenance (PM) is an essential element of any effective maintenance program to ensure maximum vehicle reliability, longevity, and passenger safety. Preventive maintenance entails performing regularly scheduled maintenance in order to prevent breakdowns, rather than simply making repairs when something goes wrong. It also involves performing necessary repairs promptly to prevent further damage and maintain vehicle safety. While preventive maintenance may be more expensive in the short run, it reduces the operation and maintenance costs throughout the life of the vehicle.

Transit vehicles are used to transport large numbers of people often with very short trips, resulting in what manufacturers call “severe use.” It is because of the “severe” nature of transit vehicles that it is so important to ensure the vehicles are in the condition needed to provide customers with reliable, safe, and comfortable transportation services. This guide is designed to help you ensure your vehicles receive proper maintenance, sustain accurate maintenance records and lower total repair and related operating costs.

Performing regularly scheduled preventive maintenance greatly reduces costs over the life of the vehicle.

## II. DEVELOPING A SUCCESSFUL PREVENTIVE MAINTENANCE PROGRAM

Most rural and specialized transit systems do not have the funds to staff a maintenance manager. Therefore, the transit manager is also the maintenance manager. This can make preventive maintenance much more difficult. The manager must understand what makes an effective preventive maintenance program and why it is so important. A successful preventive maintenance program consists of several different elements. The following discussion highlights these elements and the issues you should consider when developing your program.

Routine service and maintenance is essential to ensure each vehicle meets its maximum useful life. Every vehicle has its own maintenance requirements and recommended program outlined by the manufacturer. It is crucial to service the vehicle at the appropriate mileage recommended by the manufacturer or within the recommended time frame. In some cases, it is desirable to add services, depending on factors such as weather, terrain, service type, and annual mileage. Maintenance intervals should never exceed those recommended by the manufacturer or what is outlined in this maintenance guide. This guide outlines maintenance recommendations of the vehicle manufacturers, manufacturers of lifts or ramps, vendors that make vehicle modifications, and the experience of several seasoned technicians and engineers.

Exhibit A on the following page depicts the suggested intervals specific to transit vehicles. The information in this table is based on a Modified Minivan with a 3.5L engine. These intervals can vary depending on the vehicle and its use. Some Indiana transit systems may choose to service their vehicles every 3,000 miles as opposed to 5,000.

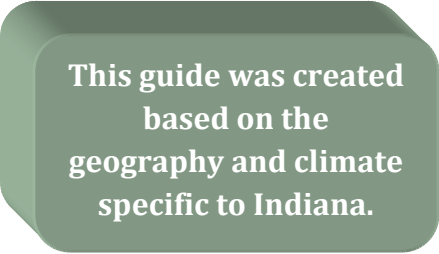
**Exhibit A: Preventive Maintenance Table**

|   | 5,000 | 10,000 | 15,000 | 20,000 | 25,000 | 30,000 | 35,000 | 40,000 | 45,000 | 50,000 | 55,000 | 60,000 | 65,000 | 70,000 | 75,000 | 80,000 | 85,000 | 90,000 | 95,000 | 100,000 |   |
|---|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---|
| Replace Engine Oil and Filter                                 | X     | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X       | X |
| Fill Washer Fluid   | X     | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X       | X |
| Inspect Cooling System  | X     | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X       | X |
| Inspect all Emergency Equipment                               | X     | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X       | X |
| Inspect Front and Rear Brakes<br>(Replace if necessary)       |       | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X       |   |
| Inspect Engine and Cabin Air Filter<br>(Replace if Necessary) |       | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X       |   |
| Lube Steering Gear and Suspension                             |       | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X       |   |
| Rotate Tires  |       | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X       |   |
| Inspect Windshield Wipers (Replace<br>if Necessary)           |       | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X       |   |
| Lube and Adjust Wheel Chair Ramp                              |       | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X       |   |
| Inspect Exhaust System  |       | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X       |   |
| Inspect Transmission Fluid                                    |       | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X       |   |
| Inspect Fuel Supply Lines                                     |       | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X      |        | X       |   |
| Inspect Ignition Cables and Plugs<br>(Replace if Necessary)   |       |        |        |        |        | X      |        |        |        |        |        | X      |        |        |        |        |        |        |        | X       |   |

It is highly recommended that the manufacturer's maintenance schedule be used to develop maintenance plans for your vehicles. This document can be used in conjunction with the manufacturer's guidelines and will assist in the documentation of all maintenance performed on your vehicles. You may wish to address other maintenance items when establishing your own program.

The following issues should be considered:

- **Mileage Intervals.** Make all service intervals mileage multiples of a common denominator. For instance, if the oil change interval is every 5,000 miles consider rotating the tires every 10,000 and performing brake checks at the same time. It is highly recommended that regular service intervals be between 3,000 and 7,500 miles based on the engine manufacturer's guidelines. Consistent service intervals increase the efficient use of labor and minimize the number of times the vehicle is in the shop. For the purpose of this guide, transit systems are given the option of servicing the vehicles every 3,000 miles or 5,000 miles. This decision depends on the vehicle use and the accessibility to facilities.
- **Seasonal Variations.** There are separate checks that should be completed in the spring and fall. Plan seasonal fleet-wide service checks such as a spring campaign to prepare air-conditioning systems for the summer, and a fall campaign to prepare for adequate winter heating, defrosting, and tires.
- **Environmental Conditions.** Incorporate local conditions when planning your maintenance program. For example, services operated over unpaved, dusty roads may require more frequent oil changes, air filters, and suspension system component replacement. Constant slow or stop-and-go driving and low annual mileage are other examples of situations where service intervals for some items such as brakes should be shortened.
- **Vehicle Cleanliness.** Establish a regular program for washing and cleaning the vehicles. Accumulated road salt or brine will greatly accelerate rusting. Dust from the roads can cause poor driving conditions and safety issues. Keeping the vehicles clean on both the interior and exterior is an important part of your company's image. Passengers expect to ride in a clean vehicle, free of dirt, grime, and graffiti.



