

FLORIDA DEPARTMENT OF TRANSPORTATION
PREVENTATIVE MAINTENANCE GUIDE



**Florida Department of Transportation
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OVERVIEW

Preventative maintenance (PM) is the cornerstone of a transit agency's maintenance program. A PM program seeks to identify and subsequently repair or replace worn or defective vehicle components before they result in a failure. This should be accomplished through a systematic program of scheduled maintenance activities, such as inspections, lubrications and services at predetermined intervals that meet the vehicle manufacturer's OEM recommendations. These inspections should ensure that vehicles remain in safe operating condition. Successful PM programs seek to have the majority of their maintenance work performed during these scheduled maintenance activities in order to have a proactive, cost-efficient maintenance program that minimizes downtime and the impact to passenger transportation. The PM program's overall effectiveness is dependent on the success and functionality of each element of the program.

The Florida Department of Transportation (FDOT) requires agencies who use state and/or federal grant funding to provide transportation services (hereby referred to as "Agencies") have preventative maintenance programs that ensure all vehicles operated by the transit agency are systematically inspected, maintained and lubricated using methods and standards that meet or exceed the vehicle manufacturer recommendations. Agencies are required to operate safe vehicles to transport clients and/or the general public. This is accomplished by ensuring vehicles are properly maintained at all times. Not only will this improve the vehicle's performance measures, but it will also help vehicles to meet their life expectancy.

The purpose of the *Preventative Maintenance Guide* is to provide Agencies with a resource to assist with developing comprehensive PM programs that emphasize passenger safety useful life of the vehicle by featuring a combination of basic guidelines, industry standards and technical support in public transit vehicle maintenance.

Vehicle types are defined as follows:

Public Transit Vehicle Definitions

Public Transit Vehicle- rolling stock that is owned, leased, or controlled by a public transit system. For the purposes of this part, vehicles that a public transit system uses for support or internal system administrative functions are not included in this definition, and vehicles used exclusively on fixed guideways, rails, or tracks are not included.

Public transit vehicles include:

- (1) Buses are motor vehicles designed or constructed for the public transport of persons. Bus types are designated in two categories:
 - (a) Type I means Medium to Heavy-duty purpose-built transit bus with a gross vehicle weight rating (GVWR) greater than 26,000 Lbs.

(b) Type II means minibuses/ cutaway and modified vans equipped to transport persons in Public Transportation.
(2) Other public transit vehicles subject to this part include rolling stock used by a public transit system, including sedans, vans, low speed vehicles, innovative vehicles, and autonomous vehicles that do not run on fixed guideways, rails, or tracks.

MAINTENANCE PLANS

Agencies are required to develop written maintenance policies and procedures that outline their routine maintenance practices. These living documents should outline how vehicle maintenance activities are performed and should provide in-depth descriptions of the agency's unique practices and staff roles and responsibilities related to completing these tasks.

The elements of a maintenance plan will vary based on the transit agency's capabilities and funding source.

Agencies that receive FTA Section 5307 and/or 5311 grant funding will develop comprehensive maintenance plans based on FAC 14-90 and/or the federal PTASP rule. Agencies that receive only Section 5310 grant funding are required to develop a Transportation Operating Procedure (TOP), based on the State Management Plan, that includes maintenance policies and procedures.

All maintenance plans should include, at a minimum, the following elements:

- **Vehicle fleet roster** – includes an inventory of all vehicles operated by the transit agency. Agencies not used for passenger transportation should indicate they are administrative vehicles. It is recommended the fleet roster indicate the vehicles' unit ID, make, model, year of manufacture, VIN, wheelchair lift/ramp accessibility, number of wheelchair positions (if applicable), current mileage and average annual mileage.
- **Preventative maintenance** – provides a detailed description of preventative maintenance inspection policies and practices. This information should include all of the target intervals used to conduct preventative maintenance inspections, routine and long-term maintenance for the vehicle fleet, the method used by agency staff to track and schedule these maintenance activities, and how defects identified during the PM inspections are prioritized and scheduled for repair by the agency.
If the agency outsources maintenance activities, it is recommended the maintenance plan or TOP include additional information such as the entity conducting the PM inspections and methods used by agency staff to provide oversight of these outsourced maintenance activities. Any campaigns and/or scheduled replacement schedules should also be included in this section.
- **Pre-Trip and Post-Trip Inspections:** describes policies as they relate to daily pre-operational and post-operational inspections, such as methods for ensuring safety

related deficiencies are identified, communicated to maintenance staff, and repaired in a timely manner.

- **Vehicle History Files:** includes a description of how maintenance documents are stored and maintained by the agency.

In addition to the elements listed above, Agencies that receive 5307 and/or 5311 funding should also include the following element:

- **Information Management Procedures and Practices:** describes policies for providing oversight of ongoing maintenance activities, such as procedures for tracking and monitoring maintenance information, including how often this information is tracked and monitored, how the information is used by the agency to provide oversight, and who is responsible for this task
- **Warranty Procedures:** describes how warranty information is tracked and monitored by agency staff, how warranty eligibility is monitored, and methods for ensuring that all applicable repairs are pursued and documented
- **Road Calls:** describe how in-service failures are tracked and monitored by agency staff to make adjustments to the PM inspection program as needed.

Those 5307 and/or 5311 Agencies who have in-house maintenance shop should also include the following elements in their maintenance plans:

- **Personnel Roles & Responsibilities:** Maintenance plans should identify agency staff roles and responsibilities as they relate to in-house maintenance program activities, such as organizational charts and staff position descriptions for senior leadership management and in-house shop technicians and personnel
- **Materials Handling:** Maintenance plans should provide information about materials handling policies, such as where safety data sheets are stored and procedures for their retention
- **Parts Department:** Maintenance plans should provide information about parts department policies and procedures, such as staffing, parts usage and recording practices, types of parts stored and inventory balancing

All maintenance plans or TOPs must include, at a minimum, the elements required by FDOT. They must also include detailed information about the agency's own unique maintenance program practices and therefore may require additional elements not listed above. The individual details of each maintenance plan or TOP should differ based on these descriptions of agency unique practices and position descriptions as they relate to vehicle maintenance programs.

PRE-TRIP & POST-TRIP INSPECTIONS

To ensure vehicles are safe for passenger transportation, Agencies are required to perform pre-operational and post-operational inspections of all vehicles used to transport passengers. These inspections should seek to identify and repair defects for components that directly impact the safe operation of the vehicle. Table 1 provides a list of components recommended by FDOT to be examined during pre-trip/post-trip inspections along with guidelines for inspecting each component.

The pre-trip inspection is a comprehensive inspection that is performed prior to the vehicle departing for service. During service, the driver should use his/her senses to check for problems during the operation of the bus, such as listening for odd noises, noticing any unusual smells, identifying fluid leaks and observing the dash gauges and indicator lights for abnormal issues that may need to be reported during the post-trip inspection. The post-trip inspection also requires a walk around of the exterior and interior of the vehicle to check for damage that may have occurred during the day's operations and personal items or suspicious packages that may have been left behind by passengers during the vehicle's service.

If multiple drivers use the vehicle each day, it is recommended that each driver perform a brief walk around of the interior and exterior of the vehicle to inspect for damage. However, it is not required that a comprehensive pre-trip/post-trip inspection be performed each time drivers change. Only one pre-trip inspection performed prior to the vehicle's first service run and one post-trip inspection performed at the conclusion of the vehicle's last service run is required by FDOT.

PRE-TRIP/POST-TRIP INSPECTION CHECKLIST FORM

Pre-trip/post-trip inspections should be documented on a checklist form. FDOT recommends that the checklist include the following information:

- Identification of the vehicle being inspected
- The date and mileage of the inspection
- The vehicle components that are inspected
- The condition of the vehicle components during the inspection
- The name and signature of the individual conducting the inspection

Completed pre-trip/post-trip inspection forms should be reviewed by a transit agency employee or designee before the vehicle is utilized for its next scheduled service. Deficiencies that are

determined to directly and/or immediately impact passenger safety should be reported to and reviewed by an agency staff member immediately so that the issue can be addressed. For assistance with determining whether identified deficiencies will affect the vehicle's safe operation, see Safety Related Defects on page 27.

