Development, Implementation and Training of Vehicle Inspection Services and Preventive Maintenance Procedures

Final Report

Prepared For

Boston Fire Department

Prepared By

Fleet Counselor Services Inc.

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Executive Summary

Introduction

The Boston Fire Department (BFD) selected Fleet Counselor Services Inc. (FCS) to develop inspection and preventive maintenance processes and programs. The contents of this report suggest adoption of an inspection program and preventive maintenance program developed by FCS that represent industry best practices.

BFD also requested evaluation of several other aspects of its operations. The following is a summary of the detailed findings recommendations that follow in this report.

Daily Inspections

FCS created daily inspection criterion that meets NFPA standards. The inspection will be programmed into a Zonar[1] handheld device, and the data can be downloaded into a fleet management system for storage and achievable documentation. The inspection is provided as a paper form for apparatus and vehicles not having a Zonar device. An aerial inspection form is included in Appendix A. FCS will coordinate with BFD to provide training on how to complete the inspection, both manually and using the Zonar device. However, the Zonar staff is responsible for training addressing the technical functionality of its devices and software.

All fire apparatus, the rescue units and most of the BFD trucks are required to complete a daily pre- and post-trip inspection. Although firefighters are exempt from having a Commercial Drivers License, they are required to follow the law regarding inspections.

Preventive and Predictive Maintenance

FCS created a preventive and predictive maintenance inspection program for BFD apparatus and vehicles based on NFPA and FCS advanced standards for all apparatus and vehicles. The companies with the highest call activity and usage will require more detailed component inspections than companies with low activity and usage. This will meet NFPA requirements and reduce maintenance costs.

FCS is designing the program for detailed component inspections to coincide with component replacement times to reduce shop repair instances. This also reduces maintenance costs as the program circumvents additional repair cost due to a component failure.

Computer Systems

NFPA requires that BFD document and store all repairs, preventive maintenance, and inspections for the life of the apparatus. The repair history is required to accompany the apparatus if transferred or sold. BFD currently does not have a fleet management system and is storing outside vendor invoices in a file folder by the asset number. The documentation that FCS reviewed is not complete making it difficult to create the PM or inspection programs effectively.

[1] Zonar is the brand name of an automotive handheld device designed to hold operators accountable for performing thorough safety inspections.

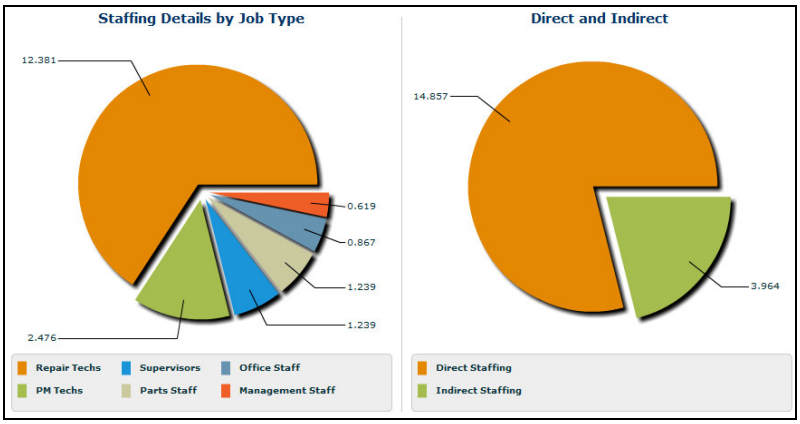
FCS recommends implementing a fleet management system to document repair history essential to ensure the success of this program. BFD has purchased and is implementing Fleet Focus, Fleet Anywhere, and FCS supports this decision. If FCS can provide support with this project, it will be treated as a priority.

Staffing

Staffing is based on the quantity and average age of fire apparatus and on technicians' having ASE Master Heavy and EVT Certification. FCS calculated staffing requirements based on incorporating apparatus on order for 2009 and 2010. The chart below indicates 15 technicians are needed to maintain fire apparatus with newer units with the same number of reserve units as BFD has now. FCS recommends hiring staff over a 3-year period until a full complement is achieved. Once a new preventive and predictive maintenance is implemented, staffing could be reduced in future years.

The existing staff of Fireman that are assigned to fleet is a total of 11 FTE's and an additional 2 Fire Chiefs. The current staffing are not fleet trained, (ASE or EVT certified staff). FCS is highly recommending that all future staff be ASE and EVT certified.

Fire Apparatus Staffing on December 31, 2010



It is FCS's understanding that some staffing acquisitions have already been completed. The City of Boston Fire Department management staff, specifically the Fire Commissioners' office, should be recognized for their fast action with this most serious matter. ASE certified Technicians are not easy to find especially with the policy of hiring residents.

Facilities

Maintenance facility size to maintain the fire apparatus fleet is effected by the age of BFD's units. FCS used the same apparatus age to calculate square footage as for staffing levels above, and determined that 32,686 square feet is required. The current size is 23,700 SF including a machine shop. Some of the shortage in square footage for shop space can be replaced with multiple shift assignments, such as a day, night and swing shifts.

Detailed Findings and Recommendations

Inspection and Preventive Maintenance Programs

Inspection of fleet assets provides a method to determine if the asset is in safe operating condition and ready to respond to an incident. Safety is the primary concern. The inspection document is required to be stored for the life of the asset, as well as the documented repairs that may or may not result from the inspection and preventive maintenance (PM) service.

The following vehicles require pre-trip and post-trip inspections as determined by the Federal Government and the State of Massachusetts[2]:

- A single vehicle with a gross vehicle weight rating (GVWR) of more than 26,000 pounds.
- A trailer with a GVWR of more than 10,000 pounds if the gross combined weight rating is more than 26,000 pounds.
- Any size vehicle that requires hazardous materials placards.

Although firefighters are exempt from testing for a Commercial Driver's License, they are required to follow other federal and state regulations. This includes performing inspections and keeping a copy of the current inspection in the vehicle at all times.

Preventive maintenance is another level of inspection in addition to operator inspection. This level is more detailed and tailored after manufacturer recommendations that define how often to check components for wear and replacement. Prior work history is the final determination for scheduling preventive maintenance periods because history can vary from manufacturers' recommendations.

The PM checklist includes changing fluids, lubricating, and inspecting and testing a long list of components to attempt to identify potential failures and broken or worn out parts. By replacing or repairing components prior to failure, BFD will accomplish the following:

- Maximize unit uptime - Maximizing the availability of the unit is the primary objective of the preventive and predictive maintenance program. Since this is scheduled maintenance, the inspection identifies potential failures for repair or replacement. The program should reduce or eliminate the possibility of breakdowns or unscheduled visits to the repair facility.
- Reduce operating costs - Improving reliability of the unit results in a reduction of operating costs because the unit is available more. Maintenance costs are reduced by eliminating additional repairs caused by the component failure.
- Increase operational safety - Ensuring the apparatus operator has a safe unit to operate not only protects the operator but also offers liability protection to other employees, the public, and the Boston Fire Department.
- Increase resale value - Staying on schedule and consistently reviewing repairs for predictive maintenance will result in increased longevity of the unit and will increase resale value at vehicle replacement time.

[2] State of Massachusetts Commercial Driver's Manual/2.0

Vehicle Inspection Procedures

Findings

FCS found that BFD does not have a formal vehicle inspection procedure. BFD is anxious to begin training personnel on inspection methods for fire apparatus and other vehicles to ensure vehicles are safe to operate. BFD wants to incorporate federal, state, and NFPA regulations into their inspection process.

The Director of Transportation, will oversee the maintenance operation and direct the new inspection process. He has many years of experience in fire apparatus maintenance. His knowledge and experience will bring many improvements to the current operation.

The absence of prior inspection and repair history will affect the accuracy of the inspection process; however, FCS is using professional hands-on experience, manufacturers' recommendations, BFD vendor invoices, Massachusetts Commercial Driver's Manual/2.0, and the 2007 Edition of NFPA 1911 to develop initial inspection procedures.

The lack of pre- or post-trip inspection reports was evident during the on-site firehouse inspections. FCS found no inspection books in any fire apparatus. Additionally, there were several vehicles in the shop requesting immediate repairs so they would not be taken out of service. One such repair, pictured below, was replacing a fuel tank strap that should have been noted during an operator inspection. The pictured example is for an apparatus towed to the repair shop by a contract wrecker. The tow was necessary due to the fuel tank falling off the truck onto the street. The pictured strap failed due to rust and corrosion. FCS further found that this unit had been in the shop for inspection earlier and that the fuel strap was noted by shop, (Motor Squad), staff, and the unit was allowed to be placed back in service. FCS will address these types of repairs with the new daily and weekly inspections.

Additionally, issues such as this example is why FCS is highly recommending that only technically certified technicians, such as ASE Certification, OEM Certification, or EVT Certification staff be employed to perform these duties.

The future inspection criteria would be used in conjunction with Zonar handheld units.

Failed Fuel Tank Strap

Inspections and Handheld Devices

Daily inspections are vital for the safety of the firefighter and the public. Firefighters need to know the apparatus is performing to standard prior to starting their tour. BFD is in the process of purchasing Zonar Systems for their front line apparatus. Zonar Systems provide a verified electronic inspection using radio frequency identification tags that contain specific vehicle information. The system electronically captures the vehicle's information and documents who performed the inspection. The information is transmitted to the fleet management system, and the appropriate personnel are notified of any defects. This system, or process, is an industry best practice.

BFD outlined which classes of equipment should be included in the inspection process. FCS created a daily and weekly inspection document for each class of apparatus that BFD specified (See Appendix A). FCS created the daily and weekly mobile inspection document in zones so it would align with the Zonar Systems 2010 handheld reader. An explanation is provided for each zone item in the document. A detailed instruction sheet will also be provided with the inspection training. FCS designed the inspection document to work either as a standalone document or in conjunction with the Zonar system's 2010 reader.

FCS has communicated with Zonar and provided them inspection criteria to be loaded into their handheld units. The Zonar training representative will instruct BFD staff on how to update the inspection criteria as needed. FCS recommends verifying the loaded inspection criteria with our list upon the delivery of any new apparatus.