This guide was created based on the geography and climate specific to Indiana.

### III. VEHICLE INSPECTIONS

Vehicle inspections are a key element in the early detection and prevention of potential failures. Drivers and certified mechanics should perform them, to varying degrees. Drivers can be excellent judges of vehicle condition because they spend more time with the vehicle than anyone else. In many cases, they may take personal responsibility for the vehicle's condition especially the interior and exterior condition. Because of this, drivers may possess a wealth of information for recognizing minor problems before they become major headaches.

#### DAILY INSPECTIONS

Vehicle checklist inspections take a relatively short period of time to complete and can greatly increase vehicle safety and decrease repair cost. Additionally, the Americans with Disabilities Act (ADA) require that vehicle accessibility features (lifts, ramps, securements, etc.) be maintained in an operative condition. A daily trial run, prior to service, of the lift equipment will help ensure such equipment is operable and signs of trouble or possible failure are detected early.

Exhibit B is an example of a daily vehicle inspection sheet. This form is to be utilized primarily by the driver of the vehicle, but can be completed by anyone within the organization who has a basic understanding of the vehicles. The first few lines request specific information about the vehicle. The box immediately following is the Preventive Maintenance (PM) Tracker. It can be used to determine the need for mechanical repair or preventive maintenance. The area on the left side of the form is for the inspector to provide any information that was noticed while examining the vehicle.

The maintenance manager should periodically review the driver pre-trip inspection for content, completeness, and to verify that all mechanical issues were properly attended to. The manager should inspect the vehicles after repairs are preformed and review all invoices.

Drivers should be given blank copies of the checklist to keep in the vehicle. Each driver will need to conduct the inspection prior to his/her route. Drivers should add comments to the checklist if a problem arises during the shift. All checklists should be submitted to management at the end of the shift. The driver should keep track of the vehicle's preventive maintenance needs and record this information in the maintenance reminder box. This information allows the maintenance staff to schedule and perform the required service in a timely manner.

Although drivers are excellent detectors of vehicle problems, they may overlook smaller issues. In some cases drivers can actually get used to strange noises and smells, causing them not to report problems. Mechanics and drivers should both inspect the vehicle through observations and checks including routine service procedures. If drivers are not

sure if a vehicle issue has potential to become a major problem, they should report it to the maintenance manager immediately.

### MAINTENANCE INSPECTIONS

When choosing a service facility it is important to look for places with certified mechanics. Most garages or dealerships will gladly show you their mechanics' certifications, if they don't have them displayed. Some of the certifications to ask for are Automotive Service Excellence (ASE), Air Conditioning, and specific dealer training for the type of vehicle or vehicle system you will need repaired. Keep in mind that mechanics who work on wheelchair lifts must be certified by the lift manufacturer. It is very important to trust the place that is working on these vehicles. Because of the modified nature of some of the vehicle components and the severe operating conditions, it is crucial that the mechanic knows how to work with these vehicles. If you do not feel comfortable with the repair facility, take it somewhere else. There are many good, honest shops that are professional and courteous. Reference Section XI for more information on selecting a repair facility.

Exhibit C is to be used by certified mechanics that perform the mechanical services on the vehicles. This is a highly recommended way to perform vehicle inspections. However, it will only be as successful as you make it. The services must be performed as defined on the schedule. All safety and performance checks must be performed at the proposed intervals. This will ensure the vehicle lasts its entire useful life. The maintenance items to be completed are itemized at the top of the page with boxes to indicate their completion. This sample has different options that determine if the component is in good condition, (meaning that no repairs are currently needed) fair condition, (meaning that it will need to be replaced sometime soon) and replace now (meaning that the component is in severely poor condition and it will need to be replaced immediately.) Example C is predicated upon only one of the many mileage intervals provided as samples within this guide.

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### EXHIBIT B: DAILY VEHICLE INSPECTION