Agencies should keep completed pre-trip/post-trip inspection forms, in which no deficiencies were identified, for a minimum of 14 days. Additionally, FDOT recommends that pre-trip/post-trip inspections with noted deficiencies be filed along with documentation of the repair for the life of the vehicle.

PRE-TRIP/POST-TRIP INSPECTION COMPONENTS

Table 1: Pre-trip/Post-trip Inspection Guidelines

Component	Pre-trip Procedure	Post-trip Procedure
Service Brakes	<ul style="list-style-type: none"> From the driver's seat, and with the vehicle running, pump the brakes three to four times and then hold constant downward pressure on the pedal. The brake pedal should be firm and should not depress. Hold the brake pedal while shifting the vehicle into drive. The vehicle should not move. Check that the warning buzzer or brake light is off. 	<ul style="list-style-type: none"> Indicate whether problems were experienced with the service brakes such as hard braking, pulling or noise from the brakes during the operation of the vehicle.
Parking Brake	<ul style="list-style-type: none"> With the vehicle running, parking brake applied, and transmission in drive, gently press the accelerator to slightly above idle to test that the parking brake is holding. 	<ul style="list-style-type: none"> Indicate whether problems were experienced with the parking brake during the operation of the vehicle since the pre-trip inspection was performed.
Tires, Wheels and Lug Nuts	<ul style="list-style-type: none"> Visually inspect all tire treads and sidewalls for excessive wear, uneven wear, cuts or damage. Visually inspect to ensure adequate tread depth for every major groove of the tire. (Minimum requirement for tread depth is 4/32 inch for the front tires and 2/32 inch for the rear tires.) Check tire inflation by thumping or knocking the tire to check for low pressure and flats. Visually inspect rims for bends, damage or welds. Check valve stems for damage or missing caps. Check that all lug nuts are present and that none are loose. Check that the wheels and hubs are free of oil or grease. Oil or grease could indicate a leaking hub or axle seal. 	<ul style="list-style-type: none"> Visually inspect all tire treads and sidewalls for excessive wear, uneven wear, cuts or damage Visually inspect rims for bends, damage or welds. Check that all lug nuts are present and that none are loose. Check that the wheels and hubs are free of oil or grease. Oil or grease could indicate a leaking hub or axle seal.
Steering	<ul style="list-style-type: none"> With the engine running check power steering assist function. With key on/engine off turn the steering wheel back and forth until the front wheels barely move. Steering play should not exceed 2 inches. 	<ul style="list-style-type: none"> Indicate whether problems were experienced with the steering such as shaking, pulling, vibration, or loose steering during the operation of the vehicle.

Horn	<ul style="list-style-type: none"> • Check that the horn works properly. The horn is considered defective if the sound is weak, inaudible, if the button is difficult to depress or the button sticks. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the horn during the operation of the vehicle since the pre-trip inspection was performed.
Lighting Devices	<ul style="list-style-type: none"> • The operator should perform a complete walk around of the vehicle or request assistance to ensure proper operation of all exterior lighting, including: <ol style="list-style-type: none"> 1. Headlights 2. 4-way flashers 3. Left and right turn signals 4. High beams 5. Brake lights 6. Back-up lights 7. Emergency Exit lights 8. Marker lights/Clearance lights • Interior and stepwell lighting should also be checked to ensure proper operation. • All lights should be checked for damage, light covers and lens clarity. 	<ul style="list-style-type: none"> • The operator should perform a complete walk around of the vehicle and check operations of all lights.
Windshield Wipers	<ul style="list-style-type: none"> • Check exterior condition of wiper blades for damage and that wiper blades and arms are secure. • From the interior of the vehicle, check for proper operation of windshield washer and blades. • Windshield should be clean with no obstructions or damage to glass in driver's view. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the windshield wipers during the operation of the vehicle since the pre-trip inspection was performed.
Mirrors	<ul style="list-style-type: none"> • Check for proper operation, securement and condition of rearview mirror, side mirrors and passenger view mirror. Mirrors should be clean, secure and adjustable. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the mirrors, such as looseness or inoperability, during the operation of the vehicle since the pre-trip inspection was performed.
Climate Control	<ul style="list-style-type: none"> • Operate and check heater and air conditioning controls and function through all selector ranges and check varying fan speed for proper function. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the climate control during the operation of the vehicle since the pre-trip inspection was performed.
Emergency Exit Windows, and Doors	<ul style="list-style-type: none"> • Check the following emergency exits for damage and proper opening and closing function: <ol style="list-style-type: none"> 1. Emergency exit windows 2. Roof hatches 3. Emergency exit door • Check for proper operation for all interlocks, warning lights and alarms on emergency exits • Check to ensure all emergency exits are properly identified 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the emergency exit windows and doors during the operation of the vehicle since the pre-trip inspection was performed.
Passenger Doors	<ul style="list-style-type: none"> • Check passenger doors for proper opening and closing function • With the vehicle running, check for audible alarm when rear passenger door is left open 	<ul style="list-style-type: none"> • Indicate if doors operated properly during the operation of the vehicle since the pre-trip inspection was performed.

	<ul style="list-style-type: none"> • Check door entry area and steps for debris or loose flooring • Check for proper operation of any interlock. 	
Interior Gauges and Warning	<ul style="list-style-type: none"> • Start engine and check all gauges and warning indicator lights. • Check that back-up alarm is audible and properly functioning. • If equipped with an Air brake system, the bus should not be operated if the air pressure gauge is less than 90 psi. 	<ul style="list-style-type: none"> • Indicate whether any warning lights illuminated or gauges were out of tolerance during the operation of the vehicle since the pre-trip inspection was performed.
Exhaust System	<ul style="list-style-type: none"> • Visually inspect the exterior exhaust system. • With vehicle running, listen for exhaust leaks and check for exhaust fumes in the vehicle interior. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the exhaust system during the operation of the vehicle since the pre-trip inspection was performed.
Wheelchair Lift and/or Ramp	<ul style="list-style-type: none"> • Conduct one complete cycle of the wheelchair lift or ramp as outlined below to ensure proper operation: • Check all warning lights and audible signals designed to operate with kneeling of a bus or operation of the wheelchair lift or ramp • Cycle lift from stow position to floor level and inspect condition of the lift or ramp while deployed. Check outboard roll stop barrier for proper latching. • Cycle lift to ground level and check for any leaking, damaged, missing parts, and for smooth operation. Raise lift from ground level. With platform slightly off ground, make sure outboard roll stop barrier raises and it is latched securely. This must be performed by visually inspecting and latching mechanism to ensure it is in the correct locked position and by physically attempting to pull/push barrier down with an adequate amount of force to make certain the barrier is securely latched. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the wheelchair lift and/or ramp during the operation of the vehicle since the pre-trip inspection was performed.
Belts and Securement Devices	<ul style="list-style-type: none"> • Check for proper number and operation, condition of wheelchair lap/shoulder belts, tie downs, and other wheelchair securement/floor attachment devices. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the belts and securement devices during the operation of the vehicle since the pre-trip inspection was performed.
Interlock Systems	<ul style="list-style-type: none"> • With the engine running, check that transmission will not shift out of park under the each of the following conditions: <ol style="list-style-type: none"> 1. Parking brake applied 2. Entry door open 3. Wheelchair lift/ramp door open 4. Emergency door open <ul style="list-style-type: none"> • Emergency door locked. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the interlock during the operation of the vehicle since the pre-trip inspection was performed.
Windows and Seats & Handrails	<ul style="list-style-type: none"> • Check condition of all windows for damage and cracks. • Check seats for securement and condition. • Check foldaway seats for proper operation. • Check passenger securement devices for condition and operation. 	<p>Perform an interior walkaround of the vehicle to check the following conditions:</p> <ul style="list-style-type: none"> • Check condition of all windows for damage and cracks.

