Everyday

Vehicle Maintenance Management

Proactive and Practical Guidance for Maintenance Managers

- Shop Operations
- Vehicle Systems & Specifications
- Personnel
- Compliance Management
- Regulations

For All Commercial Motor Vehicles

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Introduction

The *Everyday Vehicle Maintenance Management* manual is a guide to managing your vehicle maintenance operation. It looks at the tasks that could fall under the responsibility of the maintenance manager. The book provides information in two major topic areas — your operations and maintenance related activities and dealing with compliance issues.

The operations topics covered in this manual place a strong emphasis on the importance of planning; managing the maintenance operations; establishing schedules and standards; evaluating your needs when it comes to vehicles, facilities, and personnel; maintaining records; and recruiting, developing, and managing the technicians.

The compliance management sections include compliance guidance and selected regulations pertaining to Department of Transportation, Environmental Protection Agency, and Occupational Safety and Health Administration regulations.

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Overview

Why a Maintenance Manual

Vehicle maintenance is a complicated business. Whatever kind of maintenance facility you are in charge of, if you manage the overall program of both operational and compliance related topics, you've got your hands full.

This manual is intended to be used by maintenance managers at all types of commercial carriers. Whenever the term "vehicle" is used, the requirement or concept is universal and applies to all types of commercial vehicles; large (CDL-required vehicles), small (non-CDL commercial vehicles), property-carrying, and passenger-carrying. When a vehicle-specific requirement or topic is being discussed, the type of vehicle the requirement or topic applies to will be specified. Examples include the emergency-exit requirements for passenger-carrying vehicles and the new brake distance requirements related to truck-tractors.

A maintenance manager, in the sense of this manual, has the task of managing maintenance operations, people, equipment, and regulatory compliance issues. Operational management involves finding the most efficient and effective way of keeping the fleet operating safely. Personnel management involves directing a group of different people toward a common goal. Employees must be encouraged to reach their full potential if the business is to be profitable. Equipment management means making sure that each unit "pays its way." If it doesn't, it has to be replaced or eliminated entirely. Managing compliance means trying to comply with regulations from DOT, OSHA, and EPA.

Key Definitions

Commercial vehicle — A vehicle that is used in commerce (i.e., by a business) that meets the Federal Motor Carrier Safety Administration's (FMCSA) or the state's (if the vehicle is involved in intrastate-only commerce) definition of a commercial vehicle, which includes:

- A vehicle with a weight rating or actual weight of 10,001 pounds or more (single or combination)
- A passenger-carrying vehicle that seats more than 8, if the carrier is being compensated for the transportation
- A passenger-carrying vehicle that seats more than 15, if the carrier is not being compensated for the transportation
- A vehicle that must be placarded due to the type and quantity of hazardous materials it is carrying

Expected Component Life System (ECLS) — The projected time a component can be expected to remain in acceptable condition (also known as "life cycle")

Fluid sampling — Taking a small sample from a fluid when it is changed and analyzing it for condition and contaminates. It is used to locate potential future issues (such as trace amounts of coolant in an engine oil sample) or excessive wear (metal shavings in a transmission fluid sample).

For-hire carrier — A carrier that uses commercial vehicles to transport people or other people's property for a fee.

Inspection lane — A specific location at the facility where vehicles (normally inbound) are inspected by maintenance personnel upon arrival at the facility.

Intrastate commerce — The movement of passengers or property entirely within one state. Note: If the movement of the passengers or property originated in another state or will continue over state lines, the movement is considered interstate commerce when it comes to all vehicles and drivers involved, even if one of the vehicles involved in the movement never crosses state lines.

Mean time between failures (MTBF) — The average hours or mileage at which a component fails, based on a study of past failures.

Original equipment manufacturer (OEM) — The manufacturer of the vehicle. In some cases there may be multiple OEMs involved in building a vehicle (such as a dump truck which has one manufacturer's chassis, another manufacturer's engine, and another's dump body). However, the term generally refers to the chassis manufacturer.

Preventive maintenance (PM) — The practice of performing a variety of scheduled maintenance activities on commercial vehicles to prevent breakdowns or other problems.