| DAILY VEHICLE INSPECTION CHECKLIST  |            |                           |   |  |  |
|---|------------|---------------------------|---|--|--|
| YEAR _____  | MAKE _____ | VEH # _____               | DATE ____ / ____ / ____                     |  |  |
|   |            | PM TRACKER                |   |  |  |
| FUEL ADDED _____  |            | ENDING MILEAGE _____      | MECHANICAL FAILURE <input type="checkbox"/> |  |  |
| gal \$ _____  |            | STARTING MILEAGE _____    |   |  |  |
| FLUID ADDED _____   |            | TOTAL DAILY MILEAGE _____ |   | MAINTENANCE DUE <input type="checkbox"/> |  |
| qts \$ _____  |            |                           |   |  |  |
| PERFORM A BRIEF INSPECTION ON THE FOLLOWING COMPONENTS. INDICATE AND DESCRIBE ANY FAILURE THAT IS NOTED DURING THE INSPECTION. IF THERE IS MAINTENANCE DUE OR MECHANICAL FAILURE NOTED CHECK THE APPROPRIATE PM TRACKER BOX   |            |                           |   |  |  |
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 5px; transform: rotate(-45deg); white-space: nowrap;">CONDITION OKAY</div> <div style="border: 1px solid black; padding: 5px; transform: rotate(-45deg); white-space: nowrap;">ATTENTION NEEDED</div> </div> |            |                           |   |  |  |
| UNDER HOOD INSPECTION   |            |                           | DESCRIPTION                                 |  |  |
| * WASHER FLUID LEVEL  |            |                           |   |  |  |
| * OIL LEVEL   |            |                           |   |  |  |
| INTERIOR INSPECTION   |            |                           |   |  |  |
| * PARKING BRAKE OPERATION   |            |                           |   |  |  |
| * SEATBELT OPERATION  |            |                           |   |  |  |
| * DEFROSTER SYSTEM  |            |                           |   |  |  |
| * MIRRORS   |            |                           |   |  |  |
| * WINDSHIELD WIPER OPERATION  |            |                           |   |  |  |
| * WINDSHIELD WASHER OPERATION   |            |                           |   |  |  |
| * HORN OPERATION  |            |                           |   |  |  |
| * VEHICLE INSURANCE CARD  |            |                           |   |  |  |
| * VEHICLE REGISTRATION CARD   |            |                           |   |  |  |
| * CLEANLINESS OF INTERIOR   |            |                           |   |  |  |
| SAFETY EQUIPMENT  |            |                           |   |  |  |
| * BIO HAZARD KIT  |            |                           |   |  |  |
| * TRIANGLE REFLECTORS   |            |                           |   |  |  |
| * FIRE EXTINGUISHER FULLY CHARGED   |            |                           |   |  |  |
| * VEHICLE ACCIDENT PACKAGE  |            |                           |   |  |  |
| * WHEELCHAIR LIFT OPERATION   |            |                           |   |  |  |
| EXTERIOR VEHICLE  |            |                           |   |  |  |
| * WINDSHIELD GLASS  |            |                           |   |  |  |
| * TAIL LIGHTS   |            |                           |   |  |  |
| * BRAKE LIGHTS  |            |                           |   |  |  |
| * TURN SIGNAL LIGHTS  |            |                           |   |  |  |
| * BACK UP ALARM   |            |                           |   |  |  |
| * EMERGENCY FLASHERS  |            |                           |   |  |  |
| * EXTERIOR BODY OF VEHICLE  |            |                           |   |  |  |
| * TIRE CONDITION & INFLATION  |            |                           |   |  |  |
| * WINDOWS AND DOORS   |            |                           |   |  |  |
| INDICATE ANY PHYSICAL DAMAGE TO THE EXTERIOR OF THE VEHICLE. DESCRIBE THE DAMAGE ON THE LINES PROVIDED  |            |                           |   |  |  |
|   |            |                           |   |  |  |
| Driver's Side   | Front      | Passenger's Side          | Back  |  |  |
|   |            |                           |   |  |  |
|   |            |                           |   |  |  |
|   |            |                           |   |  |  |
|   |            |                           |   |  |  |
| Driver Name _____   |            | Driver Signature _____    |   | Time & Date : ____ / ____ / ____         |  |



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### EXHIBIT C: MECHANICS INSPECTION REPORT