	<ul style="list-style-type: none"> • Check for tightness of handrails and stanchions 	<ul style="list-style-type: none"> • Check seats for securement and condition. • Check foldaway seats for proper operation. • Check passenger securement devices for condition and operation. • Check for tightness of handrails and stanchions • Check for items left behind by passengers
Safety, Security, & Emergency Equipment	<ul style="list-style-type: none"> • Check for the following safety devices: <ol style="list-style-type: none"> 1. Fire extinguisher, proper charge, rating, and current inspection tag. Fire extinguisher should be secure 2. Safety triangles 3. First aid kits 4. Bio-hazard kits 5. Seat belt cutter <ul style="list-style-type: none"> • Reflective safety vest 	<ul style="list-style-type: none"> • Indicate whether safety, security and emergency equipment were used or became loose or damaged during the operation of the vehicle since the pre-trip inspection was performed
Fire Suppression	<ul style="list-style-type: none"> • Check the fire suppression dash monitor for proper function. • Check fire suppression gauges to ensure the system is properly charged. The arrow should be pointing in the green area of the gauge. • Current inspection tag. 	<ul style="list-style-type: none"> • Indicate whether the fire suppression system discharged during the operation of the vehicle since the pre-trip inspection was performed.
If Applicable	Procedure	
Fast Idle	<ul style="list-style-type: none"> • Fast idle shall only operate with transmission in park and return to idle when service brake is pressed. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the fast idle during the operation of the vehicle since the pre-trip inspection was performed.
PA System	<ul style="list-style-type: none"> • Test microphone switch, volume control and speakers for proper function. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the PA system during the operation of the vehicle since the pre-trip inspection was performed.
2-Way Radio	<ul style="list-style-type: none"> • Perform 2-way radio check. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the 2-way radio during the operation of the vehicle since the pre-trip inspection was performed.
Farebox System	<ul style="list-style-type: none"> • Make sure farebox system is operating properly and programmed for normal function. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the farebox system during the operation of the vehicle since the pre-trip inspection was performed.
Passenger Stop Request	<ul style="list-style-type: none"> • Check the passenger stop request on the left and right sides of the bus and the wheelchair accessible areas for proper function. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the passenger stop request during the operation of the vehicle since the pre-trip inspection was performed.
Destination Signs	<ul style="list-style-type: none"> • Check that signs are readable from the outside and working properly. 	<ul style="list-style-type: none"> • Indicate whether problems were experienced with the destination signs during the operation of the vehicle since the pre-trip inspection was performed.

PREVENTATIVE MAINTENANCE INSPECTIONS

The goal of preventative maintenance is to emphasize passenger safety and to ensure the vehicle and its related components reach their useful life. This is accomplished through the development of a vehicle maintenance program that emphasizes proactive, scheduled maintenance activities.

PM SCHEDULES

A successful PM program should be based on routine, systematic PM inspections. These programs seek to identify and repair defects before they result in a failure that could impact passenger service and safety. When developing PM programs, Agencies can choose their own schedules, procedures, and methods for conducting maintenance activities. This information should be included in the agency's maintenance plan and should include, but not be limited to, the following information:

PM Inspections

FDOT requires Agencies to conduct routine scheduled PM inspections of vehicle components and systems that affect the safe operation of the vehicle. As an industry standard, all of the vehicle's safety components, auxiliary components, and vehicle accessories should be placed on an inspection or service schedule. PM inspections should be performed at the predetermined interval specified by the agency in their maintenance plan or TOP. FDOT recommends that PM inspections include, at a minimum, the vehicle components specified in *Table 3* and *Table 4* of this manual based on the type of vehicle being inspected.

Routine and Long-Term Maintenance

FDOT also requires Agencies to perform routine and long-term maintenance on their vehicles to ensure they meet their vehicle life expectancy. Routine and long-term maintenance should be guided by the Original Equipment Manufacturer (OEM) recommendations for servicing vehicles. Some of the routine and long-term maintenance items include, but are not limited to, the following:

- Oil fluid and filter changes
- Brake services
- Engine services
- Transmission services
- Rear differential services
- Engine tune ups, etc.

Target Intervals

All target intervals chosen by the agency for conducting vehicle maintenance should be selected based on the following factors:

- Public safety
- Vehicle manufacturer recommendations;
- Yearly operating miles per vehicle;
- Duty cycle and operating profile of bus routes (urban, suburban, commuter, fixed route);
- Warranty implications
- Vehicle's maintenance history and/or fleet maintenance history (fleet defects, failures, campaigns, etc.)

All target intervals used by the agency to conduct OEM services and PM inspections must be clearly defined in the agency's maintenance plan or TOP.

The target interval chosen by the agency should show a positive overall impact on vehicle performance and maintenance cost per mile. This should be reflected in the agency's ongoing maintenance activities and analysis of performance indicators during their FDOT Triennial reviews. Agencies should remain prepared to demonstrate or explain the factors used to establish their target intervals.

Performing Maintenance Activities On Time

Agencies should develop an effective tracking system to ensure PM inspections, routine and long-term maintenance activities are performed on time according to the target intervals established in the agency's maintenance plan or TOP.

Per FTA guidance and the *FDOT State Management Plan*, PM activities, such as inspections and services, will be considered late if they exceed 10% of the target interval provided by the agency in their maintenance plan or TOP. For example, inspections conducted using 6,000-mile intervals must be performed within 6,600 miles of the prior inspection to be considered on time. For inspections conducted using six-month intervals, they must be performed within 198 days of the prior inspection to be considered on time. According to the Federal Transit Administration's *Comprehensive Review Guide for Triennial and State Management Reviews* and *FDOT's State Management Plan*, at least 80% of an agency's PM cycle activities that are examined must be occurring on time to be compliant with FTA and FDOT guidance regarding on-time inspections.

Sample PM Program

One approach FDOT recommends for establishing PM programs is to use a progressive PM inspection cycle to maximize efficiency and reduce vehicle downtime.

An example of a progressive PM inspection cycle is the ABAC cycle. This cycle is comprised of three progressive levels - "A" level inspections, "B" level inspections and "C" level inspections. Inspections are performed in the following sequence: A, B, A, C, using the predetermined target

mileage interval chosen by the agency. For example, if an agency chooses to perform PM inspections using a 6,000-mile interval, the inspections would follow this sequence:

Table 2: Example of ABAC PM Cycle

Inspection Type	Mileage of Inspection
A	6,000 miles
B	12,000 miles
A	18,000 miles
C	24,000 miles
A	30,000 miles
B	36,000 miles
A	42,000 miles
C	48,000 miles

It is recommended that Agencies incorporate their OEM services during their routine PM inspections to limit the amount of vehicle maintenance downtime. The sample ABAC cycle could be used to incorporate additional levels, such as D or E levels that would include OEM services needed at greater mileage intervals. PM cycles should be customized or altered to fit the agency’s needs. **All PM cycles must be clearly defined in the transit agency’s maintenance plan or TOP.** If the transit agency uses multiple PM cycles, each PM cycle must be comprehensively defined.

Oil Analysis Programs

If Agencies choose to extend target intervals for conducting oil changes that go beyond OEM recommendations, they should develop a systematic and methodical approach to implementing and documenting an oil analysis program. The interval used by the agency to conduct oil changes should be increased or decreased in increments to be consistent with the results of ongoing oil analysis samples. For example, if the agency detects a sudden rise in wear metals or contamination, they should reduce their oil change target interval.

TRACKING MAINTENANCE PROGRAM ACTIVITIES

Tracking Upcoming PM Inspections, Routine and Long-Term Maintenance

Agencies should develop and implement an effective method for tracking and monitoring all upcoming inspection and service intervals to ensure they are performed on time according to the target interval provided in their maintenance plan or TOP. The tracking method, along with the staff roles and responsibilities related to monitoring PM cycles, should be outlined in the maintenance plan or TOP.