FCS also recommends that any new bid specification should require a Zonar handheld device as part of the purchase complete with programming and operator training.

Compliance with NFPA Standards

FCS reviewed the current program's ability to comply with NFPA standards. The current program did not meet the vehicle inspection portion of the NFPA standards. BFD was not performing daily or weekly inspections on the apparatus. The only inspections performed were the annual ladder inspection, the annual pump test, and the nondestructive ladder tests. FCS found these tests performed according to NFPA 1911 Standards. BFD performs ladder tests on aerial equipment after major repairs occur, when the aerial device is subjected to unusual operating conditions of stress or load, and when there is reason to believe the manufacturer's recommended operating procedures have been exceeded. A certified third party testing facility using the NFPA 1911 standards performs ladder tests. BFD also performs nondestructive tests on their ladders according to the NFPA 1911 standards.

BFD performs annual pump inspections according to Chapter 18 of the NFPA 1911 Standards. A certified third party contractor performs pump tests. This is an industry best practice due to liability reasons. It is important to document any defects or problems with the ladder and the fire pump. This type of inspection allows BFD to compare the apparatus against the prior year's test to assure the equipment's component performance is not decreasing. BFD records indicate that the annual ladder inspection, the annual pump tests, and the nondestructive ladder tests were recently completed by fiscal year ending June 30, 2009. Prior to this, there was not a program in place to consistently test each piece of the apparatus.

The next step is to document any repairs required by the inspection. The fleet manager should sign off on the repairs and file a copy of the inspection and the documentation of the repairs. The original copy should be remitted to the company that performed the inspection and remain on file with them. A copy of the documents should remain in the BFD apparatus files as long as the apparatus is owned by BFD.

Recommendations

Inspection Criterion and NFPA Compliance

Upon review of the repair history, FCS used the NFPA 1911 Standards, the Federal Commercial Driver's License guidelines, and the Original Equipment Manufacturer's documentation to create a mobile fire apparatus daily and weekly mobile fire apparatus inspection document. Appendix A contains the inspection for an aerial. The inspection is designed to start the inspection in Zone One by checking fluid levels in the power plant area, then moving to Zone Two, the cab, and following a counterclockwise rotation around the apparatus. The underside of the vehicle and any special components like aerial and pump devices follow. This document aligns with Zonar system requirements. The paper document will be used to configure the Zonar 2010 handheld reader that will be assigned to each frontline apparatus. The daily and weekly mobile fire apparatus inspection document will be used on the apparatus that is not equipped with the Zonar system and serve as a paper backup to the Zonar system.

Inspection Criterion Review

FCS recommends that BFD fleet services review and update established inspection procedures annually, at a minimum. A team of BFD personnel should perform the review process. The team should consist of the following:

- Director of Transportation
- Fleet Safety Coordinator
- Two Shop Technicians

Select two technicians by vehicle classification[3] for each team so that all technicians have input in the process. The same teams will review and update the corresponding preventive and predictive maintenance procedure.

The inspection performed by firefighters will probably remain the same from year to year. However, reviewing the process allows the maintenance staff to add or modify an item that has a significant impact on safety.

Qualifications of Personnel

NFPA 1911 recommends that persons performing daily/weekly inspections and the operational checks of fire apparatus should meet the qualifications of NFPA 1002, Standard for Fire Apparatus Driver/ Operator Professional Qualifications, for the type of fire apparatus being checked.[4]

[3] Vehicle classification refers to a group of vehicles that have similar characteristics. Examples are pumpers or heavy-duty rescue trucks.

[4] NFPA 1911, Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, A.4.3.1.2, p1911-58.

Mission Capable Determination

NFPA states that deficiencies or problems might or might not make the apparatus unsafe but will render it unusable for some operations.[5] It goes on to state that the Authority Having Jurisdiction (AHJ) should provide a list of limitations to impose or a list of enforced conditions under which the apparatus cannot be used until the stated item is repaired. These items should include, but are not limited to the following:

1. Compartment doors will not stay closed
2. Running boards are not secure
3. Tailboard is not secure
4. Accessory step (folding step) is broken or missing

NFPA1911, Chapter 6, outlines deficiencies or problems specific to apparatus, which indicate when a unit is to be taken out-of-service[6]. Additionally, the chapter offers guidelines on how the apparatus should be physically marked so that visually, anyone can determine its status.

FCS recommends the AHJ create a written policy informing BFD personnel that fleet personnel will follow the current NFPA 1911 guidelines to determine apparatus out-of-service conditions. In addition to the items listed in NFPA 1911 Chapter 6, these items could cause apparatus to be put out of service: a separate list of defects[7] identified by the state, provincial, and local regulations; specific manufacturer's recommendations; and requirements established by the fire department that direct the apparatus be put in an out-of-service status. FCS realizes that BFD has internal guidelines regarding policies and their structure, and have included an example policy to consider below.

[5] NFPA 1911, Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, A.6.2.3, p1911-59.
[6] NFPA 1911, Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, p1911-14 through p1911-17; p1911-59.
[7] NFPA 1911, Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, 6.1.3, p1911-14.

Example Policy

Subject: Mission Capable Directive

Purpose: Define fire apparatus out-of-service criterion.

Effective immediately, all personnel are notified that out-of-service criterion for fire apparatus will follow the current NFPA 1911 guidelines. Additional items not listed in the NFPA standard that necessitate taking apparatus out-of-service are below.

Taking apparatus out-of-service indicates an unsafe condition that could pose a serious risk to the firefighter and the public. For clarification regarding this directive, contact the Director of Transportation.

Additional Manufacturer Criterion

Additional Governmental Criterion

Additional Boston Fire Department Criterion
Missing gas cap
Missing radiator cap
One or more inoperable gauges

An additional policy will be required to notify personnel how out-of-service apparatus will be marked to inform operators of the status. NFPA 1911, Chapter 6 offers several suggestions:[8]

1. Sign on the outside of the driver's door near the door handle
2. Special bag that covers the steering wheel
3. Large sign on the driver's window
4. Highly visible mechanism at the driver's position on the fire apparatus that all members of the fire department recognize as an out-of-service indicator

Zonar Handheld System

FCS, along with Zonar Systems, will provide comprehensive training to individuals selected by BFD after the Zonar Systems' equipment is installed on two or more apparatus. BFD will need to coordinate this training to meet the selected fire personnel schedules. This hands on comprehensive training will incorporate the use of the Zonar Systems 2010 handheld unit and the daily and weekly mobile fire apparatus inspection document. FCS recommends a train-the-trainer methodology to facilitate continued training after FCS and Zonar Systems' instructors provide the first round of instructions.

Preventive Maintenance

Preventive maintenance is an inspection procedure at intervals measured in time, miles, hours, or gallons of fuel for a particular equipment class. The intervals should be determined based upon the manufacturers' recommended intervals for regular or severe duty maintenance. In addition, the Director of Transportation should take into consideration their experience, the job function, working conditions and previous repair records for the equipment class.

Original Equipment Manufacturers create a scheduled maintenance cycle for each type of equipment they sell. They design this maintenance cycle to protect the piece of equipment and minimize Original Equipment Manufacturers warranty involvement. It is BFD's responsibility to review the maintenance schedules and tailor them to their specific application.

Only shorten preventive maintenance service intervals for what the Original Equipment Manufacturers term as "severe duty" maintenance segments. Servicing non-severe duty equipment too often increases the unit operating cost and provides no benefit.

BFD is responsible for the effectiveness of its preventive maintenance program. Compare preventive maintenance checklists for each schedule to the previous one-two year maintenance history by class along with maintenance items found during the operator's inspection. Look for items that occur between scheduled preventive maintenance to determine if it warrants adding the item to the checklist or changing the preventive maintenance cycle.

Predictive Maintenance

Predictive maintenance is scheduling preventive maintenance inspection and component repair or replacement prior to failure.

Since planned component replacement is less costly than unscheduled repair visits, review maintenance costs by apparatus class and repair task for improvement. Review repair tasks in

[8] NFPA 1911, Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, 6.1.5.1, p1911-14.

cost descending order. Read work order comments for specifics regarding repairs and note the mileage. Take into consideration the environment where the vehicle works as the terrain or weather may affect maintenance. Review current component brands performance. A different brand or a higher quality of the same brand may last longer. Investigate each repair task in detail before taking action. Every action taken will further reduce maintenance costs and downtime. After instituting changes, track repairs to validate anticipated results and document the cost savings. Share the cost savings with BFD personnel to improve relationships and foster a team approach to good fleet management practices.

Look for similarities on specific components that may indicate design flaws or the need for additional technician training. Frequent breakdowns on specific units can indicate abuse or poor operator practices. Look for opportunities to lower maintenance costs and at the same time improve repair practices and operator care.

One of the highest maintenance costs for fleets is tires; therefore, take time researching this expense. The right quality tire for the job function will make a difference. Make sure tire ratings are correct for the weight of the vehicle fully loaded. Consider the tread design, ply rating, composition, and heat rating.

Review service calls, breakdowns, and towing expenses for possible predictive maintenance by unit and cause by month. BFD incurs additional costs to dispatch a vendor or an employee to perform on-site repairs or towing units to a repair facility. As instances are reviewed and appropriate action is taken, the number of instances should decrease, thereby reducing maintenance costs.

Findings

FCS evaluated 214 repairs for eight front line units and did not find serious issues such as repeat repairs or major apparatus damage. However, the records were not inclusive of all the work performed on those eight units. The repair history was comprised of paper invoices for vendor repair and did not include repairs made in the BFD shop. A considerable amount of maintenance history needed to evaluate a unit's history was missing. This is evident by the lack of PM inspection records and other key repair tasks.

Below is a repair listing for unit E-51, which is an E-One Protector. This unit's history reflects that between November 30, 2001, and March 11, 2009, there were 46 repairs during which the unit was used a total of 26,962 miles. Repairs are in chronological order and include the vendor, purchase order, tasks, and a brief description of the repairs.