| Preventive Maintenance Inspection<br>20,000 Mile Service                          |                          |   |   |                                     |                          |  |  |
|---|--------------------------|---|---|-------------------------------------|--------------------------|--|--|
| LTN   |                          |   |   |                                     |                          |  |  |
| Manufacturer _____  |                          | Year _____  | Mileage _____   | Date _____                          |                          |  |  |
| Vin # _____   |                          | Veh # _____   | Repair Facility _____                                     |                                     |                          |  |  |
| <b>Please complete the following:</b>   |                          |   |   |                                     |                          |  |  |
| 1. Change engine oil, and replace oil filter                                      |                          | <input type="checkbox"/>  | 2. Refill Washer fluid                                    |                                     | <input type="checkbox"/> |  |  |
| 3. Replace cabin air filter   |                          | <input type="checkbox"/>  | 4. Lube and adjust wheelchair lift                        |                                     | <input type="checkbox"/> |  |  |
| Under Hood Inspection   |                          | S   | D   | Interior Inspection                 |                          |  |  |
| 1. Coolant condition degree ____ (minimum - 20 degrees)                           | <input type="checkbox"/> | <input type="checkbox"/>  | 27. HVAC System (LF vent)<br>Heat temp ____ A/C Temp ____ |                                     | <input type="checkbox"/> |  |  |
| 2. Power steering fluid   | <input type="checkbox"/> | <input type="checkbox"/>  | 28. Emergency exit operation                              |                                     | <input type="checkbox"/> |  |  |
| 3. Engine oil level   | <input type="checkbox"/> | <input type="checkbox"/>  | 29. Window operation                                      |                                     | <input type="checkbox"/> |  |  |
| 4. Brake fluid level  | <input type="checkbox"/> | <input type="checkbox"/>  | 30. Interior lighting                                     |                                     | <input type="checkbox"/> |  |  |
| 5. Drive belts  | <input type="checkbox"/> | <input type="checkbox"/>  | 31. Horn operation  |                                     | <input type="checkbox"/> |  |  |
| 6. Pulleys  | <input type="checkbox"/> | <input type="checkbox"/>  | 32. Seat and floor condition                              |                                     | <input type="checkbox"/> |  |  |
| 7. Master cylinder/ power brake booster   | <input type="checkbox"/> | <input type="checkbox"/>  | 33. Windshield wipers                                     |                                     | <input type="checkbox"/> |  |  |
| 8. Wiring connections   | <input type="checkbox"/> | <input type="checkbox"/>  | 34. Defroster   |                                     | <input type="checkbox"/> |  |  |
| 9. Battery condition  | <input type="checkbox"/> | <input type="checkbox"/>  | 35. Door operation  |                                     | <input type="checkbox"/> |  |  |
| 10. Air filter element  | <input type="checkbox"/> | <input type="checkbox"/>  | 36. Instrument panel & gauges                             |                                     | <input type="checkbox"/> |  |  |
| Under Vehicle Inspection  |                          | S   | D   | Outside of Vehicle                  |                          |  |  |
| 11. Front shocks  | <input type="checkbox"/> | <input type="checkbox"/>  | 37. Body damage or corrosion                              |                                     | <input type="checkbox"/> |  |  |
| 12. Rear shocks   | <input type="checkbox"/> | <input type="checkbox"/>  | 38. Headlight operation (high/low)                        |                                     | <input type="checkbox"/> |  |  |
| 13. Spring condition  | <input type="checkbox"/> | <input type="checkbox"/>  | 39. Turn signals/ Hazard lights                           |                                     | <input type="checkbox"/> |  |  |
| 14. Differential condition  | <input type="checkbox"/> | <input type="checkbox"/>  | 40. Marker lights   |                                     | <input type="checkbox"/> |  |  |
| 15. Driveshaft/ U joints  | <input type="checkbox"/> | <input type="checkbox"/>  | 41. Tail Pipe   |                                     | <input type="checkbox"/> |  |  |
| 16. Fluid leaks   | <input type="checkbox"/> | <input type="checkbox"/>  | 42. Reverse lights  |                                     | <input type="checkbox"/> |  |  |
| 17. Motor mounts  | <input type="checkbox"/> | <input type="checkbox"/>  | 43. Break lights  |                                     | <input type="checkbox"/> |  |  |
| 18. Transmission mounts   | <input type="checkbox"/> | <input type="checkbox"/>  | 44. License plate lights                                  |                                     | <input type="checkbox"/> |  |  |
| 19. Cooling system & radiator   | <input type="checkbox"/> | <input type="checkbox"/>  | 45. Mirrors   |                                     | <input type="checkbox"/> |  |  |
| 20. Ball joints/ king pins  | <input type="checkbox"/> | <input type="checkbox"/>  | Wheel Off Inspection                                      |                                     | S                        |  |  |
| 21. Steering box/ linkage   | <input type="checkbox"/> | <input type="checkbox"/>  | 46. Front rotors  |                                     | <input type="checkbox"/> |  |  |
| 22. Stabilizer/ Idler Arms  | <input type="checkbox"/> | <input type="checkbox"/>  | 47. Rear rotors   |                                     | <input type="checkbox"/> |  |  |
| <b>Wheelchair Lift Inspection</b>   |                          | S   | D   | 48. Brake calipers/ wheel cylinders |                          |  |  |
|   |                          | 23. Run the lift one complete cycle to be sure it is operable. Check for Physical damage and jerky operation.           |   | <input type="checkbox"/>            | <input type="checkbox"/> | 49. Brake linings<br>LF ____/32" RF ____/32"<br>LR ____/32" RR ____/32"    |  |
|   |                          | 24. Ensure the lift is clean of dirt, mud, gravel, or corrosive elements. Properly lubricate to the manufactures specs. |   | <input type="checkbox"/>            | <input type="checkbox"/> | 50. Tire tread depth<br>LF ____/32" RF ____/32"<br>LR ____/32" RR ____/32" |  |
|   |                          | 25. Check lift securement when stowed. Insure doors close properly  |   | <input type="checkbox"/>            | <input type="checkbox"/> |  |  |
| 26. Check for signs of seal leaking or binding hardware.                          |                          | <input type="checkbox"/>  | <input type="checkbox"/>                                  |                                     |                          |  |  |
| <b>D= Deficient</b><br><b>S= Satisfactory</b>                                     |                          |   |   |                                     |                          |  |  |
| <b>Please describe any other mechanical problems noted during the inspection:</b> |                          |   |   |                                     |                          |  |  |
|   |                          |   |   |                                     |                          |  |  |
|   |                          |   |   |                                     |                          |  |  |
|   |                          |   |   |                                     |                          |  |  |
|   |                          |   |   |                                     |                          |  |  |
| Sign _____  |                          | Date and Time _____   |   |                                     |                          |  |  |

## IV. PERFORMANCE MEASURES

While thorough documentation of vehicle servicing and repair is essential, reporting and analyzing summaries and trends related to vehicle maintenance is essential for overall program management. An individual vehicle's service record may be of little interest to an Executive Director or Board of Directors, but they will likely be interested in knowing fleet trends such as the mileage accumulated between road calls. It is essential to keep track of factors that affect your customers' view of the system and to publicize them within your operation. Such items include:

- Miles between road calls (service required when a vehicle breaks down away from the garage)
- Number of complaints of dirty, smoking, or damaged vehicles
- Number of complaints of inoperable air conditioners, heaters, lifts, etc.
- Number of miles between chargeable accidents attributable to vehicle conditions per total vehicles owned.