Oversight of Completed Maintenance Activities

FDOT requires all agencies to track and monitor their ongoing maintenance activities. This can be accomplished through a variety of methods based on the agency’s size and capabilities, such as software programs, spreadsheets or manual logs. Maintenance program oversight may include, but is not limited to:

- Reviewing completed inspection forms to address defects and schedule repairs
- Ensuring inspection forms are thoroughly completed

- Monitoring defects to identify repairs eligible for warranty repair/replacement
- Monitoring unscheduled maintenance repairs to determine thoroughness of their PM inspections
- Identifying repeat repairs to determine root causes of failures

Agencies can predict potential failures in some cases by identifying trends in their fleet maintenance program activities and adjusting their PM program to avoid the potential failures by placing components on a scheduled replacement campaign.

Adjustments to the PM program may also be based on FDOT's assessment of the transit agency's maintenance program activities, methodology for developing their PM program, and overall ability to meet or exceed vehicle manufacturer recommendations. These adjustments may result from the agency's routine oversight of fleet maintenance activities. An agency's PM program should be fluid in an effort to consistently reduce road calls, component failures and other unscheduled maintenance trends.

PREVENTATIVE MAINTENANCE INSPECTION CHECKLIST FORM

Agencies should document their PM inspections on a checklist form that includes the following information:

- Identification of the vehicle being inspected
- The date and mileage at the time of the inspection
- The name of the company conducting the inspection
- Vehicle components being inspected
- The condition of the vehicle components examined during the inspection
- The name and signature of the individual conducting the inspection

Agencies are required to retain completed PM inspection forms along with documentation of any related repairs for the life of the vehicle.

PM INSPECTION VEHICLE COMPONENTS

Agencies should ensure that PM inspections examine vehicle components specific to the type of vehicle being operated. *Table 3* provides the recommended vehicle components for Type I vehicles and *Table 4* provides the recommended vehicle components for Type II and Other Public Transit vehicles. These tables also include inspection guidelines that FDOT considers significant in the detection of deficiencies that could potentially impact passenger safety. Agencies may use these guidelines as a baseline for developing a more detailed PM inspection procedures that further describe the methods used by maintenance technicians when conducting these inspections.

The following inspection guidelines in *Table 3* and *Table 4* can be applied with slight modifications based on the make and model of the vehicle being inspected and the type of inspection being performed. The physical execution of the inspection will be based on the sequence of the component items listed on the agency's PM inspection form.

TYPE I VEHICLE COMPONENTS

Type I Vehicles

"Medium to Heavy duty purpose built transit bus with a gross vehicle weight rating (GVWR) greater than 26,000 lbs."

Table 3: Components for Type I Vehicles

Exterior Inspection
Locate vehicle in the yard, check for fluid leaks and body damage prior to starting or moving the vehicle:
Check the condition and/or operation of ramp/kneel warning
Check the condition and/or operation of all exterior lights
Check the condition and/or operation of destination signs
Check the condition and/or operation of all doors' operations and mechanisms, such as sensitive edges
Check the condition and/or operation of all component doors, body panels, and windows
Check the condition and/or operation of all exterior mirrors
Check the condition and/or operation of windshield wipers arms and blades
Check the condition and/or operation of the bike rack
Check to ensure the license plate is securely attached
Check the condition of the bumper
Check for condition of the exhaust pipe and ensure it is secure.
Interior Inspection
Check the condition, mounting and operation of the following safety related equipment: the fire extinguisher, warning triangles, engine compartment fire suppression system control panel.
Verify the proof of insurance and registration are in the vehicle.
Check the condition and operation of all the passenger stop request switches, bells and display sign.
Check the condition and operation of all emergency escape windows and roof hatches.
Check the condition and mounting of all passenger seating, stanchions and grab rails.
Check the condition and mounting of all interior trim, fixtures and barrier/modesty panels.
Check the condition and mounting of all passenger notices, warning signs or decals.
Check the condition and mounting of all interior mirrors.
Check the condition of the vinyl flooring for tears, soft spots or trip hazards.
Check the condition of all interior compartment access doors and latches.
Check all electrical compartments and or panels for secure mounting, obvious signs of damage, blown CB's or fuses and overheated components, cables or harnesses.
Check the condition, mounting and operation of all interior and exterior stepwell and curb lamps.
Check entrance and exit doors for condition and mounting.
Check wheelchair seats, belts and anchors. Check ramp/kneeler operation.

Check the condition of the driver's seat and the operation of the seat control functions. Check the condition and operation of the driver's seat belt.
Check the operation of horn for loudness and tone.
Check the condition and operation of electric and or manual steering column for tilt and telescoping function, assist and excessive play.
Check the operation and condition of the turn signal, hazard and high beam control switches.
Check the condition and operation of the drivers map light.
Check the condition and operation of the driver's booster fan in all speeds.
Check the condition and operation of all sun visors and shades.
Check the condition, operation and mounting of all dash gauges, displays, control switches, and all other electronic components found in the driver's seat area.
Check the condition of the brake and accelerator pedals for condition of the rubber covers and pivot pins for excessive play. Check brake valve plunger for sticking lubricate if needed.
Check operation of entrance and exit doors for smooth operation and correct opening and closing speed (cycle time of no more than 6 seconds from open to close). Check operation of exit door sensitive edge switches and interlock for proper function.
Check the operation of interior isle and overhead lamps in all modes (All, Right side, Front and reverse off) and the condition of the lenses.
Check the operation of the defroster fan motor in all speeds and the flow from defrost to floor.
Check operation of windshield wipers in all operating modes. Verify operation of windshield washers and proper aiming of nozzles.
Check the operation of the low air warning buzzer and warning lamp for the primary and secondary air systems.
Verify the air build up rate is within spec (85 to 100psi in no more than 40 seconds).
Verify the governor cut-out is set to the specified level (125psi ± 5psi).
Perform the three minute leak check with the engine off and the park brake released.
Engine Bay Inspection
Check the condition and operation of the following engine compartment run box controls and equipment: the rear run and rear start switches, remote throttle, run box gauges and engine compartment lamps.
Check the condition and mounting of the alternator and alternator wiring.
Check the condition and operation of all: belts, driven and drive pulleys, idler pulleys and spring-loaded tensioners.
Check the condition, mounting and operation of the following engine accessories, components and subsystems: <ul style="list-style-type: none"> ▪ Air compressor ▪ Water pump ▪ Turbocharger ▪ Fuel system components ▪ EPA emission and exhaust system components
Check the condition, mounting and operation of hydraulic radiator cooling system and steering system components.
Check the condition and mounting of engine and transmission dipsticks, dipstick tubes and oil filler assemblies and caps.
Check the condition and mounting of all the engine/transmission cooling system and vehicle heating system components, perform cooling system pressure and condition tests.
Inspect the entire engine compartment area for signs of fluid and exhaust leaks.