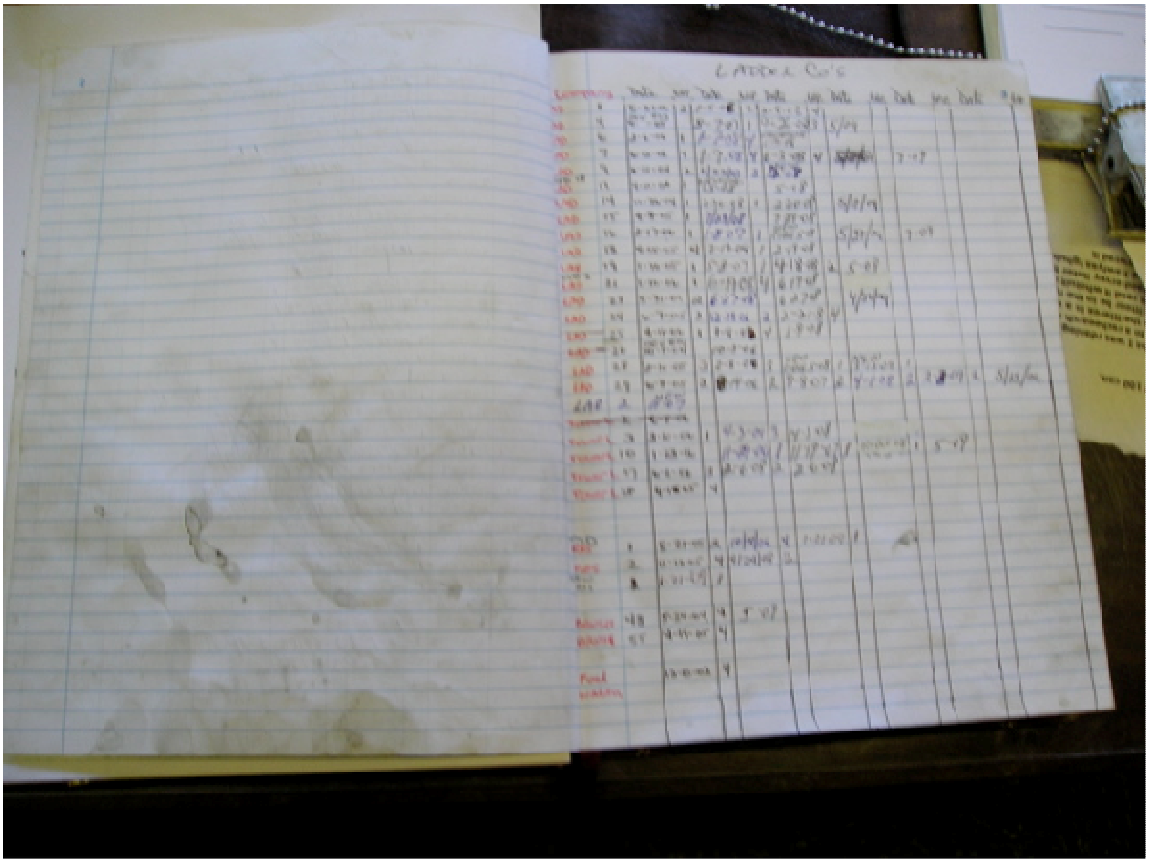
The City of Boston indicates it performed preventive maintenance service only twice over the seven-year period. The first service occurred May 9, 2005, and the second February 8, 2008. If these records portray an accurate account of preventive maintenance, the result puts the firefighters, the public, and the City at serious risk.

Unit E-51 Work History

Equipment Number	Repair (R) /PM (P)	Vendor	Purchase Order ID	Service Date	Meter	Task	Notes	Labor	Parts	Total
E-51	R	SUSPENSION SPECIALISTS, INC	361	11/30/2001	37,161	BRAKES/ STEERING	R&R C/R BEARINGS, REPL FRONT BRAKES, CALIPERS, ROTORS, WHEEL BEARINGS, SEALS	$507	$1,790	$2,297
E-51	R	GREENWOOD	6971-02B	12/21/2001	37,363	PUMP	R&R FILL NIPPLE, ADJ PUMP PACKING	$320	$0	$320
E-51	R	GREENWOOD	6971-02A	3/26/2002	38,666	BODY	REPAIR RIGHT SIDE BODY DAMAGE	$2,006	$477	$2,483
E-51	R	BAY STATE AUTO	377	12/27/2002	41,729	BRAKES/ SUSPENSION	REPL REAR BRAKE DISC PADS, REAR SEALS, HUBS, ROTORS, CALIPERS, CHAMBERS, DRAG LINK, FRONT SPRINGS AND BRACKETS	$1,529	$1,995	$3,524
E-51	R	BAY STATE AUTO	NONE	12/30/2002	0	STEERING	REPL STEERING BOX	$520	$1,487	$2,007
E-51	R	BAY STATE AUTO	307	12/5/2003	45,846	SUSPENSION	REPL LEFT REAR HELPER	$135	$231	$366
E-51	R	BAY STATE AUTO	357	1/20/2005	50,489	SUSPENSION/ STEERING	REPL 2 REAR SPRINGS, 2 SPRING SEATS, 4 HOSES, STEERING BOX	$1,193	$2,673	$3,866
E-51	P	CITY OF BOSTON	NONE	5/9/2005	0	PREVENTIVE MAINTENANCE		$0	$0	$0
E-51	P	CITY OF BOSTON	NONE	5/9/2005	0	STEERING	REPL STEERING BOX	$520	$1,487	$2,007
E-51	R	BAY STATE AUTO	412	1/10/2006	54,754	BRAKES	REPL 2 REAR SPRING BRAKE CHAMBERS	$371	$461	$832
E-51	R	GREENWOOD	18360	4/21/2006	0	PUMP	R&R DISCHARGE 1, 3, 4, DECK GUN VALVE	$663	$508	$1,171
E-51	R	GREENWOOD	18360	4/21/2006	0	PUMP	R&R INPUT SHAFT SEAL, OUTPUT SHAFT SEAL	$510	$67	$577
E-51	R	GREENWOOD	18360	4/21/2006	0	TANK	R&R MASTER DRAIN	$68	$0	$68
E-51	R	GREENWOOD	18360	4/21/2006	0	ELECT	R&R RELIEF VALVE CONTROL	$187	$205	$392
E-51	R	GREENWOOD	18360	4/21/2006	0	PUMP	R&R HAND THROTTLE ASSY	$68	$82	$150
E-51	R	GREENWOOD	18360	4/21/2006	0	BODY	STRAIGHTEN FRONT BUMPER/REPL R/SIDE WARNING LIGHT	$289	$99	$388
E-51	R	GREENWOOD	18360	4/21/2006	0	LUBE	R&R AUTO LUBE	$357	$117	$474
E-51	R	GREENWOOD	18360	4/21/2006	0	PUMP	3-STAGE TEST	$345	$0	$345
E-51	R	GREENWOOD	20805	8/1/2006	0	TANK	REBULT TANK FILL AND REAR DISCHARGE VALVES	$304	$138	$442

Equipment Number	Repair (R) /PM (P)	Vendor	Purchase Order ID	Service Date	Meter	Task	Notes	Labor	Parts	Total
E-51	R	GREENWOOD	20805	8/1/2006	0	MANIFOLD	REPLACE ROTTED MANIFOLD WITH STAINLESS	$1,017	$113	$1,130
E-51	R	GREENWOOD	RON	8/1/2006	0	PUMP	TIGHTENED PUMP PACKING	$162	$0	$162
E-51	R	GREENWOOD	06-1006	8/8/2006	0	MANIFOLD	REPL ROTTED MANIFOLD WITH STAINLESS	$0	$0	$0
E-51	R	GREENWOOD	06-1006	8/8/2006	0	TANK	REBUILT TANK FILL AND REAR DISCHARGE VALVES	$0	$0	$0
E-51	R	GREENWOOD	06-1006	8/8/2006	0	PUMP	TIGHTENED PUMP PACKING	$0	$0	$0
E-51	R	SCHLAGER'S TOWING SERVICE	141001	12/27/2007	0	TOW		$510	$0	$510
E-51	R	SUSPENSION SPECIALIST, INC	459	12/28/2007	62,784	SUSPENSION	U BOLTS BROKEN, TORQUE FASTENERS FRONT SUS OKAY	$85	$49	$134
E-51	P	CITY OF BOSTON	NONE	2/8/2008	0	PREVENTIVE MAINTENANCE		$0	$0	$0
E-51	P	CITY OF BOSTON	NONE	2/8/2008	0	STEERING	REPL STEERING BOX	$520	$1,487	$2,007
E-51	R	SCHLAGER'S TOWING SERVICE	141659	2/20/2008	0	TOW		$223	$0	$223
E-51	R	SUSPENSION SPECIALISTS, INC	595	3/6/2008	62,967	SUSPENSION /STEERING /BRAKES	R&R FRONT SPRINGS, KING PINS, BUSHINGS, BOTH TIE ROD ENDS, STEERING GEAR ASSY, FRONT ROTORS, PADS, CALIPER SLIDES, REPACK WHEEL BEARINGS, SEALS	$2,626	$5,227	$7,853
E-51	R	SCHLAGER'S TOWING SERVICE	145462	8/29/2008	0	TOW		$195	$0	$195
E-51	R	GREENWOOD	469222	9/22/2008	63,453	PUMP	R&R DISCHARGE	$1,525	$0	$1,525
E-51	R	GREENWOOD	469222	9/22/2008	63,453	ELECT	REPAIR PUMP PANEL LIGHTS	$85	$71	$156
E-51	R	GREENWOOD	469222	9/22/2008	63,453	PUMP	PACKING NUT	$572	$119	$691
E-51	R	GREENWOOD	469222	9/22/2008	63,453	PUMP	MASTER DRAIN R&R	$275	$0	$275
E-51	R	GREENWOOD	469222	9/22/2008	63,453	BRAKES	AIR LEAK	$339	$325	$664
E-51	R	GREENWOOD	469222	9/22/2008	63,453	PUMP	R&R PRIMER HANDLE	$325	$0	$325
E-51	R	FREIGHTLINER	469162	2/19/2009	64,123	BRAKES/ STEERING	ADJUST, BRAKES, CTR BEARING FOR DRIVE SHAFT HAS TO MUCH PLAY, PITMAN ARM LOOSE, ETC	$150	$0	$150
E-51	R	SUSPENSION SPECIALISTS, INC	572A	3/11/2009		BRAKES	INSPECTION/REPAIR	$2,322	$1,110	$3,432

FCS is recommending major changes to all aspects of the existing PM program. The current PM program encompasses tracking service in a log book pictured below:



Recommendations

Preventive Maintenance Scheduling, Criterion, and Algorithms

Earlier in our report, FCS provided explanations for preventive and predictive maintenance. Briefly, a preventive and predictive maintenance schedule anticipates when fluids and filters need to be changed and when components will need replacement prior to failure. Schedules are a combination of manufacturers' recommendations, actual work history, and the Director of Transportation's knowledge of the apparatus and its working environment.

