

NEVADA DEPARTMENT OF TRANSPORTATION (NDOT) VEHICLE PREVENTIVE MAINTENANCE PLAN

INTRODUCTION

Public transit vehicle assets represent a significant investment of public funds. It is the goal of the Federal Transit Administration (FTA) to ensure that all public transit assets, including vehicles, are preserved and maintained cost-effectively, in a state of good repair, and that they remain in safe condition. The Nevada Department of Transportation's (NDOT's) responsibility as direct recipient of FTA funding is to see that this goal is met and, in response, has prepared this Preventive Maintenance (PM) Plan to be customized, adopted, and implemented by all NDOT program Sections 5311 and 5310 grantees. This Plan represents the minimum PM effort that is necessary to have an effective program. Systems may choose to add or increase Plan components as local regulations and needs require.

GOALS AND OBJECTIVES

The goals and objectives of a vehicle maintenance program are:

1. *Maintain vehicles to promote the safety and comfort of passengers, operators, and protect the public.*
 - ◆ Conduct regular pre- and post-trip inspections in order to identify vehicle and equipment problems and assure vehicles are in good operating condition.
 - ◆ Conduct basic preventive maintenance service routines in a timely manner to identify vehicle problems and keep vehicle systems in good repair.
 - ◆ Conduct vehicle repairs in a timely manner and in accordance with industry best practices.
 - ◆ Maintain a clean appearance for vehicles through regular interior and exterior cleaning.
2. *Manage preventive maintenance and repair activities to promote the reliability of the service by minimizing service interruptions due to vehicle or equipment failure.*
 - ◆ Regularly inspect vehicles in order to identify and correct problems and to prevent service interruptions.
 - ◆ Schedule repairs promptly in order to minimize service interruptions.
 - ◆ Utilize subcontractors as needed to perform specialized services and to supplement each system's maintenance staff efforts.
 - ◆ Schedule each system's PM activities to maximize fleet availability during service peaks.
 - ◆ Analyze repairs and road failures to identify trouble-prone components or systems for proactive attention.
3. *Maintain vehicles and equipment to promote cost-efficiency of operations.*
 - ◆ Maintain and repair vehicles to ensure their operation at peak efficiency, including fuel efficiency, emissions systems, etc.
 - ◆ Analyze fleet fuel usage and repair data; identify vehicles which may need remedial work or may need to be moved to inactive status.

- ◆ Maintain vehicles and related equipment to fulfill manufacturer’s warranty requirements and pursue warranty repairs where applicable; research and follow up on any applicable recalls or service bulletins.
- ◆ Maintain vehicles to maximize the useful vehicle life, including the life of key components such as tires, brakes, batteries, etc.
- ◆ Manage the maintenance program to be cost effective in terms of staff time, service vendors, and parts and supplies costs.

DEFINED TERMS

OEM: Original Equipment Manufacturer.

PM: Preventive Maintenance.

System: For purposes of this document, refers to a Section 5310 or Section 5311 grantee.

Service: For purposes of this document, refers to a specific required maintenance service as part of a PM Plan.

PREVENTIVE MAINTENANCE (PM) PLAN ELEMENTS

Each Section 5310 and Section 5311 grantee must develop a Preventive Maintenance Plan addressing each of the following elements listed below.

- ◆ ***Pre- and Post-Trip Inspections.*** Each vehicle will be inspected at the start and end of each shift by the driver who has been trained in the procedure. A walk-around will be performed with a vehicle pre-trip checklist and any irregularities documented and reported to the mechanic/supervisor before the vehicle leaves the lot. At the end of the driver’s shift, the driver will need to complete the post-trip section of the form. If there are any issues, the mechanic/supervisor needs to be notified. Please see Attachment 1 for a sample Pre- and Post-Trip Inspection form. If the vehicle is transferred to another driver during the course of the day, the “Replacement Driver Inspection” section of the form must be completed.
- ◆ ***Basic Service Routines.*** Per the recommendations of the manufacturers of the chassis, bus body (including ADA components), and wheelchair lift, a thorough preventive maintenance schedule will be established and followed for each vehicle. At or before the recommended mileage intervals or oil life percentage, the system’s mechanics will perform all elements of maintenance due at that milestone. Please see the “Determining Vehicle Preventive Maintenance Schedule” section, Attachments 2, 3A-3C, and 4 regarding vehicle PM schedules.
- ◆ ***Vehicle Cleaning.*** Interior cleaning and sweeping of each in-service vehicle will be performed at the end of each shift by the System’s driving or cleaning staff. Vehicle exteriors will be washed on a weekly basis, or more frequently, as needed. Vehicle interiors will have a detailed cleaning every three months.
- ◆ ***Vehicle Repairs.*** The need for a vehicle repair may be discovered during a pre- or post-trip inspection, preventive maintenance inspection, or breakdown. The mechanic or supervisor will determine warranty coverage for the vehicle’s system or component(s) requiring

attention, and if appropriate, pursue warranty repairs with the vendor, bus or chassis manufacturer, or authorized warranty outlet. All warranty repairs and recalls must be reported to the State. The System's mechanic or supervisor will determine whether the repair can be performed in-house, or because of the need for special diagnostic expertise or equipment, will be assigned to an acceptable subcontractor. Please refer to Attachment 5, Subcontractor List. Some systems/components on a vehicle may require the servicer to have specific certifications; whoever manages the PM program will need to be aware of this.