Check the condition and mounting of all engine air intake components.
Lower/Underside Inspection – VEHICLE MUST BE RAISED OFF THE GROUND TO ALLOW PROPER TESTING/INSPECTION OF STEERING & SUSPENSION and VEHICLE UNDERCARRAGE
Check the condition of the king pin bushings and bearings, front and rear wheel bearings and operation of the front and rear interlocks.
Inspect and clean the batteries, battery cables/connections, battery compartment components, battery tray and slides. Test the batteries and record the test results.
Check the condition of the wheels and mounting hardware, axle flange and hub covers.
Inspect, test and record the tire sidewall condition, tread condition, tire pressures and tire tread depths.
Perform fluid and filter services
Check the condition and mounting of the steering gear box and the hydraulic hoses for damage and leakage.
Check the condition and mounting of all steering components to include but not limited to: tie rod ends, steering links, steering shafts and linkages.
Check all ABS valves for condition secure mounting and leaks. Check ABS electrical connections and harnesses for damage and proper routing.
Check the condition, mounting and serviceability of all foundation brake components to include but not limited to: s-cam shafts and bushings, slack adjusters, brake spiders, brake shoes, brake drums, brake calipers, and rotors. Record brake lining, brake pad and or rotor thicknesses.
Check the condition and mounting of all air bellows and height control valves.
Check the condition and mounting of all suspension shock absorbers.
Check the condition and mounting of all air system valves.
Check the condition and mounting of all air supply components to include: air tanks, hoses, piping, fittings, check valves and the air dryer.
Check the condition and mounting of all suspension components to include but not limited to: axles, axle mounts, torque arms and radius rods, sway bars, sway bar links and bushings.
Check the condition of bus frame, structure, cross members and brackets for damage, cracks or missing fasteners.
Check the fuel tank for secure mounting, damage or leaks. Check fuel filler and cap assembly for secure mounting and leaks.
Check the condition and mounting of the driveshaft, and the driveshaft u-joints and slip joint for play, verify presence of driveshaft guard.
Check the condition and mounting of all engine and transmission mounts and brackets.
Check the condition and mounting of the transmission heat exchanger assembly.
Check starter for condition, secure mounting and the condition of electrical connections. Check all engine to frame ground connections.
Check the differential housing for cracks, damage or leaks. Check for leaks at wheel ends and pinion seal, clean and check the differential breather assembly. Check differential fluid level, top off as needed.

Check and record brake strokes at all wheel ends. Check released push rod for even length side to side and observe for smooth application and release of brakes. Check and record brake lining/pad and rotor thickness.
Grease undercarriage components.
Perform required fluid and filter changes associated with PM type being performed.
Test drive the vehicle to observe the condition of the following components: Engine performance Shift points Steering Suspension Brakes Speedometer

TYPE II AND OTHER PUBLIC TRANSIT VEHICLE COMPONENTS

Type II Vehicles	“Paratransit type buses of any length such as minibuses, cutaway and modified vans equipped to transport persons in Public Transportation.”
Other Public Transit Vehicles	“Motorized rolling stock that provide public transportation and include sedans, vans, low speed vehicles, and autonomous vehicles that do not run on fixed guideways.”

The following preventative maintenance inspection guidelines can be applied to Type II and Other Public Transit Vehicles with some modification for applicable vehicle components.

Table 4: Components for Type II and Other Public Transit Vehicles

A-Level Inspection Components
Interior Components
<p><u>Passenger Door/ Check Operation of All Interlocks and/or Starter Interrupt</u> Check to ensure interlock system is working properly when parking brake is applied. If equipped, check passenger door sensitive edge operation.</p>
<p><u>Standee Line & Warning</u> On vehicles designed to allow standees, check the condition of the standee line and sign. Check for sign prohibiting anyone from occupying a space forward of the line.</p>
<p><u>Flooring/ Steps/ All Interior Panels</u> Inspect floor covering for tears, rips, or gouges. Inspect headliner for damage, sag, or dirt. Inspect the condition of side panels. Check steps for yellow edge or nosing to pronounce presence of steps.</p>
<p><u>Wheelchair Belts/ Floor Anchors</u> Check wheelchair seat belt lap extensions and wheelchair shoulder harnesses for proper function. Inspect wheelchair securement devices for damaged webbing and proper operation of locking mechanism. Inspect floor tie down anchors. Ensure the vehicle is equipped with the proper amount of securement devices for the number of wheelchair positions.</p>
<p><u>Passenger Seat Condition/ Foldaway Seat Operation</u> Inspect seat covering for the driver and passenger seats for rips, tears, gouges, exposed springs, and security of floor mounting. Arm rest(s) should be inspected for proper attachment to seat(s). Check folding seats for proper operation of adjustment controls. Check the driver’s seat for proper fore and aft movement and tracks should be lubricated as necessary.</p>
<p><u>Passenger Seat Belts</u> Seat belts should be inspected for proper retraction mechanisms and damaged webbing.</p>
<p><u>Stanchions & Hand Rails</u> Inspect condition of the grab rails and stanchions for the standee passengers.</p>

<p><u>Roof Hatches/ Operation</u></p> <p>Check roof hatches to ensure proper function and that they shut and open properly.</p>
<p><u>Emergency Door and Window Operation</u></p> <p>Check emergency door operation to ensure proper function. Check window exits to ensure all exits function properly. Ensure that all emergency exit signage is clear and legible.</p>
<p><u>Fire Extinguisher/ First Aid Kit/ Emergency Triangles/ Spill Kit</u></p> <p>Inspect the above-mentioned safety equipment to ensure it is in proper working order, securely mounted, and easily accessible.</p> <p>Fire extinguisher must be fully charged with a dry chemical or carbon dioxide, having at least a 1A:BC rating and bearing the label Underwriters Laboratory Inc.</p> <p>Check maintenance tag for expiration date and condition of all components for damage or conditions that may prevent operation.</p> <p>Nozzle outlets must be unobstructed</p>
<p><u>Fire Suppression System</u></p> <p>If equipped with fire suppression system check "System OK" LED is illuminated.</p> <p>Check that system is properly charged and that all instruction labels are intact, clean, and legible. Ensure inspection tag for expiration date.</p> <p>Check the condition of all components for damage or conditions that may prevent operation. Nozzle outlets must be unobstructed, properly aimed, and must have their protective covers.</p> <p>Tank system area should be free of thrash or debris. Trash or refuse container cannot be located in area of fire suppression system.</p> <p>Check fire suppression systems that extend into the battery compartment.</p> <p>Follow the fire suppression system manufacturer's guidelines for servicing the system.</p>
<p><u>Interior Lights</u></p> <p>Inspect all interior lights.</p> <p>Check all emergency exit lights at emergency windows and rear exit door.</p>
<p><u>Vehicle Registration/ Plates</u></p> <p>Check condition and currency of license plate and registration and appropriate manuals and documentation.</p>
<p>Drivers Compartment</p>
<p><u>Brake & Accelerator Pedals</u></p> <p>Check pedals for sticking, binding, or failure to return to normal position.</p> <p>Check pedals for excessive pad wear.</p>
<p><u>Driver's Seat & Belt</u></p> <p>Check the driver's seat for proper fore and aft movement, and tracks should be lubricated as necessary.</p> <p>Check the driver's seat belt for proper retraction mechanisms and damaged webbing.</p>
<p><u>Horn Operation</u></p> <p>Check horn. The horn must be capable of emitting a sound audible under normal conditions from a distance of not less than 200 feet.</p>
<p><u>Service Brake Operation</u></p> <p>Perform a brake test to ensure brakes are operating properly.</p>
<p><u>Check All Gauges/ Switches</u></p> <p>Activate ignition switch and check all warning indicator lights (oil, battery, engine, etc.) for proper operation. If the vehicle is equipped with gauges, check proper readings after the engine has been started.</p> <p>Check all switches, levers, and knobs for proper function.</p>
<p><u>Check Fast Idle</u></p> <p>Check fast idle system for proper operation.</p>

<p><u>Check Air System Pressures</u> Perform leak down test</p>
<p><u>Shift Lever Operation</u> Move the shift lever into each gear and ensure the detents are operating correctly.</p>
<p><u>Parking Brake Operation</u> Test parking brake on an incline or by pulling against the brake with the engine.</p>
<p><u>Back-Up Alarm</u> While depressing the brakes shift the vehicle into reverse and check the audible back-up alarm.</p>
<p><u>Driver's & Panel Lamps</u> Inspect the interior lights. Check all emergency exit lights at emergency windows and rear exit door. Check all dash and gauge lights for proper operation.</p>
<p><u>Interior Mirrors/ Sun Visor</u> Check inside rear view mirror(s) for proper mounting, adjustment, and condition of the glass. Also check the right and left exterior mirrors for adequate field of vision. Check sun visor.</p>
<p><u>Windshield Wipers & Washers</u> Inspect windshield for cracks, scratches, and any visible damage. Operate windshield wipers and washer through all ranges on wet glass to ensure proper operation. Check washer fluid level.</p>
<p><u>Climate Control System/ Fans</u> Operate and check heater and air conditioning controls through all selector ranges and check varying fan speed for proper function. Check rear unit output as applicable.</p>
<p><u>Fare Collection System</u> If equipped, ensure fare collection equipment is securely mounted and operating properly.</p>
<p><u>Cleanliness</u> Check the general cleanliness of the vehicle interior.</p>
<p>Exterior Inspection</p>
<p><u>Check for Damage/ Corrosion/ Bumpers & Mounts/ Decals</u> Inspect exterior of vehicle for signs of body damage, missing trim, decals, paint condition, and any signs of developing rust. Check front and rear bumpers. Inspect for loose, damaged or missing hardware.</p>
<p><u>Condition of All Glass</u> Inspect all windows for cracks, blemishes, or other damage.</p>
<p><u>Wiper Blades & Arms</u> Inspect condition of windshield wiper blades and arms. Replace if needed.</p>