The lack of maintenance history dictates that the preventive and predictive criterion and schedule be reviewed no later than 12 months after its inception. Review the program for all vehicle and apparatus classes annually, and every year thereafter to ensure safety and cost effectiveness. Every new model entering the fleet, and every existing model as it ages, may cause a modification to the program.

FCS has completed our recommended PM inspection component criteria. The PM inspection list, in its entirety, is in Appendix B. The list is actually part of a PM inspection database of items or components for inspection at various service intervals. The inspection intervals for components are determined by the activity of a company and are crosschecked with utilization data such as miles driven and hours in operation.

The core of the PM program is a scheduling system that applies component inspection based on actual calls performed annually and usage. The key of the scheduling system is a series of PM Status Codes. There are five status codes in all. Each status code has specially engineered PM inspection criteria. FCS recommends reviewing the PM criteria for effectiveness by evaluating the repairs performed during the prior year, by company.

FCS created PM codes based upon the number of annual calls by company. To understand the development of the scheduling methods and the inspection criteria, FCS created the charts below.

Chart 1 shows the annual number of calls by PM status code and chart 2 shows the percentage of calls.

Chart 1

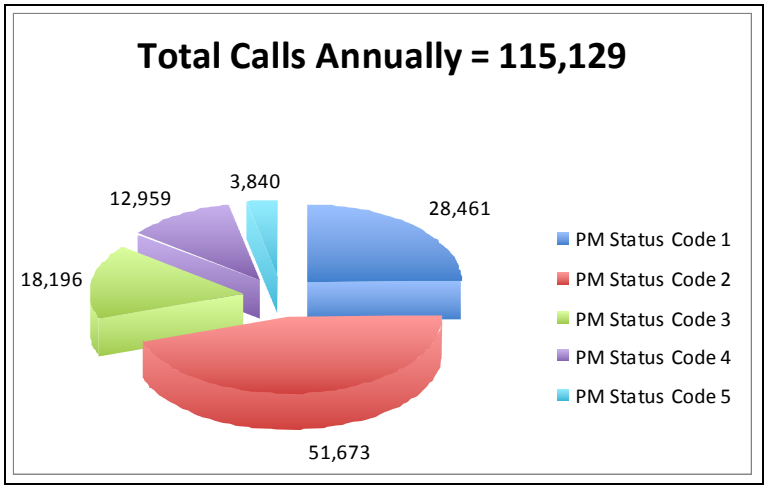


Chart 2

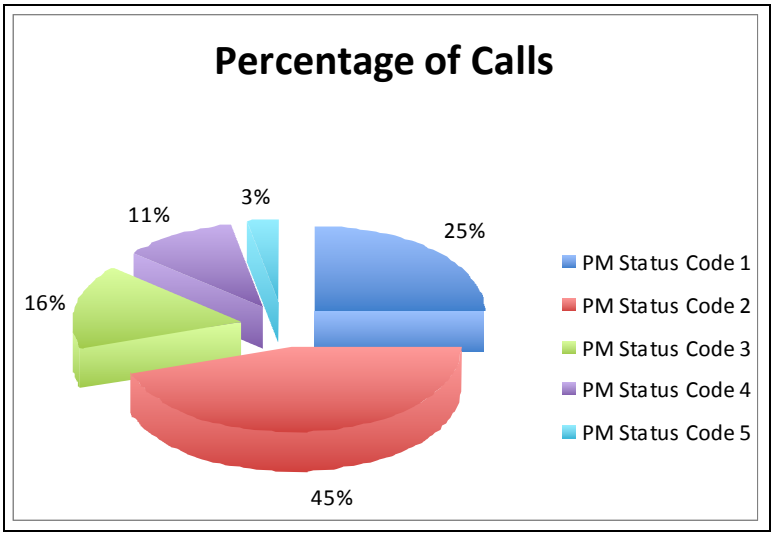


Chart 3 shows the number of units by PM status code and chart 4 the percentage of units.

Chart 3

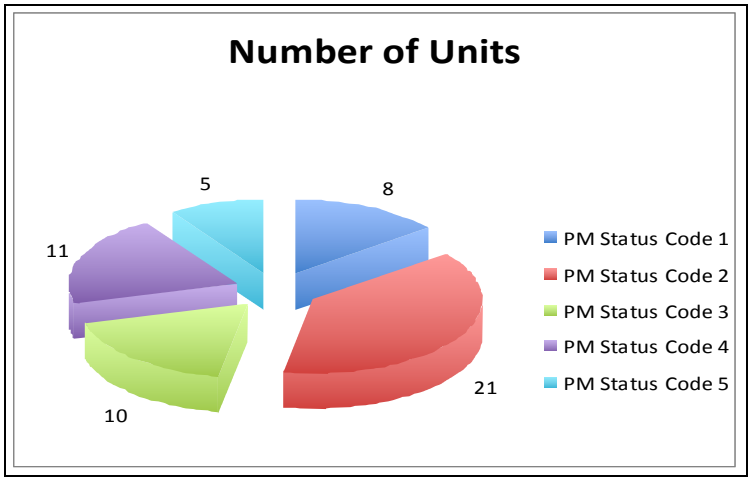
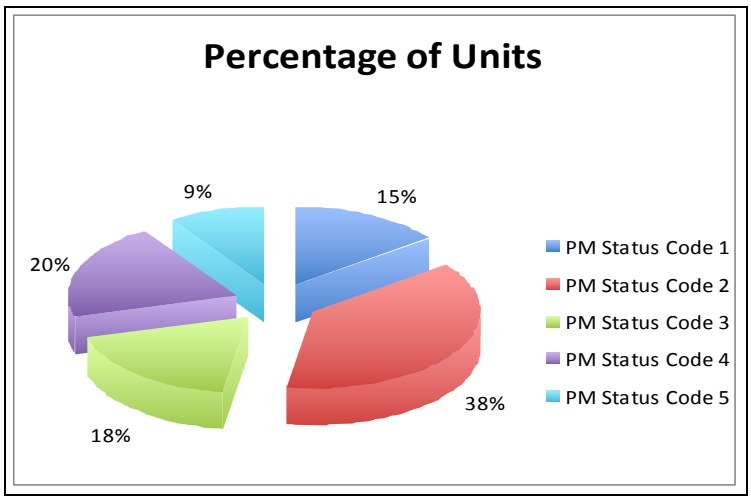


Chart 4

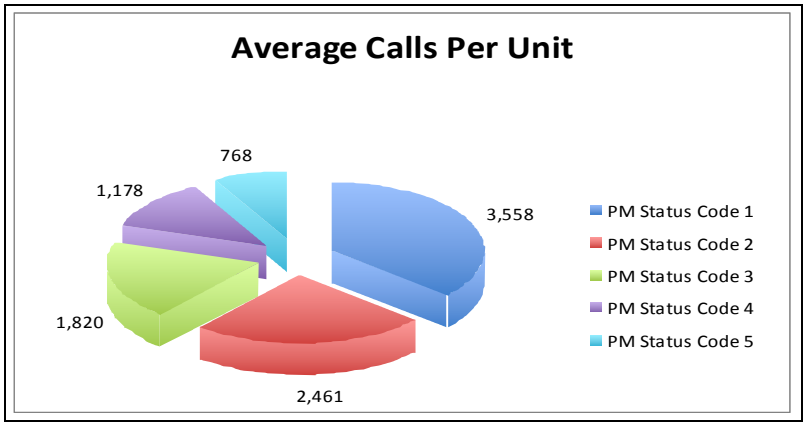


FCS created preventive maintenance scheduling based on call activity and usage in miles and hours of operation. What this means is that inspection criteria, which is the list of items or components being inspected, is different for low usage companies than for high usage or high call activity companies at any given interval. FCS recommends dividing PM inspection intervals into time intervals as follows:

- Weekly
- Monthly
- Quarterly
- Annually

Each of the intervals scheduled by Fleet Operations will be by unit number and location. A fully trained fleet technician will perform the weekly inspections at the firehouse. Monthly, quarterly, and annual inspections are scheduled services at the fleet shop, which will require a reserve unit. PM Status Code 1 receives the highest number of calls per unit, and so on.

Chart 5



Below are the PM Inspection Companies that reflect high activity and usage. Please note that most of the usage records are not current. Higher activity companies will receive a more detailed inspection of components.

PM Status 1 Companies

Company	PM Program	Total Runs Per Year	Average Annual Miles	Average Annual Hours
L26	PM Status Code 1	3,735		
TL17-L17		3,715	585	113
E37		3,674	710	91
L15		3,649	593	
L04		3,611	243	87
E33		3,563	87	57
E21		3,458	748	55
E07		3,056	585	42

The number of components inspected for PM status 1 companies are more than other companies or locations and include all aspects of the NFPA 1911 inspection requirements as well as other criteria found during FCS's evaluation of repair history.

PM Status 1 companies average 3558 calls per year.