## V. REPLACEMENT VERSUS REPAIR

"If it ain't broke, don't fix it!" is a time-honored cliché. However, this philosophy does not apply to preventive maintenance. If we could always predict the exact point of any component failure, maintenance would be much easier. In the real world, however, it makes sense to replace or rebuild certain components prior to failure, as long as you can do so without incurring extraordinary costs.

"Condition Based" is the maintenance philosophy used to monitor the condition of the vehicle components to predict pending failure.

**Component Failure information can be obtained on the web, from INDOT officials, or by contacting a transit system with similar vehicle fleets and operating conditions.**

Diagnosis is made based on inspection or trend monitoring to identify imminent failure; the repair is then scheduled and performed before the vehicle becomes inoperable. One advantage to this approach is the achievement of a maximum useful life from the component.

While this routine replacement concept can be applied to a wide variety of components, it requires experience with particular vehicles in a unique environment. If you have no prior experience with a new vehicle, it is recommended that you contact other operators that use the same vehicle. This information may be obtained by contacting INDOT or transit systems with the same type of vehicles. Ensure they have similar circumstances with good maintenance records to assist you in developing a routine component replacement schedule.

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A replacement schedule can assist in predicting the average replacement cost, and warn of signs of failure. This type of maintenance can save time, frustration, and money. It will also assist in tracking problems and reduce spending money on multiple ineffectual repairs.

Exhibit D on below describes the normal estimated life of components on the modified minivan. However, parts may fail at any time and it is best to be prepared for those expenses. This chart is meant to serve as a reference so you can estimate repair costs and frequency. Depending on the environment and the vehicle use this information may vary. These are also average costs, the prices may differ.

**EXHIBIT D: REPLACEMENT SCHEDULE AND COST ESTIMATION**

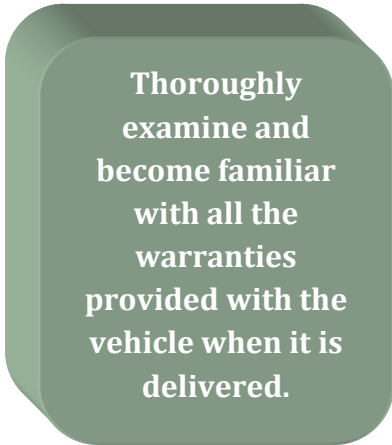
| Component   | Estimated Failure Mileage Cycle | Average # of Repairs Over Vehicle Lifetime | Average Replacement Cost | Estimated \$ Over Vehicle Lifetime |
|---|---------------------------------|--|--------------------------|------------------------------------|
| Hoses   | 20,000                          | 5  | \$ 40.00                 | \$ 200.00                          |
| Front Brake Linings   | 20,000                          | 5  | \$ 200.00                | \$ 1,000.00                        |
| Four Wheel Tire Replacement   | 35,000-45,000                   | 3  | \$ 500.00                | \$ 1,500.00                        |
| Alignment   | 40,000                          | 2  | \$ 80.00                 | \$ 160.00                          |
| Steering Rods and Arms  | 45,000-50,000                   | 2  | \$ 150.00                | \$ 300.00                          |
| Drive Belts   | 40,000                          | 2  | \$ 50.00                 | \$ 100.00                          |
| Alternator (Severe Use)   | 40,000                          | 2  | \$ 200.00                | \$ 400.00                          |
| Check Engine Light Diagnostics  | 50,000                          | 2  | \$ 130.00                | \$ 260.00                          |
| Emission System Failure   | 60,000                          | 2  | \$ 120.00                | \$ 240.00                          |
| Shock Absorbers   | 60,000                          | 2  | \$ 100.00                | \$ 200.00                          |
| Alternator (Normal Use)   | 70,000                          | 1  | \$ 200.00                | \$ 200.00                          |
| Door Pin  | 80,000                          | 1  | \$ 120.00                | \$ 120.00                          |
| Water Pump and Thermostat   | 80,000                          | 1  | \$ 300.00                | \$ 600.00                          |
| Exhaust Muffler   | 100,000                         | 1  | \$ 200.00                | \$ 200.00                          |
| Catalytic Converter   | 100,000                         | 1  | \$ 500.00                | \$ 500.00                          |
| Estimated Repair Cost over the life of the vehicle (assuming 100,000 miles) |                                 |  |                          | \$ 5,980.00                        |

## V. WARRANTIES

A vehicle warranty is an assurance made by the manufacturer of a part or component that it will perform properly for a specific period of time and level of use. If the product does not meet this assurance the manufacturer must fix or replace the component.

Your vehicle will come with a number of warranties including body modifications, chassis, and major components. These can take many forms, but generally include some combination of mileage and time, and will often contain exclusions for “consumable” items such as brake pads, batteries, and tires. Additionally, warranties generally have stipulations regarding operating and maintaining the vehicle in accordance with the manufacturer or supplier’s recommendations.

Thoroughly examine and become familiar with all the warranties provided with the vehicle when it is delivered. Make sure you have read all of the “fine print.” In rare instances, the warranty covers 100 percent of all repair costs for the entire period. The component coverage and mileage can vary greatly from vehicle to vehicle. There can be exclusions depending on the mileage and operating environment. It is crucial to understand the service agreements and extended warranties. Do not enter into any agreements unless you completely understand the contract. All INDOT supplied vehicles have warranties, which at minimum cover all labor and replacement parts for a period of three years or 36,000 miles on the chassis, whichever comes first. Warranties cover the basic vehicle with separate warranties for ancillary equipment (i.e. air conditioner, wheelchair lift, wheelchair securement systems, seats, vehicle modifications, etc.) Some components will have warranties that last much longer. For instance, emission systems (catalytic converter and oxygen sensors) can have warranties that last up to 100,000 miles. It is very important to read and completely understand the warranty prior to paying for repairs.