Any relevant certifications relating to the repair or servicing of vehicle systems/components for staff or subcontractors must be on file.

- ◆ **Documentation and Analysis.** All records pertaining to each individual vehicle, including procurement, maintenance and repairs, **MUST** be retained as long as the vehicle remains in service for the System, plus three years beyond the disposition of the vehicle.

Each vehicle will have its own binder/folder/file in which all records pertaining to that vehicle can be organized and stored. These individual vehicle folders may be either electronic or paper. Appropriate maintenance software may be used. The following information **MUST** be documented for each vehicle:

- ◆ Basic Vehicle Information
 - Vehicle manufacturer, year, make, model, size, type, vehicle chassis VIN number, license plate number, ADA components, and internal agency inventory tag or vehicle number.
- ◆ Basic Lift Information
 - Lift make, VIN number, and capacity.
- ◆ Pre- and Post-Trip Inspection Checklist
 - If any issues arose from the inspections, the associated action and outcomes must be included.
- ◆ Preventive Maintenance Work/PM Inspection Checklists
 - Broken out into vehicle and lift sections.
 - Keep current year working and previous two years onsite, not archived.
- ◆ Repairs and Warranty Work
 - Broken out into vehicle and lift sections.
 - Track failures in work performed on all ADA systems.
- ◆ Procurement Information
 - All information regarding the procurement process.

Maintenance staff are required to prepare a monthly report on all maintenance and repairs that occurred during the month. This frequency of data analysis will enable timely identification of trends. If specific components are wearing out too quickly or having too many issues, PM schedules can be adjusted.

All attachments must be completed and attached to the PM Plan.

DETERMING PREVENTIVE MAINTENANCE (PM) SCHEDULES

Each Section 5310 and Section 5311 system is responsible for determining and implementing preventive maintenance (PM) schedules for all vehicles.

Original Equipment Manufacturer (OEM) Recommended Schedules

The original equipment manufacturer (OEM) manuals that were included with the vehicle upon delivery are the most definitive resource which will dictate the preventive maintenance (PM) schedule for each type of vehicle and lift. The OEM manuals can be downloaded via the links in the tables in Attachment 4. Keep in mind that these manuals will have suggestions for driving conditions that are out of the ordinary, such as heavy dust and excessive idle time, which will augment suggested maintenance cycles. System managers and maintenance staff know the conditions that the system's vehicles are exposed to and should adjust intervals accordingly.

The PM schedule is most commonly broken down into groupings of maintenance activities typically designated by letters, described below. The PM breakdowns for lifts will be designated by cycle counts.

PM Schedule Chart

The actual maintenance portion of preventive maintenance is composed of scheduled and standardized inspections and maintenance. This is sometimes referred to as the vehicle's "scheduled service," or simply "service." PM services are commonly designated as A, B, C, D, etc. The complexity of each PM service increases from A to B, B to C, and so on. While breaking maintenance down into these letter designations is common, it is not required; it can be separated into whatever designations work best for the individual System.

PM "A" service is also known as a "maintenance check-out" or "safety inspection" and generally consists of a safety check and lubrication, as well as checks of key components such as brakes, lifts, lights, tire condition and inflation, and fluids. It also includes checking and adjusting high-wear components. The normal interval for "A" service is between 1,500 and 2,500 miles on light-duty vehicles and between 5,000 and 10,000 miles on medium- and heavy-duty vehicles. Typically, these PM "A's" are scheduled at the halfway point of the vehicle's oil change interval. Oil changes for older vehicles are indicated by either time or mileage. On newer vehicles oil changes are based on the percentage of oil quality. Maintenance staff must be aware of this difference between older and newer vehicles and adjust PM schedules accordingly. **Due to excessive idling of vehicles used in Section 5310 and Section 5311 systems, it is recommended to set schedule A at 6,000 miles for light- and medium-duty transit vehicles (not including minivans, sedans, etc.).**

During the PM “A,” emergency exits, hatches, and windows must be inspected, exercised, lubed, and adjusted.