<p><u>Exterior Mirrors</u> Inspect mirror brackets for secure mounting or rusting. Check mirrors for broken/fading glass.</p>
<p><u>Check Light Lenses & Reflectors</u> Check the condition of the exterior light lenses and reflectors.</p>
<p><u>Condenser Fan Operation</u> Visually inspect fan blades for cracks, bends and proper clearance from shroud or screen. Turn on the air conditioning system and check fan operation, listen for any unusual noises, and check for debris.</p>
<p><u>All Access Doors/ Engine Cover & Latch Operation</u> Inspect exterior access doors and lubricate hinges or spring latches as necessary. Check and lubricate hood latch and check hood retainer bar. If applicable, check battery compartment door latches for proper operation and that compartment door will securely latch.</p>
<p><u>Tire Damage & Wear</u> Inspect all tires (including spare) for damage or excessive wear, signs of uneven wear due to imbalance or improper front end alignment and check sidewalls for scrubbing or damage. Determine tread depth using tread depth gauge. Tread group pattern depth shall not be any less than 4/32 (1/8) inch, measured at any point on a major tread groove for tires on the steering axle and no less than 2/32 (1/16) inch measured at any point on a major tread groove for all other tires. Check air pressure in all tires including spare using tire air gauge. Check hubcaps for secure mounting.</p>
<p><u>Check Wheels/ Lug Nuts/ Valve Stems</u> Check wheel lugs for proper torque. Check all wheels, including spare, for any damage, welds, or improper bead seating of tire, or missing balance weights. Inspect valve core, all tires must have FDOT approved valve stem caps. Inflate-through valve caps are preferred.</p>
<p><u>Fuel Cap and Door</u> Check fuel cap for proper fit and any signs of damage to fuel servicing piping/ hoses.</p>
<p><u>Leveling</u> Check vehicle for proper leveling and ensure it is not severely leaning from side-to-side or from front-to-rear or rear-to-front.</p>
<p>Engine Compartment</p>
<p><u>Clean Batteries and Terminal Ends/ Check Electrolyte Level</u> Check battery mounting tray condition for corrosion and wear. Check battery case for cracking or damage. Check post and fasteners for corrosion – clean and cover with protectant. If applicable check and service water levels. If equipped with a maintenance free battery, check “green” indicator.</p>
<p><u>Check Battery Hold Downs/ Cables/ Ground Straps</u> Check battery hold downs. Check cables for fraying or signs of deterioration. Check battery slide out tray for proper function.</p>
<p><u>Record Voltage Output</u> Check and record charging system voltage output at batteries. Load test and record voltage batteries individually.</p>

<p><u>Check Belts/ Tensioners & Hoses/ Air Compressor Mounting</u> Inspect all belts for signs of wear, fraying, cracks, glazing, and proper tension. Inspect heater hoses and connections. Check air compressor mounting for alignment, missing / loose bolts and bracket fractures and/or breaks.</p>
<p><u>Check All Fluids</u> Check transmission fluid level, and check the color for any signs of overheating. Check the fluid levels for engine oil, engine coolant, power steering fluid, brake fluid and windshield washer fluid.</p>
<p><u>Inspect for Leaks</u> Inspect all lines, hoses and reservoirs for signs of leakage. Check engine, transmission, differential and all engine accessories for signs of leaks around gaskets, seals, drain plugs, etc.</p>
<p><u>Check Radiator Core/ Mounts</u> Inspect radiator core and mounts for proper operation. Check the radiator cap for signs of leaks or pressure loss. Remove and inspect the radiator cap. At this time, the radiator cores and the interior of the radiator housing may be visually inspected for corrosion or clogging. Inspect remote coolant reservoir, should be clear enough to visually check coolant level. Pressure test coolant system and cap with proper testing equipment.</p>
<p><u>Check Wiring for Routing/ Chafing & Loose Connections</u> Inspect wiring and all connections for signs of chafing, corrosion, loss of insulation and crimping. Ensure wiring does not contact moving parts or heated surfaces.</p>
<p><u>Check Engine Mounts</u> Check for any signs of loose hardware or deterioration/oil-soaked contamination. Inspect transmission mounts.</p>
<p><u>Replace Engine Oil & Filter</u> Change oil according to manufacturer's specifications.</p>
<p><u>Check Air Filter</u> Remove air filter and inspect air intake hoses and clamps. Visually inspect all vacuum hoses and connections. Replace air filter according to manufacturer's guidelines.</p>
<p><u>Check Fuel Filter</u> Check and/or replace fuel filter. Inspect fuel lines for leaks or damage.</p>
<p><u>Check/ Clean A/C Filters & Cores/ Lines for Routing/ Chafing</u> Remove filters and clean or replace, if equipped. Inspect lines for any signs of leaks or chafing. Clean condenser and evaporator fins of any debris.</p>
<p><u>A/C Compressor Mounting/ Clutch</u> Inspect compressor for any loose or missing hardware. Check pulley alignment and correct if needed. Ensure all wiring is securely routed.</p>

Chassis/Drive Line

Steering Gear/ Linkage & Arms

Check steering column for any absence or looseness of U-bolts or positioning parts; worn, faulty, or any welded universal joints.

Check steering wheel for broken spokes or cracks and for securement.

Check steering box for any mounting bolts loose or missing, any cracks in gear box or mounting brackets.

Check for any looseness of the pitman arm on the steering gear output shaft. Check for leaks.

Steering Shaft & Free Play

Check for any motion, other than rotational, between any linkage member and its attachment point.

Check for loose clamps or clamp bolt on tie rod or drag link.

Check for linkage components that are not secured with proper pins or devices.

Check for any looseness in any threaded joint.

Lube Chassis

Lubricate all steering and suspension zirk fittings.

Check Differential Oil Level/ Clean Breather/ Check Axle Seals

Check for proper fluid level. Ensure breather is clean. Check seals for any signs of leakage. Ensure all hardware is secure.

Check Exhaust System for Mounting/ Leaks/ Restriction

Check the exhaust system for mounting, routing, leaks and restrictions.

Wheelchair Lift Inspection

Lift Manufacturer Tag/ Month & Year Manufactured/ State of FL Certificate

Check that each wheelchair lift or ramp are legibly and permanently marked by the manufacturer or installer with the following information:

- The manufacturer's name and address
- The month and year of manufacture

A certificate that the wheelchair lift or ramp securement devices, and their installation, conform to State of Florida requirements applicable to accessible buses.

Check Lift Wiring for Routing/ Chafing & Loose Connections

Inspect all lift wiring for proper routing. Inspect pendant cord for any damage.

Check Lift for Damage/ Inspect Lift Anchor Bolts

Inspect lift towers for proper alignment. Ensure lift mounting hardware is secure.

Cycle Lift – Check all Safety Systems Including Barriers

Lower lift to ground level and check for damaged, missing parts, and for smooth operation.

With platform slightly off ground make certain the outboard roll stop barrier raises and it is latched securely.

Continue to raise lift to floor level and check for any unusual noises or abnormal operation.

Lift should not fold in with weight (50 pounds) on it.