Thoroughly  
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with all the  
warranties  
provided with the  
vehicle when it is  
delivered.

Adjustments may need to be made to the vehicle. Therefore, make arrangements for the vehicle to be serviced at an authorized warranty repair facility. It is highly recommended that you take care of problems quickly, before they cause major failures (which often occur after the warranty period.) Documentation of attempts to repair a problem while still under warranty will usually result in a favorable claim. Unrepaired warranty items may result in your vehicle being out of commission for a longer period of time and you may have to pay costly repair bills.

Most repairs can and should be handled by the local auto or truck dealership representing the chassis manufacturer (e.g. Ford, Chevrolet or Dodge). You must contact the original

vendor when warranty work needs to be completed. The vendor will advise on next steps including where an authorized dealer is located in your area. If the vendor is uncooperative or unresponsive to your requests, it is imperative that you contact INDOT to resolve the issue.

Use the warranties as a basis for future maintenance activities by ensuring that any required servicing is directly incorporated into your preventive maintenance program (i.e., lubrication schedules for lifts.) Plan to review the performance and condition of specific warranty-related items and components at a service interval shortly before any major warranty milestones in order to ensure that you recoup as much benefit as possible from your warranties.

In many cases, extra-cost extended warranties are available. These should be closely examined before any purchase is made. Extended warranties often have limitations regarding which components are covered. They can be progressive in nature, diminishing the ability to recover the cost of labor and parts. Therefore, it is essential to think in terms of annual mileage and whether you are authorized to conduct warranty repairs in-house or through a repair shop of your choice. It can be difficult to find a repair facility that will accept extended warranties.

## **VI. MONITORING SUPPLIERS**

Tracking your suppliers' performance (price, quality, and reliability) is another essential element of a successful preventive maintenance program. For instance, your fuel consumption can have a significant impact on the service and repair level required on the electronic systems, catalytic converter and emission systems.

Another area that requires close monitoring is the performance of rebuilt and aftermarket parts (i.e., new parts built by a company other than the original equipment manufacturer, or OEM). Rebuilt parts, such as alternators and pumps, may offer up-front cost savings. However, such units may have a shorter operational life than new parts. By monitoring the life of rebuilt parts, you can determine whether true savings are realized, or whether total cost is actually greater once you factor in the cost of another rebuilt unit and the labor associated with multiple replacements.

**Only through experience will you gain the background necessary to make informed decisions in the future. Good maintenance records and purchasing documentation are essential and must be initiated when first beginning operation or introduce a new vehicle into service**

You should also be aware that in many cases involving heavy-duty items such as starters and compressors, a trade in (core) unit is required. This “core” is generally not used in your rebuilt unit; rather it becomes the rebuilt product for another operation.

Like rebuilt parts, aftermarket parts may offer an up-front cost savings. After-market parts may be advertised as built to the same specifications as the OEM part, but only through monitoring can you determine whether the part’s life is truly comparable.

The best way to monitor the suppliers is to keep track of parts replaced and other repairs. You can track suppliers’ performance based on historical trends. For instance, if you buy a part from a supplier and it breaks more often than normal, it is a safe bet that the supplier does not provide the best parts. You should use this information to find a supplier who will give you reliable parts.

## **VII. DOCUMENTATION**

Another key to any successful maintenance program is up-to-date, accurate record keeping. Please download the appropriate maintenance manual for your vehicle from INDOT’s website. While documentation is necessary for purposes of budget control, good records will also enable you to optimize your preventive maintenance program by providing:

- The database to enable you to establish proper intervals for routine maintenance and servicing.
- Information on repetitive failures or replacement intervals, and the performance of rebuilt or after-market parts and of consumable suppliers;
- Early warning of impending major problems through tell-tale signs such as increased oil consumption;
- Back-up information for warranty claims (particularly marginal claims near the end of the warranty period where supporting documentation can often be the “clincher” in claim payment); and
- Documentation of any personnel-related patterns (e.g. more frequent tire or brake replacement on a particular driver’s vehicle versus the fleet average).

In situations where maintenance is contracted to a third party, good documentation is the key to minimizing disputes. Under this scenario, management should make the extra effort to review the repair bills and develop/maintain the database required for adjustments to the preventive maintenance program. Maintenance is never “out of sight/out of mind” to the smart operator. Utilize the maintenance program to make recordkeeping and documentation simpler and less time consuming.

The most effective way to record and track work is through the use of the “repair order.” This paperwork becomes the critical record for documenting the repair and its associated costs, including labor hours. Once a repair has been complete, a description of the service



## **VIII. PERSONNEL / DEPARTMENTAL RELATIONSHIPS**

Internal conflicts plague many organizations and unfortunately, transportation operators are no exception. Good communication and interpersonal relationships among your staff and departments is the key to the effective execution of maintenance and, if anything, this importance increases with the size and complexity of the organization.