Preventive maintenance checklist (PM checklist) — A checklist provided to the technician to guide the technician through the required PM activities and to document the condition of the vehicle before and after the PM.

Preventive maintenance schedule (PM schedule) — An established schedule of maintenance activities based on date, miles, or hours that uses a letter or number code to indicate the maintenance activity to be undertaken (e.g., PM A, which would be a "safety check," PM B "full service," PM C "annual inspection," etc.).

Private carrier — A carrier that uses commercial vehicles to transport its own people or property.

Wear limit (also known as "cut-off point") — The point at which a component has sustained enough wear that it should or must be replaced.

Yard check — The practice of checking the vehicles that are parked at the facility to attempt to locate ones that have problems or are due for maintenance.

In Depth

Fleet Maintenance Organization

The organization of a vehicle fleet depends a great deal on its size. Large for-hire fleets usually have a formal organization like any major business with trained people performing specialized tasks. The in-house maintenance shop staff may be equally specialized: equipment manager, shop supervisor, parts person, tire person, line mechanics, regulatory compliance person, etc. The company may also have a mix of shop facilities at various locations around the country, from very large and specialized, to very small and general.

Fleet management for the small fleet is naturally lean. People typically wear more than one hat in this kind of operation. Rather than being specialists, they will probably be generalists,

possibly even bringing a background in a family business to their job. A few individuals must handle all the budgeting and accounting tasks, legal licensing and insurance paperwork, driver hiring and managing. They must also go out and get the business, and then service the customer.

The private fleet's goals are not really the same as a for-hire operation. The corporation to which it belongs has created a fleet to meet price and service requirements that are not being met by outside carriers. Because of this, many times private fleets do not operate their own equipment and maintenance facilities. They lease equipment and have lease arrangements that require the leasing company to perform the maintenance. However, the private fleets must still have individuals who are well-versed in equipment maintenance and the associated regulations. Even though the private carrier does not own the vehicles, or maintain them, they are still legally responsible for them (including the inspection and maintenance of the equipment).

Also, private fleets may still have maintenance needs. The operation of a small maintenance facility to perform quick and easy repairs (fixing lights, airing tires, etc.) may be necessary if the leasing company's shop is too far away or not available all hours the fleet is operating. In some of these cases, the vehicle maintenance may be handled through the general maintenance department at the facility. If this is the case, the personnel performing the maintenance may need a considerable amount of guidance on vehicle maintenance.

While the maintenance department does not have to worry about "turning a profit," it does need to keep an eye on costs. It must be able to maintain and repair vehicles as economically as an outside shop. The conveniences of having an inside shop (no need to schedule shop time with an outside entity, the ability to prioritize work, control of manpower, faster turnaround times, in-depth knowledge of the equipment and maintenance schedules, etc.) can be outweighed if the shop becomes too expensive to operate.

Maintenance is a very labor-intensive part of fleet operations. Even the best diagnostic equipment is only as good as the technician who uses it. The shop can only be cost-effective when productive people are employed there. The challenge to maintain a safe, reliable vehicle at the lowest possible cost can only be achieved by people who really believe in this goal. The goals of the maintenance shop and the themes that will run throughout this manual are to increase productivity, reduce maintenance costs, and improve vehicle utilization to increase profitability.

The whole principle of an effective vehicle maintenance operation is to keep the vehicles rolling, so they have the maximum opportunity to make money for the company. Whether you work with a for-hire trucking operation, a for-hire motor coach company, a school bus company, a private fleet, or some other kind of transportation company, profit is at the bottom of most considerations.

Why Have PM and Schedules

PM, or preventive maintenance, involves scheduling inspections and maintenance to prevent vehicle breakdowns. The PM program, and the associated scheduling, are at the heart of any effective maintenance program. It is the logical place for a maintenance manager, as well as a manual intended for a maintenance manager, to begin.

Present regulations require that every motor carrier shall systematically inspect, repair, and maintain, or cause to be systematically inspected, repaired, and maintained, all motor vehicles subject to its control (49 CFR §396.3). The full text of the DOT inspection requirements can be found in the DOT compliance management and section.