Due to varying lift configurations refer to your lifts Owner's Manual for a list of warning lights, audible alarms, and safety mechanisms to ensure all of these safety devices are working properly.

Record Lift Cycle Count

Document the lift cycle count on your preventative maintenance inspection form.

<p><u>Check for Hydraulic Leaks/ Level</u> Inspect cylinders, hoses, pump and reservoir for any signs of leaks. Check for proper fluid level. If hydraulic fluid is to be added, only use lift manufacture's or approved equivalent type of fluid.</p>
<p><u>Clean, Lubricate & Adjust Lift As Needed</u> Check lift padding and labels. Check lift manual operation and instruction label. Lubricate appropriate lube points. All lubricates used must meet manufacture's specifications, lubricates must be odorless and not leave a residue. Refer to original owner's manual for lift adjustments if necessary.</p>
<p>Tire Tread Depth/Inflation</p>
<p><u>L/ Front</u> Record the tread depth and air pressure for the left front tire.</p>
<p><u>R/ Front</u> Record the tread depth and air pressure for the right front tire.</p>
<p><u>R/R Inside</u> Record the tread depth and air pressure for the right rear inside tire, if applicable.</p>
<p><u>R/R Outside</u> Record the tread depth and air pressure for the right rear outside tire.</p>
<p><u>L/R Inside</u> Record the tread depth and air pressure for the left rear inside tire, if applicable.</p>
<p><u>L/R Outside</u> Record the tread depth and air pressure for the left rear outside tire.</p>
<p>Note for all tires: Use manufacture's tire pressure recommendation, located on inside driver's door GVWR label.</p>
<p style="text-align: center;">B-Level Inspection Components – in addition to all A-Level inspection components</p>
<p>Chassis/Drive Line</p>
<p><u>Shocks/ Springs/ MorRyde</u> Inspect shock absorber cylinders for signs of leakage. Check bushings for signs of wear and the mounting brackets for secure mounting. Inspect coil and/or leaf springs for signs of damage or wear. Check MorRyde shear springs and related components, if equipped. Check the air springs for leaks, cracks and dry rotting.</p>
<p><u>Torque Rods</u> Inspect for any damaged or missing bushings. Ensure all hardware is intact and secure.</p>
<p><u>Check Drive Shaft & U-Joints</u> Check the driveshaft. Check slip joint for play. On vehicles with two-piece drive shafts, check center support bearing for excessive compression of the rubber insulator. Inspect the center support bearing by rotating the inner race while holding the outer race. Replace if there is evidence of roughness or wear. Lubricate driveline u-joints and slip yoke.</p>
<p><u>Check Brakes</u></p>

<p>This task must be performed on a vehicle lift. Remove wheels and inspect all brake pads/linings for wear. When reinstalling wheels, all lug nuts must be properly torqued to manufacturer's specifications by means of hand torque wrench, impact gun only to be used in combination with correctly rated torque-stick wrench.</p>
<p><u>Air Tank Mounting/ Lines and Valves</u> Check air tank(s), lines and valves for secure mounting, look for any loose or missing hardware. Check for leaks.</p>
<p><u>Underbody/ Mounts & Frames</u> Inspect underbody mounts and frame for proper securement. Look for any loose or missing hardware, bushing deterioration, cracks, etc.</p>
<p><u>Fuel Tank Mounting & Fuel Leaks</u> Check fuel tank for secure attachment to vehicle by inspecting for loose, broken or missing mounting bolts or brackets (some fuel tanks use springs or rubber bushings to permit movement). Check fuel system for any visible leak at any point.</p>
<p>Brake Inspection</p>
<p><u>Brake Foundation/ Lines/ Rotors/ Drums</u> Check rotors/drums for wear, scoring, and warping. Check calipers/cylinders and brake lines for signs of wear, chafing or leaks. Check for any dirt or grease accumulation on the brake system.</p>
<p><u>L/ Front Measurement</u> Record the remaining lining on the left front brake.</p>
<p><u>R/ Front Measurement</u> Record the remaining lining on the right front brake.</p>
<p><u>L/ Rear Measurement</u> Record the remaining lining on the left rear brake.</p>
<p><u>R/ Rear Measurement</u> Record the remaining lining on the right rear brake.</p>
<p>Test Drive</p>
<p><u>Check Engine Performance</u> Start engine and check for any unusual noises. Check exhaust stream for any unusual color, odor or sound. Check for any active or inactive fault codes and if the engine has any outstanding Technical Service Bulletins from manufacturer. During operational test drive, check for smoothness of acceleration.</p>
<p><u>Check Shift Points</u> During operational test drive, check operation and position of shift lever and indicator. Check operation in each gear. Check shift points through all gear ranges in drive position.</p>
<p><u>Steering</u> During operational test drive, check the centering of the steering wheel and the smoothness of turns. Also check for looseness in steering wheel.</p>
<p><u>Suspension</u> During operational test drive, check for proper tracking of the vehicle, balance of tires, and front-end alignment.</p>

<p><u>Brakes</u> Check for smooth pedal operation during braking. Check for any pulling, vibrating or shaking while braking. Check for any unusual noises such as grinding or squealing coming from wheels.</p>
<p><u>Speedometer</u> During operational test drive, check operation of speedometer.</p>
<p>C-Level Inspection Components – in addition to all A-Level and B-Level inspection components</p>
<p>Engine Compartment</p>
<p><u>Test Anti-Freeze Protection</u> Test antifreeze for proper protection level using the correct testing equipment. Caution, many modern engine coolants cannot be mixed. Be sure when adding coolant to only use manufacture’s recommended coolant.</p>
<p><u>A/C Pressure Check</u> Conduct thorough operational check and inspection of air conditioning system to ensure proper operation and ensure there are no leaks. Note: All air conditioning work involving opening the system for repair and recharging must be performed by an EPA 608 certified technician.</p>
<p>Chassis/Drive Line</p>
<p><u>Check Front Wheel Bearings/Hubs</u> This task must be performed on a vehicle lift. Inspect wheel bearings, clean and lubricate or replace if necessary. Vehicles with hub bearings, check bearings for play, roughness and noises. Check sealed wheel hubs for end play, roughness and noises.</p>
<p>Long Term Maintenance in addition to all A-Level, B-Level and C-level inspection components</p>
<p>OEM Recommended Services and Intervals</p>
<p><u>Drain & Refill Differential</u> Drain and refill differential fluid according to the OEM recommended intervals at a minimum.</p>
<p><u>Transmission Fluid/ Filter</u> Remove transmission pan and drain fluid according to the vehicle’s OEM recommended interval. If the transmission torque converter is equipped with a drain plug, drain fluid from it as well. Inspect debris in the bottom of pan for signs of internal transmission damage. Check the color of fluid for signs of overheating. Remove and replace filter screen.</p>
<p><u>Engine Tune-Up</u> The engine must receive a tune-up service according to OEM recommended intervals.</p>
<p><u>Coolant System Fluid Flush & Fill</u> The coolant must be replaced, and system flushed according to OEM recommended intervals.</p>
<p><u>Brake Fluid Flush & Fill</u> Brake fluid must be replaced, and system flushed according to OEM recommended intervals.</p>
<p><u>Power Steering Fluid Flush & Fill</u> Power steering fluid must be replaced and system flushed according to OEM recommended intervals.</p>

CLASSIFYING DEFECTS

FDOT considers some vehicle components essential to the vehicle's safe operation. There are two categories of these safety components: critical safety components and safety-sensitive components. **Critical safety components are considered by FDOT to be crucial to the vehicle's safe operation. When critical safety components are identified as defective during a vehicle inspection, they must result in the vehicle's immediate removal from service until they are repaired.**

The following are examples of systems that are classified as critical safety components by FDOT and are considered to directly and immediately impact passenger safety.