PM Status 2 Companies

Company	PM Program	Total Runs Per Year	Average Annual Miles	Average Annual Hours
L23	PM Status Code 2	2,950	373	
E24		2,878	521	73
E41		2,858	593	69
E14		2,836	71	39
L14		2,753	438	35
L24		2,712	137	13
E04		2,703	469	78
L07		2,676	601	70
L06		2,624	329	31
E03		2,429	501	73
E10		2,389	419	48
E22		2,377	487	35
L18		2,327	542	84
L16		2,232	641	45
L29		2,228	308	58
E42		2,212	595	11
TL10-L10		2,174	595	
E53		2,168	720	68
E52		2,079	502	48
E18		2,043	491	54
E39		2,025	539	53

Fleet will review PM Status 2 companies on a quarterly basis for their total number of calls and usage. Each company's calls and usage will dictate the type of PM inspection they receive. The number of components inspected for PM Status 2 companies are less than PM Status 1, but still include all aspects of the NFPA 1911 inspection requirements as well as other criteria found during FCS's evaluation of repair history. Until a company's total calls and usage dictate receiving a PM Status 1 service, the units will continue to receive a PM Status 2 service. After a unit receives a PM Status 1 service, the original PM Status 2 is assigned and the cycle repeats. This same cycle applies to PM Status 3, 4, and 5 companies.

PM Status 2 companies average 2461 calls per year.

PM Status 3 Companies

PM status 3 companies average 1820 calls per year.

Company	PM Program	Total Runs Per Year	Average Annual Miles	Average Annual Hours
L11	PM Status Code 3	1,986	115	56
E16		1,940	571	62
E28		1,925	603	55
E17		1,921	522	62
TL3-L03		1,905	410	
E29		1,879	502	58
E05		1,798	504	64
L28		1,726	125	
L25		1,561	405	10
E48		1,555	378	54

PM Status 4 Companies

PM Status 4 companies average 1178 calls per year.

Company	PM Program	Total Runs Per Year	Average Annual Miles	Average Annual Hours
E30	PM Status Code 4	1,371	26	5
E50		1,310	387	48
TL2-L02		1,276	351	52
L01		1,275	517	40
E08		1,260	323	35
L09		1,153	344	52
L19		1,102	202	18
E20		1,095	354	
E02		1,053	258	33
L21		1,044	432	30
E55		1,020	53	17

PM Status 5 Companies

PM Status 5 companies average 768 calls per year.

Company	PM Program	Total Runs Per Year	Average Annual Miles	Average Annual Hours
E51	Scotia PM Status 5	871	419	51
E09		827	307	45
E56		818	197	30
E32		744	48	4
E49		580	440	30

Interim Inspection Process

With safety in mind, FCS has the following recommendations. FCS recommends that BFD not hire a full complement of technician's immediately to perform weekly, monthly, quarterly and annual inspections. Staff implementation should be phased in over a 3-year period. Until qualified personnel[9] are hired, FCS recommends the following:

1. Use contractors that have ASE Certified Heavy Technicians on staff, to perform weekly and monthly inspections. If time permits, the quarterly and annual inspections should follow.
2. Contract out all annual inspections ASAP. It is very important that the annual ladder and pump, as well as safety inspections, be completed each year.
3. Use existing certified fleet technicians to perform inspections.
4. Use a combination of the above to perform inspections.

FCS recommends that BFD fully implement the complete PM program and inspection process, as designed herein, using their certified technicians' within 3 fiscal periods following the date of this report. As older apparatus is replaced, and as the new PM program is implemented, staffing levels required can be reduced in future years. Incorporate into the weekly inspection process a review of Zonar daily reports. Relay instructions that discrepancies be reported to the Director of Transportation or his designee.

[9] Qualified personnel are defined as having an ASE Certified Heavy Technician Certification, an EVT Certification, or an OEM Certification. Hire personnel with a condition of employment stating that technicians must pass all missing ASE Certifications within 12 months after hire date and pass the full complement of EVT Certifications within 36 months of hire date.

Summary and Progression to Different PM Status Code

Average Number Of Calls Per Unit

PM Status Code 1	3,558
PM Status Code 2	2,461
PM Status Code 3	1,820
PM Status Code 4	1,178
PM Status Code 5	768

As noted above there is a considerable difference between each PM status code or company. This allows the PM program to be efficient and cost effective. By only inspecting those components that require extra attention, due to high use during a PM Status 1 service, the cost of a PM inspection will be limited to the actual wear and tear placed on the companies.

Fleet services, Director of Transportation, will monitor the progression from one PM status group to another on a quarterly basis.

Below is a chart showing by company, the call activity and usage. FCS is waiting for information to complete the chart.

Boston Fire Department
Company Activity Report July 1, 2008 - June 30, 2009

Company	PM Program	Total Runs Per Year	Average Annual Miles	Average Annual Hours	Fires	Building fires	Vehicle / Aircraft fires	Grass / outside fires	Overpressure Ruptures	Rescue / EMS	Hazardous Conditions	Service calls	Good Intent Calls	False Alarms	Natural Disasters
L26	PM Status Code 1	3,735			580	545	20	15	5	904	271	392	562	1,010	11
TL17-L17		3,715	585	113	427	394	15	18	7	1,023	194	412	385	1,265	2
E37		3,674	710	91	627	559	17	51	6	845	295	312	587	992	10
L15		3,649	593		442	421	10	11	4	994	205	375	480	1,131	18
L04		3,611	243	87	476	423	38	15	7	983	226	675	438	802	4
E33		3,563	87	57	473	415	12	46	9	966	222	300	472	1,115	6
E21		3,458	748	55	446	363	35	48	4	1,279	158	656	362	550	3
E07		3,056	585	42	402	353	10	39	3	856	180	275	327	1,011	2
Averages		**3,558**	**507**	**74**											
L23	PM Status Code 2	2,950	373		508	448	37	23	1	927	200	444	324	542	4
E24		2,878	521	73	577	512	28	37	2	895	215	397	314	476	2
E41		2,858	593	69	439	336	21	82	3	802	248	262	556	542	6
E14		2,836	71	39	462	399	19	44	2	877	223	450	351	467	4
L14		2,753	438	35	390	343	24	23	4	824	205	256	550	520	4
L24		2,712	137	13	183	160	10	13	3	881	163	332	430	718	2
E04		2,703	469	78	247	194	12	41	3	882	177	287	380	723	4
L07		2,676	601	70	340	283	40	17	1	829	153	534	378	438	3
L06		2,624	329	31	265	226	29	10	-	1,025	219	271	338	505	1
E03		2,429	501	73	278	241	15	22	7	983	139	347	261	399	15
E10		2,389	419	48	185	137	13	35	2	688	144	210	335	812	13
E22		2,377	487	35	408	382	9	17	3	864	198	201	232	467	4
L18		2,327	542	84	295	254	16	25	4	719	177	297	267	562	6
L16		2,232	641	45	321	282	18	21	4	833	226	303	206	338	1
L29		2,228	308	58	378	324	43	11	1	798	172	328	263	275	13
E42		2,212	595	11	395	324	16	55	1	773	144	178	294	426	1
TL10-L10		2,174	595		332	262	28	42	1	690	167	183	249	550	2
E53		2,168	720	68	348	288	21	39	6	840	246	208	204	314	2
E52		2,079	502	48	448	397	28	23	2	703	187	228	303	207	1
E18		2,043	491	54	306	257	21	28	-	778	160	179	294	325	1
E39		2,025	539	53	292	214	17	61	4	638	213	214	249	413	2
Averages		**2,461**	**470**	**52**											
L11	PM Status Code 3	1,986	115	56	214	193	8	13	4	535	122	195	273	639	4
E16		1,940	571	62	245	209	16	20	1	924	134	201	167	257	11
E28		1,925	603	55	315	234	28	53	2	706	151	146	184	418	3
E17		1,921	522	62	320	267	20	33	2	664	126	290	275	243	1
TL3-L03		1,905	410		158	126	21	11	2	280	121	262	255	827	-
E29		1,879	502	58	232	186	7	39	4	518	105	127	241	638	14
E05		1,798	504	64	138	89	11	38	3	689	160	310	215	219	64
L28		1,726	125		205	168	19	18	5	606	143	230	156	379	2
L25		1,561	405	10	123	103	10	10	3	597	158	161	184	335	-
E48		1,555	378	54	233	179	18	36	2	517	147	191	140	324	1
Averages		**1,820**	**414**	**53**											
E30	PM Status Code 4	1,371	26	5	139	103	10	26	2	519	150	97	151	310	3
E50		1,310	387	48	159	104	15	40	1	518	129	93	136	247	27
TL2-L02		1,276	351	52	141	114	11	16	2	395	130	171	173	264	-
L01		1,275	517	40	128	110	9	9	1	251	107	196	230	346	16
E08		1,260	323	35	165	135	11	19	1	241	109	148	247	331	18
L09		1,153	344	52	97	67	16	14	1	356	140	137	98	319	5
L19		1,102	202	18	121	96	14	11	2	326	75	186	181	210	1
E20		1,095	354		114	83	12	19	-	560	78	77	111	153	2
E02		1,053	258	33	117	89	8	20	2	274	72	173	180	234	1
L21		1,044	432	30	118	102	4	12	1	341	114	127	103	213	27
E55		1,020	53	17	114	90	2	22	2	428	69	166	114	126	1
Averages		**1,178**	**295**	**33**											
E51	PM Status Code 5	871	419	51	142	122	5	15	2	264	74	71	128	147	43
E09		827	307	45	134	99	2	33	1	295	83	93	88	131	2
E56		818	197	30	131	91	4	36	-	298	45	77	76	184	7
E32		744	48	4	61	39	5	17	1	265	78	64	63	152	60
E49		580	440	30	92	69	5	18	3	171	49	57	73	122	13
Averages		**768**	**282**	**32**											

Preventive Maintenance Cost Standards

FCS has developed time standards for the various levels of PM inspections. These standards are not tested and are dependent on the following:

- Local weather conditions
- Shop equipment availability
- Technician education and training

The following is a matrix containing time standards according to frequency of company activity and usage.

Time Standards

Status Level	Weekly	Monthly	Quarterly	Annually
PM Status 1	1.2	4	12	24
PM Status 2	1.2	3.5	12	24
PM Status 3	1	3	10	24
PM Status 4	0.6	3	10	24
PM Status 5	0.5	3	8	24

Time estimates are in hours and tenths of hours. This format coincides with most fleet management systems. As the annual inspection requires the same inspection level, the times are all the same.