Compliance Point

The regulations require a carrier to have a systematic maintenance program. However, they do not provide guidance on what it must include. That is up to the carrier to determine.

Regulations are not the only reason to run an effective PM program. A well-maintained vehicle is less likely to be involved in an accident, will be more productive, and require less unscheduled maintenance and repair, which is more expensive than PM. To sum it up, PM leads to less accidents, better customer relations, and a lower cost of operation.

Another strong incentive for a good PM program is the possibility that the vehicle will be pulled over for a roadside vehicle inspection. If the vehicle is found to have a mechanical condition that might result in a breakdown or an accident, it will be put out of service. The vehicle cannot resume its trip until the unsafe condition is corrected.

Preventive maintenance is also an attitude, a commitment. It doesn't mean simply getting a vehicle into the shop and fixing what you see. It means being constantly on the lookout for things that might go wrong. It means getting the best, most cost-effective equipment for the vehicle and then taking care of it. This is much like preventive medicine that stresses good eating habits and regular exercise as a continuing prescription for good health and long life.

The PM philosophy is widely used, not only because it reflects a modern attitude of conservation, of using what assets one has wisely, but because it saves money. No one can argue with the bottom line. As PM takes hold, the standard of excellence for a maintenance shop changes from getting the fastest repairs to getting the fewest repairs.

PM also requires careful recordkeeping of what is done. In addition to complying with regulations, PM records have another use. Once reliable PM schedules are established, they are refined for the individual vehicle and can be used to predict maintenance. Fleets that do not use records for more than simple documentation are not taking advantage of the goldmine of information that's there. And it's quite likely that those fleets are not managing their vehicles, the vehicles are controlling them.

To sum it up, vehicles that are put out of service or breakdown will require unscheduled maintenance (repairs). Repairs done on the road can be very costly both in lost productivity time and additional repair costs (commercial shops tend to have a considerably higher cost) when compared to the cost of operating a PM program. Using a "we'll fix it when it breaks" maintenance program can get very expensive.

Shop Operations: Determining Maintenance Schedules

Determining PM Intervals

Measuring the interval

The first decision that needs to be made when determining a PM schedule is what method of measurement you are going to use. There are several methods used to schedule vehicles for preventive maintenance. The three most common methods are:

- Time — This method is by far the easiest for management, but is often the most wasteful as far as technicians' time, parts, and cost. Scheduling vehicle preventive maintenance based on time means exactly what it says. A vehicle will be scheduled into the shop every x amount of days regardless of mileage or engine hours used since its last PM.
- Miles — Scheduling PMs based on vehicle miles driven is the most common method used for scheduling vehicle preventive maintenance. A vehicle will be scheduled into the shop after a pre-determined amount of miles have been driven on the vehicle. There are, however, a few problems associated with this method. The biggest problem is that scheduling PMs based on mileage does not take into account issues such as severe duty, excessive engine idle time, and power take off (PTO) time. To compensate for this, some carriers that use mileage shorten the mileage interval to compensate for severe duty, excessive idling, or PTO time.
- Engine hours — Scheduling PMs based on engine hours makes sense for vehicles that work hard during every mile, but do not do many miles. Waste trucks, concrete haulers, and gravel trucks are all good examples of vehicles that are typically scheduled for PMs based on engine hours. The reason these trucks are routed into the shop for PMs on the basis of engine hours is because they are constantly working hard — even though the truck may be averaging low miles per hour and miles per day.

The type of vehicles and the type of operation will determine the best type of PM scheduling for your individual company.