Most transportation operations encounter internal conflicts between the various personnel and departments by virtue of the priorities inherent in their duties. For example, drivers who take the time to report a defect may be convinced that the maintenance staff is incompetent if problems are not corrected prior to the time they are next assigned that vehicle. They are likely unaware, for example, that the dispatcher had an urgent need for an extra vehicle or that since the defect was not safety related, maintenance had decided to handle the problem at the next scheduled servicing; or that the replacement part was not available at the time (keeping inventory small is an essential part of a low cost operation).

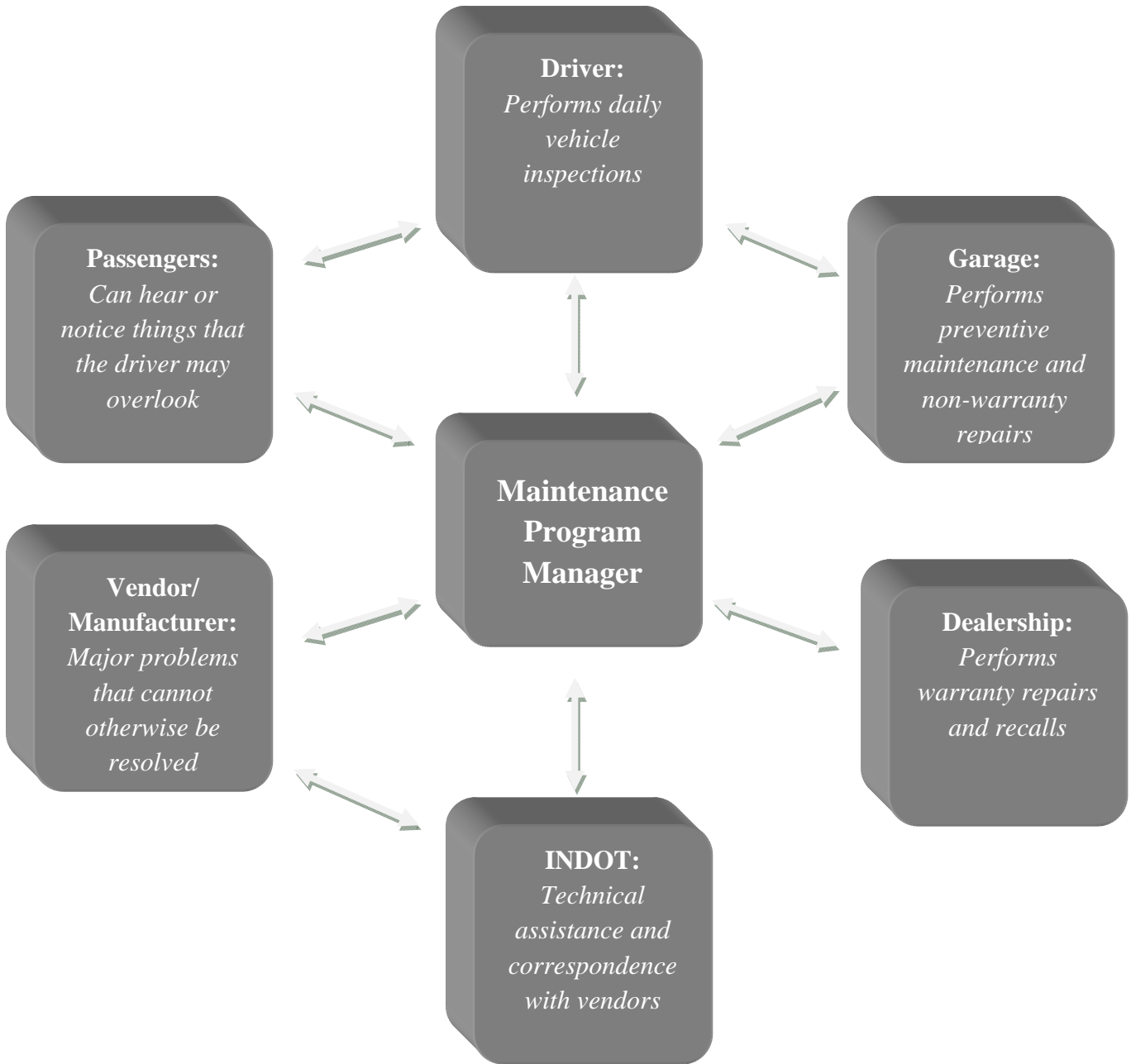
Similarly, dispatchers tend not to understand that repairs and repair times are not entirely predictable, particularly on older vehicles where rusted nuts and bolts do not always easily yield to the wrench, or where making one repair can uncover another problem. Finally, mechanics believe that if they had the dispatcher's job there would be no last minute calls for extra vehicles, or for a vehicle that was just raised on the garage hoist.

Consistent execution of a preventive maintenance program requires the cooperation and interaction of all parties, both in establishing the program and making it work on a day-to day basis. The following actions will help improve communication among your staff and reduce organizational conflicts.

- Involve all parties in the development of documentation for inspection, service intervals and other inter-departmental maintenance activities;
- Be realistic in your expectations (for example, a proper pre-trip driver inspection will improve reliability, but may take as much as 10 to 15 minutes to perform); and
- Pay attention to administrative details. To whom does the driver turn in a defect report? Who is responsible for notifying maintenance and/or dispatch? Who prioritizes the repairs or decides that a vehicle is no longer roadworthy? Who tells maintenance what the future vehicle needs may be and how much notice they can expect?