- Steering System
- Service and Parking Brakes
- Suspension
- Tires, Wheels and Wheel End Components
- Interlock Systems
- Wheelchair Lift components that effect the safety of the passenger (example: outer roll stop barrier)

The following are examples of systems that are classified as safety-sensitive components by FDOT that may require further assessment to determine whether they could cause a direct and immediate impact to passenger safety:

- Fuel and Exhaust Systems
- All Lights, Mirrors, Wipers and Warning Devices
- Interior Controls, Gauges, and Safety Equipment
- Air System
- Emergency Exits (doors, windows, etc.)
- Fire Suppression Systems

These lists include examples of safety related components and are not intended to be all-inclusive. Agencies must exercise judgment and caution when determining whether a defect may impact passenger safety and be classified as critical or safety sensitive. The assessment must be made using a methodical risk analysis approach. The policies, procedures and staff duties related to these assessments should be described in the agency's maintenance plan or TOP. Determinations should be documented on the inspection form where the safety-sensitive defect was identified. The form should document whether the defect was determined to need immediate repair or whether the vehicle can safely provide temporary service while the repair is deferred to a later date. While making these determinations, Agencies should also consider issues such as American Disability Act (ADA) requirements. For example, 49 CRF 37.163(e) states,

"If there is no spare vehicle available to take the place of a vehicle with an inoperable lift, such that taking the vehicle out of service will reduce the transportation service the entity is able to provide, the public entity may keep the vehicle in service with an inoperable lift for no more than five days (if the entity serves an area of 50,000 or less

population) or three days (if the entity serves an area of over 50,000 population) from the day on which the lift is discovered to be inoperative.”

The inspection form should indicate any limitation or restrictions placed on the use of the vehicle because of the safety defect identified.

The inspection with the noted deficiency, along with any related repair documentation, should be retained and filed by the transit agency in the corresponding vehicle history file.

DEFECT IDENTIFICATION/REPAIR

In cases where a vehicle component is found to be defective or experiences a failure, the subsequent repair or replacement of that component should be documented on a work order that includes the following information:

- Identification of the vehicle that was repaired
- The date and mileage of the repair
- Information regarding the origin of the defect being repaired
- A brief description of the vehicle component repair or replacement that was conducted
- Identification of the company conducting the repair
- The name and/or signature of the technician conducting the repair

To ensure passenger safety, vehicle component repairs, rebuilds or replacements performed should meet the original manufacturer and/or industry standards for that specific type of vehicle.

It is recommended that the inspection form noting the defect and related repair work order or invoice be documented and filed by the transit agency in one of two ways:

- The inspection form containing the defect(s) and separate corresponding repair documentation must be filed together in the vehicle history file; OR
- The inspection form containing the defect(s) will include information regarding any repair(s) made because of the inspection. Documentation of repair(s) directly on the inspection form must still include the minimum repair documentation information listed above.

For agencies that have manual vehicle history files, it is recommended the inspection form and related repair documentation be retained and filed together in the vehicle history files.

For agencies that have electronic vehicle history files, it is recommended the agency retain the inspection form and the related repair information in their software programs and have direct and immediate access to this information upon request by FDOT.

IN-HOUSE MAINTENANCE PROGRAMS

Agencies with in-house maintenance facilities should meet or exceed the following guidelines:

Maintenance Technician Qualifications

Agencies should ensure maintenance technicians performing PM inspections:

- (a) Understand the requirements set forth in Chapter 14-90, FAC and can identify defective components.
- (b) Are knowledgeable of and has mastered the methods, procedures, tools, and equipment used when performing an inspection for the types of vehicles operated by the bus transit system
- (c) Have at least one year of training and/or experience as a mechanic or inspector in a vehicle maintenance program, and has sufficient general knowledge of the types of vehicles owned and operated by the bus transit system to recognize deficiencies or mechanical defects.

It is preferred that only maintenance technicians who meet FDOT's minimum qualifications conduct PM inspections. In cases where maintenance technicians conducting these inspections do not meet the minimum qualifications, it is recommended that Agencies provide further assessment and validation related to the technician's ability to conduct comprehensive inspections that meet or exceed the standards developed by FDOT.

Maintenance Technician Training

All maintenance technicians performing PM inspections should participate in ongoing technical training for vehicle components specific to the types of vehicles operated by the agency. Agencies should track and document all maintenance training certifications held by each technician employed by the agency to be filed along with personnel records.

OUTSOURCED MAINTENANCE PROGRAMS

FDOT recommends that Agencies who outsource PM inspections develop service agreements with their outsource provider to ensure that these inspections meet or exceed the transit agency policies outlined in their maintenance plan or TOP. Service agreements should ensure that the outsource provider conducts PM inspections, services and other maintenance activities according to the intervals and policies outlined in the transit agency's maintenance plan or TOP. The transit agency should monitor and conduct oversight of the outsource provider's work to ensure it meets these standards, as well as the policies and procedures outlined in their service agreement.

FDOT recommends the following vehicle components to be inspected while the vehicle is suspended on a lift:

- Torque rods
- Ball joints
- Steering Gear/Linkage & Arms
- Lube Chassis

- Drive shaft & U-joints
- Differential Oil Level/Clean Breather/Axle seals
- Drain and refill differential fluid
- Replace transmission fluid and filter
- Front Wheel Bearings
- Air Tank Mounting/Lines & Valves
- Exhaust System for Mounting/Leaks/Restrictions
- Underbody/Mounts & Frames
- Fuel Tank Mounting & Fuel Leaks
- Brake Foundation/Lines/Rotors/Drums
- L/Front Brake Measurements
- R/Front Brake Measurements
- L/Rear Brake Measurements
- R/Rear Brake Measurements
- Engine Oil & Filter
- Shocks/Springs/MOR/ryde

MAINTENANCE PROGRAM COMPLIANCE

Agencies must undergo a complete review of maintenance program policies, procedures and activities by FDOT every three years during their Triennial Review. The maintenance reviews examine the transit agency's ability to meet applicable standards established by FDOT by using data gathered during the Triennial Review process. The criteria for meeting these standards is further outlined in the *FDOT State Management Plan*. An agency's overall compliance will be determined based on the agency's ability to meet the applicable requirements, as well as the agency's adherence with the policies outlined in their maintenance plan or TOP.

For more information in regards to Triennial Reviews and compliance, please visit: www.floridacota.org

TECHNICAL ASSISTANCE AND RESOURCES

FDOT has established numerous technical assistance resources to assist Agencies with the development of comprehensive maintenance programs.

FDOT has contracted with the Center for Urban Transportation Research (CUTR) at University of South Florida to form the Transit Maintenance Analysis and Resource Center (TMAARC). The TMAARC program offers maintenance technician training, opportunities to network with fellow maintenance managers and professionals through the Florida Transit Maintenance Consortium and provides additional technical assistance and support to Agencies in the area of maintenance.

For more information about the TMAARC program, please visit: www.TMAARC.org

FDOT has also contracted with Lively Technical College to launch the Lively Paratransit Inspection Program (LPIP). The LPIP program offers maintenance technician training for paratransit type vehicles, opportunities to network with rural maintenance managers and professionals through the Florida Association of Paratransit Technicians Consortium and hosts a multitude of training and technical assistance resources to assist Agencies in the area of preventative maintenance. Some of these resources include, but are not limited to:

- Training courses for Paratransit Maintenance Technicians
- Maintenance plan templates for in-house and outsourced maintenance programs
- *Transportation Operating Procedure* templates for 5310-only agencies
- Facility and Equipment Maintenance Plan templates
- Outsource Service Agreement templates
- Sample Preventative Maintenance Inspection forms for Type I, Type II and Other Public Transit vehicles
- Sample Pre-trip/Post-trip Inspection forms

For more information about the LPIP program, please visit: www.LivelyPIP.com

FDOT has contracted with CUTR to develop the Compliance Oversight and Technical Assistance (COTA) program to assist FDOT Districts with performing Triennial Reviews to assess Agencies' maintenance, safety and operations programs. The COTA program also hosts technical assistance resources to assist Agencies with ensuring they have transportation systems that operate safely and efficiently.

For questions related to vehicle maintenance compliance, please visit: www.floridacota.org