Methods for determining interval

This part of the maintenance program, the PM intervals, comes from several sources:

- The original equipment manufacturers' (engine, transmission, and other component OEMs) recommendations are the primary source and the most important ones. If the fleet has bought a new vehicle, that's the only reliable source of information. You should follow the recommendations exactly until your own experience proves otherwise. You can also get information about expected component life from those manufacturers and plan accordingly. You must be careful about deviating from the OEM's recommendations. If you deviate too far you may lose some, or all, of the warranty on the vehicle or vehicle components.
- Your repair records (your history) are the second source. Even if you are planning PM for a new vehicle, past maintenance history on similar vehicles that do the same work can give you important clues about how the fleet vehicles have been operating and helps you plan the maintenance schedule for the new vehicle.
- Your own people (drivers, technicians, and other shop personnel) are your third source. Ask them for suggestions. A successful PM program will need the cooperation of everyone, and the best way to get that support is to start out with the same people. They should help to put the plan together. Ask for specific ideas about the PM intervals.
- Tracking internal performance measures. These measures can include oil sampling (if oil samples tested following oil changes are indicating oil breakdown, shortening the

interval may be necessary), part failure analysis, unscheduled repairs, on-the-road repairs, on-the-road breakdowns, and out-of-service violations. It does not make any difference how well your maintenance schedule matches up with the OEM's recommendations, if the vehicles are constantly breaking down or are constantly in need of major repairs (such as engine replacements).

One issue that will need to be considered when establishing the maintenance interval is the need to service the emissions system. In vehicles built to the 2007 and 2010 emissions standards there are parts in the emissions system that require regular service. Diesel particulate filters (DPF), selective catalytic reduction (SCR) systems, and exhaust gas recirculation (EGR) components all require routine service.

Determining PM Checklists

As was mentioned earlier, PM involves scheduled inspection and maintenance of the vehicle. One key to making sure the necessary items are being inspected and maintained is the development of maintenance checklists. At the end of this chapter there are examples of PM checklists that are commercially available. If you want to develop your own, there are many factors that must be considered. Some of these factors are:

- OEM recommendations. All OEMs provide recommended inspection and maintenance items and procedures. These should serve as the basis for any program you develop.
- Regulations. Certain inspections are mandated in the Federal Motor Carrier Safety Administration regulations. An example of a mandated inspection is the periodic (annual) inspection. The items found in Part 393 and Appendix G can serve as the basis for any checklist covering a required inspection.
- Your history. By data-mining maintenance records and determining ECLS and MTBF for various parts and components, you can predict when parts and components become unreliable. Also, testing samples of fluids can determine the length of time fluids should be left in the various components, and therefore, the timing on fluid changes.
- Your people. If your technicians are reporting that they are constantly having to repair a part or component on vehicles, and the part or component is not on the PM checklist, you should consider adding it.

In the above discussion we hit on some terms and concepts that we need to further explore.

ECLS and MTBF

ECLS, or Expected Component Life System (sometimes referred to as Expected Component Life Cycle System), is a method of studying vehicle maintenance trends and replacing parts and components before they fail.

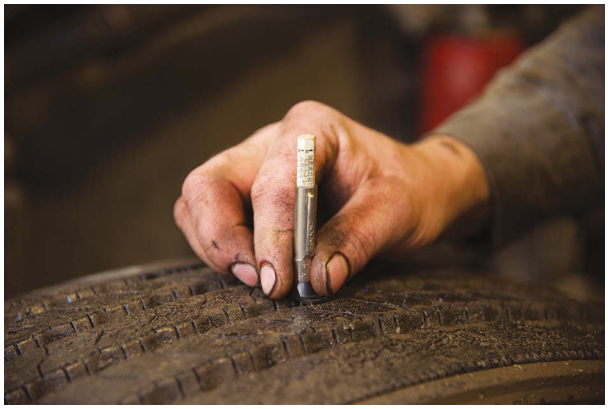
The first step to effectively using ECLS to determine PM checklists is having accurate maintenance data. By digging through the maintenance records and mining data out of the records, the maintenance manager can determine the Mean Time Between Failures (MTBF) for all parts and components on the vehicle. The MTBF is nothing more than the average miles or hours that a component fails

Once the MTBF has been determined, the next step is to determine the ECLS replacement schedule for the component. If the ECLS is set at the MTBF, roughly half of the vehicles will suffer a failure of the component or part before it is replaced. If the ECLS is set at the earliest known failure point, then many times the part or component will be removed from the vehicle well before replacement is necessary.