The above time standards do not include the following:

- Travel time
- Shop clean up time
- Parts ordering
- Work order processing
- Time spent in communications with the operator or other Fire Department staff
- Time spent training on specialized components for inspection purposes
- Time preparing for inspection
- Delivery of unit to or from shop

The tasks above are indirect time activities and should be tracked and reported as accurately as possible. Indirect time is time spent by the technician not repairing fleet units. Direct time is time spent by the technician repairing fleet units. Hence, the time standards above are estimated direct time activities.

Time standards are for unit inspection only. Components found requiring replacement need additional time to complete the repairs.

Cost standards are determined using a timed flat rate established for PM inspection. Take the time standards above multiplied by the technician labor rate to determine the cost standard. A fleet best practice for a technician, which requires additional time to perform the inspection, would be to document the reasons on the work order.

Preventive Maintenance Responsibilities

Preventive maintenance program responsibilities are below. Assigning responsibility ensures good communication, resolution to issues, good documentation, accountability, and above all safety.

The term “written communication” includes E-mail, PDA devices, and any other means of communication. Archive communication for a minimum of one year or must meet local, state and national archive retention requirements, (which is every the longest period of time stipulated).

FCS recommends that BFD fleet services review and update established PM inspection procedures annually, at a minimum. A team of BFD personnel should perform the review process. The team should consist of:

- Director of Transportation
- Fleet Safety Coordinator
- Shop Supervisor
- Two Shop Technicians

Select two technicians by vehicle classification for each team so that all technicians have input in the process. The same teams will review and update the corresponding pre-trip inspection procedure.

The PM inspection performed by technicians may not remain the same from year to year. Review work orders for repairs that occur between PM inspections. Evaluate the repairs and add or modify the PM inspection as deemed necessary. New models and aging apparatus will affect the PM inspection program making continued review part of the process.

Responsibilities

Task	Person responsible for completion	Person(s) that requires communication	Type of communication	Time requirement / allotment	Expected results
Development of PM Schedule	Director of Transportation	Each Company Commander	Written	Weekly	Unit will be ready for inspection if not responding to a call.
PM work order processing and completion	Fleet Services Field Technician	Director of Transportation	Written	Daily	All labor and parts charges, meter readings and technician notes are complete.
Maintaining PM Status assignments	Director of Transportation	Each Company Commander, Fleet Services Field Technician, parts / inventory staff	Oral and written as needed	As occurred	Effected staff to make adjustments
PM inspections not completed	Fleet Services Field Technician	Director of Transportation	Written	Daily	Reschedule completion of PM inspection
Additional repair work required	Fleet Services Field Technician	Director of Transportation and parts staff	Written	As it occurs - immediately	Schedule repairs
Unit assigned as not mission ready - out of service	Fleet Services Field Technician - Operator - Company Commander	Director of Transportation	Oral and written as needed	As it occurs - immediately	Schedule repairs
Unit returned to active service Mission ready	Director of Transportation, Company Commander / Operator	Each Company Commander	Oral and written as needed	As it occurs - immediately	Unit is returned to service
Unit is down awaiting parts	Parts / Inventory staff	Each Company Commander, Fleet Services Field Technician and Director of Transportation	Written	As it occurs - immediately	Parts are ordered and staff is notified ASAP when parts are in
Operator caused failure	Fleet Services Field / Shop Technician	Each Company Commander and Director of Transportation	Written	As it occurs - immediately or when repair are completed	All data forwarded to training office and Deputy Commissioner
Mechanical failure	Operator	Fleet Services	Written	As it occurs - immediately	Scheduled for repair

Quality Assurance

FCS recommends that Boston fleet services perform random quality assurance inspections on internal PM inspections and work performed at outside vendors. The Director of Transportation and the Fleet Services Safety Coordinator should share this responsibility. The quality assurance inspection for the weekly inspection performed by shop technicians must be on-site at the house assigned to that company. The chart below outlines the recommended number of accountability assignments to use for internal shop PM inspections and outside vendor PM work.

Quality Assurance Inspection Required				
Status Level	Weekly	Monthly	Quarterly	Annually
PM Status 1	2	4	6	8
PM Status 2	1	2	3	6
PM Status 3	0	1	1	4
PM Status 4	0	1	1	4
PM Status 5	0	1	1	4

Most of the random inspections will occur at the fleet services facility. The apparatus and items selected for inspection should be at random and held in confidence from the technicians and companies. Inspections should take place prior to releasing the apparatus back into service. Document each inspection including findings.

PM Accountability

NFPA record accountability requirements are as follows:[10]

1. Records shall be maintained on the results of all apparatus inspections, maintenance requests, preventive maintenance, repairs, and testing.
2. Separate files shall be established and maintained for each individual fire apparatus.
3. All records shall be kept for the life of the vehicle and delivered with the vehicle upon transfer or change of ownership.

NFPA recommends that the AHJ should also identify the state and local regulations regarding record retention as a minimum.[11]

Fleet best practice follows the NFPA standard above. Assign unique asset numbers to fleet units, including apparatus, which remain with the unit forever. Using this method, BFD can always identify a specific fleet asset for any reason. Even when an apparatus is retired, the work order history and the apparatus information will remain in the fleet management system for as long as the computer system can store the information. Keeping this data is essential to determine an abundant amount of information, some of which follow:

- Future cost savings
- Deficiencies in certain models
- Annual maintenance costs
- Replacement cycles

The accepted method for storage and documentation on apparatus and other fleet assets for accountability is a computerized fleet management system. FCS understands that this will be in place soon.

Create policies and procedures describing how to document the process in the fleet management system. Communicate the process to fleet staff and enforce it.

[10] NFPA 1911, Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, 4.7.1-4.7.3, p1911-13.
[11] NFPA 1911, Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, A.4.7, p1911-59.

Fleet Computer Systems

Having an effective vehicle and apparatus management system is an essential tool to the BFD fleet operation. Without the right kind of data, BFD cannot make the right decisions regarding modifying the preventive maintenance program, or knowing when to replace vehicles and apparatus. BFD does not have a fleet management system and has purchased Asset Works Fleet Focus, Fleet Anywhere. Time is of the essence to implement the system in order to meet commitments on NFPA standards.

FCS supports the decision of the Fire Department using the City's existing fleet maintenance system. BFD should thoroughly examine the class code structure and PM scheduling function. These control the reporting and PM scheduling for all fire department vehicles and apparatus. Reports should be developed during system implementation to ensure receiving adequate data.

Class Codes

The National Association of Fleet Administrators (NAFA), which is a nationally recognized association for fleet managers, devised a coding system that will work for all fleet assets. Most fleets use this type of system to classify their equipment. FCS recommends that BFD consider this system or something similar. If interested, FCS can provide a copy of their codes and assist BFD with refining them.

Equipment Numbering

Each asset number in a fleet management system must be unique even after disposal. Therefore, using ladder or engine company numbers to identify apparatus becomes a problem. Store this identification in a different data field not used by the software program, which the BFD fleet operation can update as needed. Every fleet has a different numbering system, and other Boston departments using Fleet Anywhere will have suggestions.

Primary Meter Updates

Accurate meter readings determine:

- Utilization
- Replacement
- Warranty periods
- Preventive and predictive maintenance scheduling
- Measuring minor and major component replacement
- Miles per gallon
- Cost per mile

Upon implementing Fleet Focus, BFD will have one central management database to incorporate repair and fuel transactions with their respective meter readings. Since fuel transactions occur more often than repairs, they are vital to update the preventive maintenance program.

Fleet Focus, Fleet Anywhere's preventive maintenance report system, indicates equipment due and overdue for service based on a date, meter, and gallons. The preferred method is hour meter usage because components require replacement by meter usage. When equipment is not serviced in a timely fashion, it increases the opportunity for additional mechanical damage. This fact alone results in unnecessarily high maintenance costs and increased asset downtime.

Stress the importance of accurate meter readings by creating a meter policy. The Zonar handheld device requires a meter to perform an inspection. FCS recommends using the hour meter. Require apparatus and other vehicles not using the Zonar device to email the Director of Transportation daily meter updates by a certain time. The fleet office will enter the readings into the fleet management system in order to update meters for the PM inspection program.

Cost Management

The fleet operation must track parts, labor, and vendor repairs using standard repair tasks that provide cost by component and mechanical system detail. Without this level of cost tracking, fleet cannot identify problem areas for maintenance improvement, nor can they identify which manufacturer and model performs the best for equipment replacement planning. Fleets refer to this level of tracking as a repair task or job code.

Repair Task Codes

Assigning a repair task or job code to each part, labor entry, and outside vendor transaction allows repair categorization and provides a method to analyze cost detail. The most common code structure used by government fleets is from the American Trucking Association called the Vehicle Maintenance Reporting Standard codes (VMRS). Codes are extensive; however, fleet can choose the codes to best meet its needs.

Most fleets use six digits of the VMRS codes to track costs. The first three digits indicate the component system or group, such as 017 for tires. The next three digits specify the repair or replacement detail, such as front passenger side tire, rear driver side tire, etc.

Example: 017-101 (Repair group 017, Replacement detail 101)

FCS recommends using repair or job task standards to ensure the accuracy and consistency of repair costs used for analysis. A cost effective method of evaluating costs is by vehicle and equipment classification. Categorize vehicles and apparatus into class codes with similar characteristics. These similar characteristics can apply to the following:

- Preventive maintenance
- Replacement cycles
- Specifications
- Utilization

Separating vehicles and apparatus by classification provides average repair costs for a class group when looking at the big picture and the option of drilling down to an individual unit if needed.

To evaluate maintenance costs for replacement, separate maintenance costs for different makes and models within a specified classification to determine the most cost effective. In addition, examine costs by component system down to the individual component level. Evaluating this level of detail can provide information such as:

- The quality of the parts used
- Component system costs by make and model
- Technician efficiency

BFD cannot determine the overall cost effective make and model by class because this level of detail is currently not available. Evaluating costs by individual unit level at its assigned location can identify which makes and models perform the best in their respective environments by system and component. This will enable BFD to build the best equipment into a standard that will meet all working environments.

Repair Reasons

Routine fleet maintenance includes placing in service, normal wear and tear, accidents, vandalism, and abuse repairs. Inclusion of repairs for accidents, vandalism, and abuse skew cost analyses when comparing similar equipment between manufacturers and models for replacement. An accurate analysis uses costs that represent component replacement based on normal wear and tear over the lifetime of the asset. An efficient preventive and predictive maintenance program identifies components that need replacement prior to failure. This results in decreased maintenance costs and increased vehicle and apparatus uptime.