EXHIBIT F: MAINTENANCE COMMUNICATION WEB



## **IX. TRAINING AND DIAGNOSTIC**

Effective training is essential to the proper diagnosis of vehicle problems and their subsequent repair or replacement. As vehicles become increasingly complex and rely upon expensive electronic and computerized controls and monitoring systems, the need for adequate training becomes much more important.

We suggest that you encourage or even require your mechanics and/or drivers to take advantage of the training offered by vehicle manufacturers and component suppliers. Some manufacturers run training schools on a regional basis, and suppliers, as well as converted vehicle manufacturers, may supply service representatives to provide in-house training. Ask to see the certifications of anyone who is working on your vehicles. Remember, it is an INDOT requirement that mechanics who work on wheelchair lifts must be certified by a lift manufacturer.

If you are performing maintenance in-house, purchasing diagnostic equipment may be a sound investment. It is essential, in this electronic era, to take as much of the guesswork out of the trouble shooting process as possible. Diagnostic equipment can pay for itself in increased maintenance department productivity and vehicle reliability.

## **XI. WHO WILL MAINTAIN THE VEHICLES?**

Every maintenance program will be unique due to the mix of vehicle types and ages, fleet size, services provided and arrangements for maintaining the vehicles. Determining who will perform vehicle maintenance is an important decision. Options include:

- Contracting part or all of your maintenance to commercial mechanics
- Contracting part or all of your maintenance to other agencies, municipal garages or others such as school bus operators, MRDD facilities, etc.
- Performing part or all of your maintenance in-house

Who will perform which elements of your maintenance program will largely depend upon your ability and desire to obtain the staff, parts inventory, equipment, and facilities to perform your own maintenance, as well as your proximity to existing maintenance facilities that have the ability to service your vehicle. Remember that if you contract out your maintenance, you still bear the responsibility of verifying and documenting the work performed. Talk to several garages if possible. Look at their shops and review the type of records they keep. Ask for the certifications for the people who will be working on your vehicles. Provide them with your fleet roster and a copy of your vehicle's maintenance manual. You can even ask for proposals to compare the different garages. Take your time and don't hesitate to ask questions.

It is best to have all or most of your fleet serviced at the same garage every time. Since there will be regularly scheduled preventive maintenance performed on each vehicle, this guarantees business for the shop that you choose. It is very important to shop around before making a decision. Following are some of the questions that should be asked of all facilities that are being considered.

1. Will the facility be able to perform all preventive maintenance items on the entire fleet of vehicles?
2. What does the facility charge for the following preventive maintenance items?
  - a. Oil and filter change
  - b. Air filter replacement
  - c. Four wheel tire rotation
  - d. 6 cylinder tune up
  - e. 8 cylinder tune up
  - f. Transmission service
  - g. Cooling system flush
  - h. Wiper blade replacement
3. Will the facility charge extra for regularly scheduled preventive maintenance checks (such as Exhibit C Mechanics Inspection Report)?
4. Will the facility be able to diagnose the vehicles within 24 hours of loss of operation?
5. Will the transit system have priority over other vehicles in for service?
6. What is the normal hourly rate?
7. Will the facility give a discounted rate for fleet customers?
8. Will the transit system receive a discount on parts?
9. Do the technicians have ASE or Master Technician Certifications?
10. Are any of the technicians EPA Section 609 certified for air-condition repairs?
11. Do any of the technicians have the proper electrical training and experience to work with modified vehicles?

12. Does the facility have the proper training and equipment to work on vehicles with wheelchair lifts or ramps?
13. Will the facility be able to perform road side services, such as flat tire replacements?
14. Does the facility perform repairs on flat tires? If so what is the method?
15. What is the facility's method for documenting repairs?
16. What is the warranty for parts and service?
17. Can this facility perform diesel services?
18. Do any of the technicians have a CDL?
19. Will the facility pick up and deliver the vehicles?
20. What are the hours of operation?
21. Please explain all the types of service that the facility will perform.

## **XII. SUMMARY**

There are many customer service problems that can be identified due to lack of maintenance. Vehicle maintenance can determine whether or not you have the vehicles in the condition needed to provide customers with reliable, safe, and comfortable services. This guide explained the importance of vehicle maintenance, and record keeping on services as well as advice on how vehicle maintenance functions might be improved.

Preventive maintenance involves the input and inspections of both drivers and maintenance workers. These include the driver pre-trip inspection and the mileage-based inspections. The driver pre-trip inspection has drivers inspect their vehicle before departing the garage for revenue service. The pre-trip inspection covers exterior, interior, and under the hood checkpoints as well as a check for emergency equipment and should be tailored to meet the needs of each specific transit system.

The mileage-based inspections monitor a specified list of components with similar life cycles. This inspection typically involves lubrication, filter replacement, inspection for wear and damage, and fluid level checks. Other aspects of the inspections can be found previously in this guide.

Preventive maintenance is an essential element of an effective vehicle maintenance program and key to any transportation operation. A good preventive maintenance program tailored to your vehicle fleet and system's needs should increase vehicle reliability, vehicle longevity, and passenger safety. Preventive maintenance is more than routine services such as changing oil and rotating tires. It is a methodical system of regularly scheduled maintenance procedures that include daily inspections, prompt attention to minor repairs, knowing thoroughly and taking full advantage of your vehicle warranties, and monitoring your suppliers for fuel and vehicle parts with the lowest prices, highest quality, and maximum reliability. With the information and forms provided in this guide, you should be well on your way to implementing an effective preventive maintenance program.