Shop Operations: Determining Maintenance Schedules

The basic question becomes, what are you willing to accept for an on-the-road failure rate? If you do not want any on-the-road failure of the component in question, then you will want to set the ECLS at the earliest known failure point. However, if the item is not a critical component, or an item whose failure can be easily dealt with when the vehicle is on the road, then using the MTBF point as the replacement point may be acceptable.

Wear limits



Some components, such as tires and brakes, can be tracked through the MTBF and ECLS programs, but their replacement will be directly tied to the vehicle inspections. The MTBF and ECLS data can be used to compare tire and brake performance, but the decision to replace the parts will be based on the findings of inspections. This is done through determining "wear limits" on parts and components.

Wear limits are the minimum acceptable depths or thicknesses you are willing to allow on a component, regardless of the MTBF or ECLS data. An example would be tires. The legal minimums for a tire are 4/32" on the steer axle, and 2/32" on all other positions. As a company you have decided that you are not going to allow the tires to wear down to that point. You will replace steer tires at 8/32" and all other tires at 4/32" (this is then considered your failure point for MTBF purposes).

The MTBF and ECLS can give you a general idea of when the wear limit should be reached, but how many hours or miles it takes to reach the failure point is irrelevant. Once the tire has worn to the predetermined point (either 8/32" or 4/32"), the tire is replaced.

Best Practice

Doing the legwork to determine when components fail and establishing realistic cut-off points is what helps you determine when components should be replaced. This is one key to avoiding on-the-road breakdowns.

Fluid sampling

Another method of determining maintenance needs that does not involve MTBF and ECLS is fluid sampling.

Fluid sampling and testing can provide the maintenance manager with a "wear limit" method of analyzing the internal condition of a component. A prime example is the engine.

By simply looking at an engine the maintenance manager cannot tell the condition of the internal parts. A MTBF study can determine when most of the engines will fail. But with engine rebuilds being an expensive repair, doing a rebuild simply based on MTBF and ECLS data could lead to unnecessary and costly maintenance.

Taking an oil sample, and having it tested, can give the maintenance manager a look inside the engine. If antifreeze is appearing in the oil, that can indicate a head gasket is leaking. Iron, steel, chromium, or aluminum particles in the oil sample can indicate that the one of the internal components of the engine is beginning to fail. The presence of excessive copper (or similar metals) in the oil can indicate that there are bushings or bearings that are beginning to wear.

Sampling and testing other components can also locate problems. Transmissions, differentials, and auxiliary hydraulic systems (wet kits) are all examples of components where sampling and testing can indicate problems in advance of failure.

Testing the fluids in every vehicle component at every service could get costly ($7 to $15 dollars per test). Many carriers are willing to pay this and consider it part of the PM cost of the vehicle. As well as providing early warning of problems, a regular sampling program can help with any warranty claims associated with the component (sampling will show the failure was a sudden failure, not due to neglect over time).

What many carriers that use sampling do is combine sampling with MTBF and ECLS data. When the vehicle first enters service, samples are only taken at benchmark intervals, such as during quarterly or the annual inspection. Once a vehicle reaches a predetermined threshold, the sampling and testing then become part of all regular inspections. Here is an example of a combination approach:

- **Engine:** Due to MTBF and ECLS data we will sample and test engine oil as part of the annual inspection for the first two years. After the second annual inspection engine oil sampling and testing will be performed as part of each oil change.
- **Transmission:** Due to MTBF and ECLS data we will sample and test transmission oil as part of the annual inspection for the first five years. After the fifth annual inspection transmission oil sampling and testing will be performed as part of each oil change.
- **Differentials (including interaxle):** Due to MTBF and ECLS data we will sample and test differential oil as part of the annual inspection for the first five years. After the fifth annual inspection differential oil sampling and testing will be performed as part of each oil change.