FCS recommends establishing additional repair reasons as needed to track maintenance activities accurately.

Fleet Management Reports

FCS recommends conveying actual vehicle status to BFD companies. A web site where they can view *soon due*, *due*, and *overdue* PM information for apparatus, is an effective communication tool.

In the future, when reports may become available, actual repair information will be useful. It is important for the Fleet Manager to point out savings to upper management.

The following is a list of recommended management reports for the BFD fleet office:

Recommended Daily Reports

- Units Down For Repair – List the date and time the unit went down for repair; unit number; company; reason(s) for repair (PM, front end noise, flat tire, etc.); estimated completion date; and the actual completion date and time. Update information concerning the repairs when they are complete.
- Service Call, Breakdown, and Towing Log – List the date and time the unit went down, unit number, company, operator, and reason. Update the log with actual repair information as needed.
- Meter Errors – Write an exception report listing work orders and fuel transactions where the meter is xxx hours lower or higher than the last meter. Verify the correct meter and update the software. Accurate meters are required for preventive maintenance, warranty, utilization, replacement, measurement of minor and major component replacement.

Recommended Semi-Monthly Reports

- Preventive Maintenance – Review the PM report for units *soon due*, *due*, and *overdue* for preventive and predictive maintenance for the month. Watch the due and overdue units to ensure service is completed prior to the end of the scheduling criteria, and send reminders to users as needed.

Recommended Monthly Reports

- Preventive and Predictive Maintenance – List units *soon due, due*, and *overdue* for service for the next month; the service level (Weekly, monthly quarterly or annually); and the mileage or date that the unit is due/overdue. Monitor reports to ensure that vehicles and apparatus are never overdue for service.
- Utilization – List low usage apparatus by section and class for the prior month.
- Accident, Damage in Operation, Vandalism, Abuse report – These are repair reasons for maintenance to review for action to produce a cost savings. Compare costs from year to year to validate if actions are producing a savings.
    - Accidents – Damage caused from a collision with another vehicle or object. Track incidents by driver, weather, time of day, location of damage, etc.
    - Damage in Operation – An example is a belt brakes while driving a vehicle. Is the repair and extended damage due to the driver not performing inspections or perhaps deterioration that should have been seen and corrected during the last preventive and predictive maintenance?
    - Vandalism – Destructive asset damage by the public. Does this occur in a certain area? Can a practice be changed to reduce instances?
    - Abuse – Component failure due to driver's action or non-action.
- Fuel MPG – List each apparatus and mpg for prior month based on detailed fuel transactions.
- Fuel MPG Detail – List each fuel transaction for the prior month and mpg by apparatus.
- Fuel by Operator – List detail fuel transactions for the prior month by driver.

Recommended Quarterly Reports

- Quarterly Utilization Report – List low usage apparatus with month by company and class, for the previous quarter.
- Quarterly Fuel Budget Report – List by company their fuel budget, percentage, and amount expensed year to date compared to budgeted percentage and amount year remaining.
- Quarterly Maintenance Budget Report – List by company their maintenance budget, percentage and amount expensed year to date compared to percentage and amount remaining for the year, (report may not be available soon).

Recommended Annual Reports

- Annual Utilization Report – List the previous 12 months by company, class, apparatus, month, and usage for each low usage unit.
- Annual Fuel Budget Report – List by company their fuel budget, percentage and amount expensed year to date compared to percentage and amount remaining.

- Annual Maintenance Budget Report – List by company their maintenance budget, percentage and amount expensed year to date compared to percentage and amount remaining, (report may not be available soon).
- Maintenance Cost by Class and Repair Group – List by class in descending cost order each repair group for the previous 12 months. Review costs for savings starting with highest costs. Compare to previous years' totals for improvement, (report may not be available soon).

As Needed

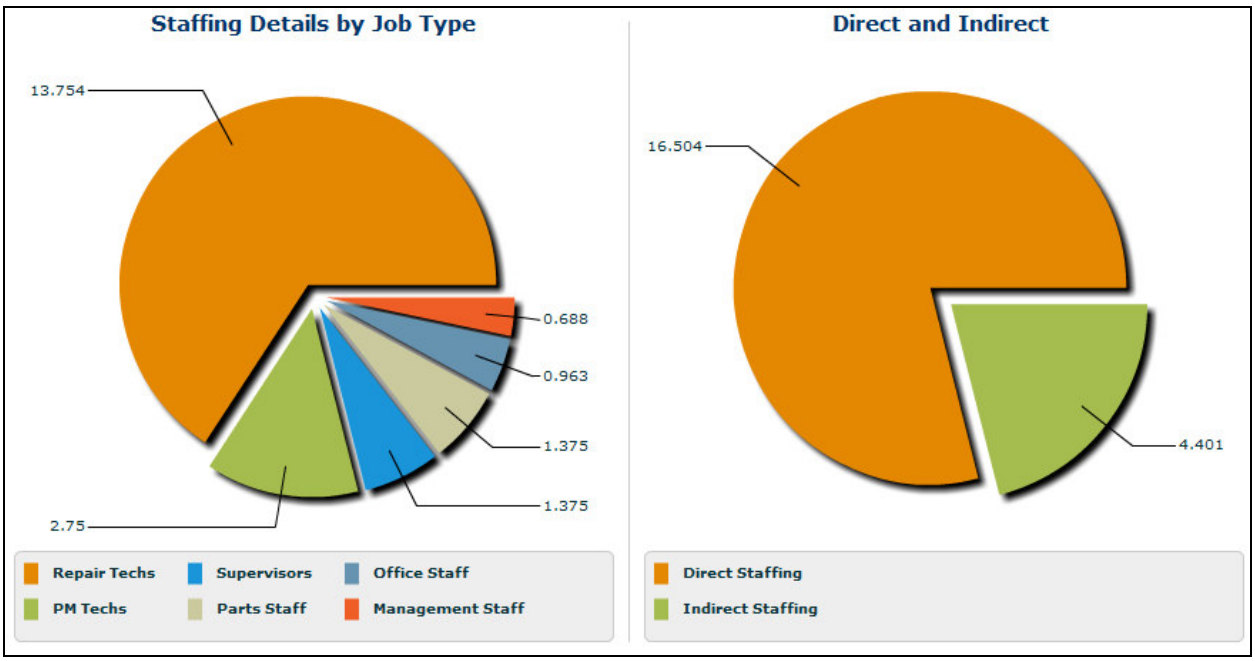
- Update (annually) preventive and predictive maintenance checklists by class.
- Add, delete or modify reports.
- Current Year-to-Date, Life-to-Date Vehicle and Apparatus Costs – List by company, class and unit, year-to-date and life-to-date usage, fuel gallons, fuel cost, repair costs, and cost per mile, (report may not be available soon).
- Vehicles and Apparatus Due For Replacement By Class – Forecast by class, company and unit, those assets projected to be due for replacement by age, mileage or LTD maintenance costs. List units within the class in descending order by mileage, (report may not be available soon).
- Maintenance Cost by Class and Repair Task Detail – Parameter to list one or more classes, the total cost for each task within one or more repair groups. Useful to determine which part of a repair group is causing the high maintenance cost, (report may not be available soon).
- Maintenance Cost Work Order Detail – Work order detail for class and repair task evaluation. List license number, work order number, mileage, technician comments, parts, labor, outside contractual cost, and total. Comments help to determine if component replacement is due to normal wear, abuse, warranty, manufacturer defect, or some other reason, (report may not be available soon).

Once reports are established, there may be occasional requests for a special report. To respond to the request in a timely manner, it is essential that the Director of Transportation, technicians, and other fleet staff have access to either build their own reports or have a person familiar with the database that can prepare queries or reports on demand.

Staffing Recommendations

According to FCS staffing calculations, to maintain the current fleet the correct number of fleet staff to maintain the fire apparatus, less the light and specialized equipment is below. Staffing is based on the quantity and average age of the fire apparatus and on technicians' having ASE Master Heavy and EVT Certification; not fire fighting staff. The number of reserve apparatus were also considered.

Fire Apparatus Staffing



According to our calculations, approximately 16 ASE-Certified and Emergency Vehicle Technician (EVT) certified shop and service truck positions are needed to maintain the fleet. As stated previously, FCS recommends that BFD not hire a full complement of personnel immediately. FCS recommends phasing in staff over 3 years. Additionally, as older apparatus are replaced and the PM program is fully implemented, staffing levels can be reduced in future years. An additional four to five positions such as parts staff, shop supervision, management, and office duties are required to provide support. FCS does not recommend filling the position from the firefighter pool, as the technology used in the construction of today's fire apparatus demands highly trained and certified shop technicians. This is a must if the new PM program is going to be successful. FCS looks to the airline industry as an example. The technicians working on today's aircraft are thoroughly trained and certified and they are not commercial airline pilots. While some airline employees may have a private pilot licenses, they do not operate on a commercial level. FCS recommends this type of certification level and competence.