PM “B” inspections normally include all PM “A” items, as well as an oil and filter change and more in-depth checks of the engine and driveline. The normal interval for “B” service is 3,000 to 5,000 for light-duty vehicles and 10,000 to 20,000 for medium- and heavy-duty vehicles. A PM “B” should also include a download of the Electronic Control Module (ECM) and action on any trouble codes or problems reported by the ECM (if applicable).

PM “C” service calls for both PM “A” and PM “B” service as well as more extensive service (i.e., alignment, scheduled component replacement, DOT annual inspection, and other scheduled engine and driveline component inspection or replacement). Normally, “C” services are scheduled annually. To make sure they are performed in a timely manner, it is not unusual (and considered a best practice) for systems to actually schedule them at an 11-month interval.

A maintenance software program can be used to track these breakdowns of services performed or the information can be entered into a spreadsheet. Depending on the maintenance group, schematics in the vehicle manuals must be referenced.

Attachment 2 shows examples of PM schedules taken and adapted from the list of OEM manuals previously referenced. Additionally, Attachments 3A-3C, which are titled as “Schedule A, B, or C,” are generic templates that will work for all light to medium duty transit vehicles and are to be used at 6,000 mile intervals. For example, use Schedule A at 6,000 miles, Schedule B, at 12,000 miles, and Schedule C at 18,000 miles, then restart at 24,000 miles with Schedule A.

ADJUSTING YOUR OEM SCHEDULE

The OEM maintenance schedule is the best way to approach a PM Plan but specific aspects of the Plan may need to be adjusted to account for local conditions and what “makes sense” from a logistical implementation perspective. For example, if vehicles are exposed to considerable starting and stopping, the parameters will need to be adjusted accordingly. Or, if vehicles are consistently operated on unpaved dusty roads, the parameters will also need to be adjusted.

Systems in Nevada can experience weather extremes, both cold snowy conditions of the mountains and the hot dustiness of the desert. While most OEM deviations will occur from vehicle and component analysis over time, there are a few things to keep in mind for each climate extreme.

For the hot dusty areas, the dust becomes an issue with pivot areas and air filters. You may need to increase the lubrication program of pivot joints and increase frequency of air filter replacement in addition to additional external washing of the vehicle. In areas of extreme heat with stop and go services, brake rotors can develop hot spots resulting in possible premature weakening. This can be addressed by increased frequency of inspections.

In colder areas the temperature can impact a vehicle's ignition. Diesel vehicles below 40° F. will need to be stored indoors or should have a block heater. Gas vehicles should have a block heater or be stored indoors when the outside temperature falls below 20° F. Without one of these two solutions the vehicle will either not start or if it does, will put a strain on the starter and battery, shortening their lifespan. In addition, when the temperature is less than 20° F. hydraulics can have issues or fail. The OEM will have required types of oil for different temperature ranges. Regarding engine oil, synthetic and multi-grade oils will not be affected by temperature. While uncommon, if a vehicle is still using flat oils, they will be affected by cold temperatures and will need to be adjusted accordingly.

A best practice to determine ideal oil change intervals for the fleet is oil analysis. The three things to monitor are the buildup of soot, the silicon levels, and changes in viscosity. These three parameters help determine the quality of the oil. You can then adjust your internals accordingly. If you do decide to deviate from the OEM recommendations, you will need a letter from the manufacturer of the vehicle's engine stating that this practice will not void the engine warranty.

Vehicle batteries, regardless of type (lithium, deep cycle, VRLA, etc.), will have reduced longevity and efficiency when exposed to extreme hot and cold temperatures; in very cold temperatures failure can occur. Consult the battery manufacturer's manuals for specific limitations and considerations.

Knowledge gained as a result of day-to-day operation of a system, combined with information acquired by the regular and on-going assessment of service data, should be used to adjust the PM schedule to meet the specific needs of a System's fleet. Any divergence from the OEM's intervals must be documented in the vehicle's file with what was adjusted and why.

SUMMARY

As the direct recipient of FTA funding, it is NDOT's responsibility to ensure that all public transit assets acquired with FTA funding, including vehicles, are preserved and maintained cost-effectively, in a state of good repair, and that they remain in safe condition. It is with this goal in mind that NDOT has prepared this Preventive Maintenance (PM) Plan to be customized, adopted, and implemented by all NDOT Sections 5311 and 5310 grantees. NDOT will review and approve each PM Plan and monitor each System's continued adherence as part of its on-going FTA program oversight.

ATTACHMENTS

Attachment 1: Pre-Trip and Post-Trip Inspection Form

Attachment 2: OEM Example PM Schedules

Attachment 3A: Schedule A

Attachment 3B: Schedule B

Attachment 3C: Schedule C

Attachment 4: OEM Location References

Attachment 5: Subcontractor List

Attachment 6: Fleet Information