Shop Operations: Determining Maintenance Schedules

Documenting Preventive Maintenance

The FMCSA regulations require that the company have a record system that shows the vehicle's maintenance schedule, and last and next scheduled service (both due date and nature of the service). The regulations do not spell out how a company is to accomplish any of this. The regulations do not provide a "required schedule" or "required form and format" for documentation. The regulations only require that a company have a systematic maintenance program and document it. One reason the FMCSA does not "spell out" a preventive maintenance schedule that carriers must follow is because of the wide variety of commercial vehicles that are in operation and covered by these regulations. Everything from pickup trucks to motorcoaches to tractor-trailers are covered by these regulations.

To develop and document the preventive maintenance program a maintenance manager will need to use the information we have mentioned so far, and then develop and document the maintenance program for each vehicle (or group of vehicles). This is not as complicated as it sounds.

First, for preventive maintenance purposes and later tracking divide the vehicles in the fleet into "dynamic groups." Each group should be made up of similar vehicles (based on similar traits and maintenance requirements, not necessarily make and model).

Next, review the existing information for each group and write a preventive maintenance schedule (including intervals, checklists, and wears points for important and high-wear components).

Once you have established the schedule for each of the dynamic groups, copy them and place a copy into the corresponding vehicle files. As well as containing the preventive maintenance information, the vehicle files must also contain identifying information (vehicle number, make, VIN, year, tire size, and the entity providing the vehicle if it is not owned by the company), and records of all inspections, maintenance, and repairs. This is required by the FMCSA regulations under §396.3. For more information on these regulations see the DOT tab in the Compliance section of this manual.

Finally, either on a form in the file or physically on the file, keep track of each scheduled preventive maintenance, and record when the next scheduled maintenance is due.

Some companies go one step further to make the process easier. In addition to the files they use a wall board that displays the individual vehicles and last/next service. This way, technicians and supervisors can tell at a glance when a vehicle received scheduled preventive maintenance last, and if it coming due for its next service.

Compliance Point

One key point to remember: The FMCSA is letting you develop your own preventive maintenance program and schedule. However, the FMCSA is going to expect you to adhere to your program and schedule, just as if they were regulations. This really is a case where you "get to write your own regulations." As long as you have a documented preventive maintenance program that includes a maintenance schedule, records that show past and future maintenance, your vehicles are being serviced in accordance with your schedule, and your vehicles are passing roadside inspections, the FMCSA will be satisfied with your preventive maintenance program and schedule.

Example of a PM Schedule

The actual maintenance portion of PM is composed of scheduled and standardized inspections and maintenance. This is sometimes referred to as the vehicles' "scheduled service," or simply "service." PM services are commonly designated as A, B, C, D, etc. Under the normal system, every letter you move up into the alphabet represents an increase in the complexity of the PM service (and time required).

PM A services are also known as a "maintenance check-out" or "safety inspection" and generally consist of a safety check and lubrication as well as checks of key components such as brakes, lights, tire condition and inflation, and fluids. It also includes checking and adjusting high wear components. Typically, these PM As are scheduled at half of the oil change interval of the vehicle. The normal interval for A service is between 1,500 and 2,500 miles on light vehicles, and between 5,000 and 10,000 miles on medium and heavy duty vehicles.

Note: Some companies use an "inspection lane" and perform an A service every time the vehicle returns to the maintenance facility.

PM Bs normally include all PM A items, and also include an oil and filter change, as well as 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 ECM and action on any troublecodes or problems reported by the ECM (if applicable).

One consideration with passenger-carrying vehicles is that the pushout windows, emergency doors, and emergency door marking lights must be inspected once every 90 days. If the vehicles will not be undergoing PM Bs within 90 days, then this inspection item will need to be included in the PM A inspections for these vehicles.

PM C service calls for both A and B service items and a more extensive service (i.e., alignment, vehicle component replacement, scheduled engine and driveline component inspection or replacement, etc.). Many carriers will also do the DOT annual inspection required by §396.17 (see the Compliance Management and Regulations sections for more information on this required inspection). Normally, C services are scheduled at least annually, due to the annual inspection requirement in §396.17. To make sure they are done in a timely manner, it is not unusual for carriers to actually schedule them on an eleven-month schedule. Carriers based in California, where there is a 90-day inspection requirement in the state law, will normally schedule at least the inspection portion of the C services for every three months.

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