ASE certified parts inventory staff is needed. The current inventory has no accountability or management. Not having the proper parts on hand will cause downtime to continue to be a serous issue. Some inventory, as noted below, far exceeds requirements and escalates fleet operating costs. An approach that some agencies have adopted is to contract out parts inventory management to a contractor such as NAPA. Known fleet agencies that have been successful in outsourcing parts are as follows:

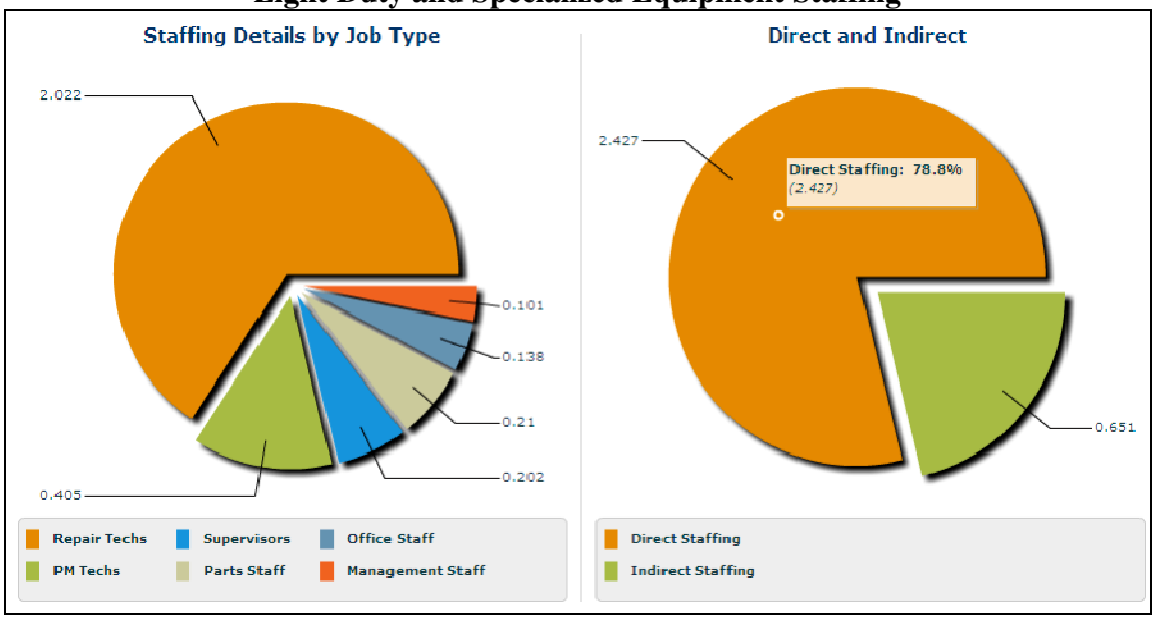
1. City of Chicago, contact Kevin Campbell, 1-312-744-5228.
2. City of Des Moines, contact Brian Bennett, 1-515-323-8940.
3. City of Cincinnati, contact Dave Cavanaugh, 1-513-352-3680.

Inventory above for new tires far exceeds the demand or use.

FCS noticed many other inventory items lying all over the place with doors wide open. A total, detailed, inventory management program is desperately needed.

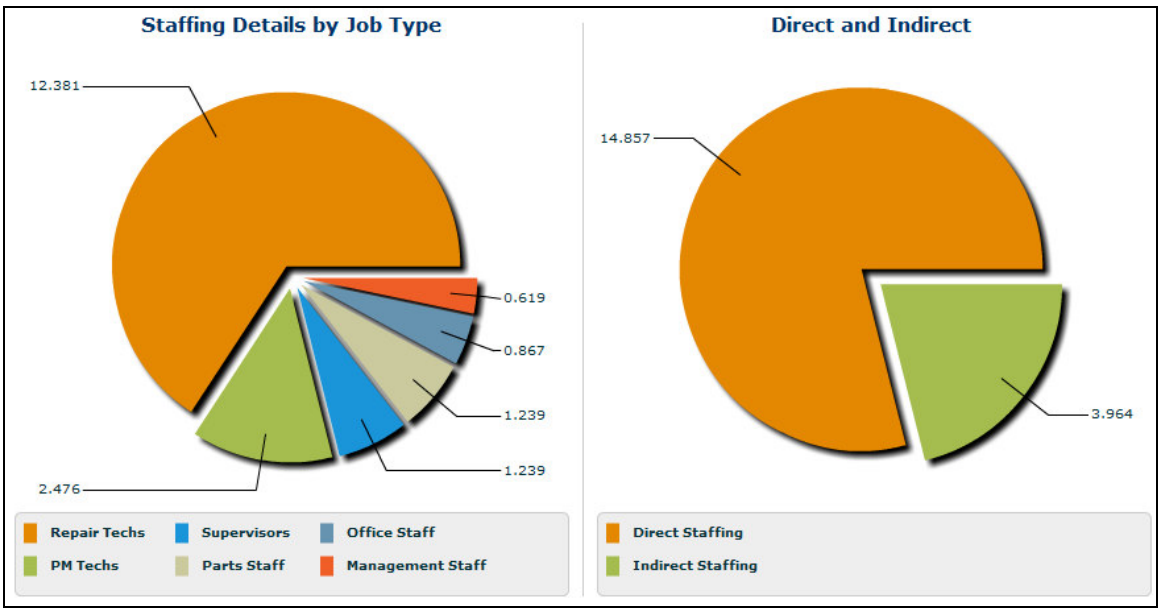
An additional staff of 2.5 shop staff and ½ administrative staff are needed for the light duty and specialized equipment as noted below. These staff members need only ASE light duty certification.

Light Duty and Specialized Equipment Staffing



The fire apparatus staffing levels below were determined by projecting the average age of the apparatus fleet by December 31, 2010. This includes delivery of 4 aerial ladders and 5 engines, keeping the same number of reserve units, and removing the oldest units from inventory. The overall age of the apparatus fleet will not significantly affect staffing levels. FCS's calculator shows reducing technician staff from 16 to 15 people.

Fire Apparatus Staffing on December 31, 2010



Facility Recommendations

FCS calculated the amount of shop space required to maintain and service the fire apparatus fleet including reserve units. The existing shop space that can be converted is approximately 23,700 s.f. including a machine shop and storage. FCS estimates 36,312 S.F. are needed. However, some of the shortage in square footage for shop space can be replaced with multiple shift assignments, such as a day and night swing shift.

By implementing a work shift environment (day and evening shifts), a smaller facility can be used. However, the parts inventory must be increased to provide parts to night shift employees.

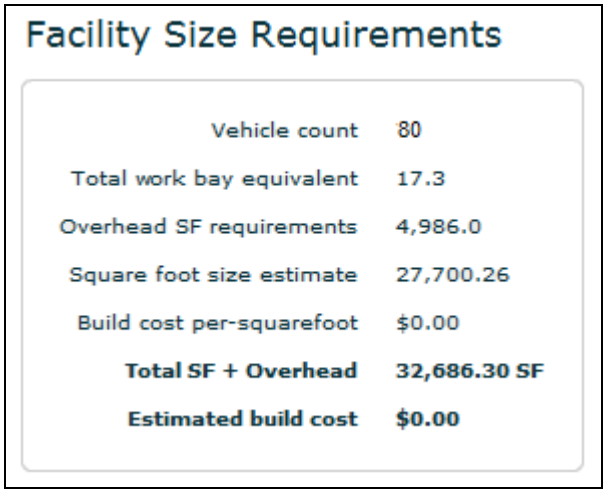
Facility Size Requirements

Vehicle count	80
Total work bay equivalent	19.2
Overhead SF requirements	5,539.1
Square foot size estimate	30,772.86
Build cost per-squarefoot	$0.00
Total SF + Overhead	**36,311.98 SF**
Estimated build cost	**$0.00**

The use of weekly on-site inspections and minor repairs will lessen the shop demand. The increase in PM activity will reduce future repairs. However, it normally requires one full complete cycle of all levels of PM inspection to realize the benefits from a good PM program. These benefits include reduced downtime, fewer road calls, reduced parts consumption, and a much safer fleet.

FCS highly recommends the houses with the most activity and usage be placed on top priority for completion of all levels of PM inspection.

FCS projected a decrease in facility size for the fire apparatus fleet for December 31, 2010. The calculations include receiving 4 engines and 5 aerial ladders, removing the oldest units from the fleet, and keeping the same number of reserve units. The resulting average age of the fleet does not significantly affect the facility size requirements.



Facility Size Requirements

Vehicle count	80
Total work bay equivalent	17.3
Overhead SF requirements	4,986.0
Square foot size estimate	27,700.26
Build cost per-squarefoot	$0.00
Total SF + Overhead	**32,686.30 SF**
Estimated build cost	**$0.00**

Appendix A – Daily Aerial Inspection

Fire Department: _____ Date: _____

Apparatus Number: _____ Station Number: _____

Mileage (Start) _____ Mileage (End) _____ Hours (Start) _____ Hours (End) _____

Inspector (print): _____ Signature: _____

Legend: X = Okay C = Corrected NA = Not Applicable OOS = Out of Service
R = Repair required (requires a comment in the comment section)

ZONE ONE:	ACTION		
	OKAY	REPAIR	OOS
Engine Compartment	✓	✓	✓
Check fluid levels *engine oil, transmission fluid, power steering, windshield washer, and coolant. Check fluids for contaminants such as oil in the coolant and antifreeze in the oil.*			
Check hoses *for leaking and damage.*			
Check drive belts *for tightness, cracks, and wear.*			
Check batteries *for fluid level, terminal corrosion, charge level, missing cell caps, and leaking cell. Make sure batteries are properly secured.*			

ZONE TWO:			
Cab Interior			
Check seat belts *for broken latches, frayed belts, missing belt, and functionality.*			
Check seats *for damage, cuts, tightness, and frame cracks.*			
Check gauges *for functionality and broken lenses. Check fuel level.*			
Check horn *for functionality.*			
Check switches *for functionality.*			
Check warning lights *for functionality.*			
Check mirrors *for cracks, chips, broken or loose brackets, adjustment, and cleanliness.*			
Check siren *for functionality. Check siren remote switches.*			
Check interior cab lights/fans *for functionality.*			
Start the engine. *Listen for unusual noises. Make sure parking brake is set and apparatus is in neutral.*			
Check steering wheel *for excessive play. It is considered excessive play when the steering wheel moves more than 10 degrees without moving the tires. Engine must be running.*			
Check air brake governor. *Place two wheel chocks on driver's side. Start engine to build air pressure. The governor should cut-out between 120-125 psi.. With the engine still running apply the service brake repeatedly until the compressor starts working. This should happen at approximately 100 psi.*			
Check the parking brake *system for air leakage. With the engine off release the parking brake to monitor air leakage. After the initial loss the system should NOT lose more than 2 psi per minute.*			
Check service brake *for air leakage. Apply the service brake and monitor the air loss. The apparatus should not lose more the 3 psi per minute after the initial loss. Listen for audible air leaks.*			

ZONE TWO cont'd:	ACTION		
	OKAY	REPAIR	OOS
Cab Interior	✓	✓	✓
Check low pressure warning system. *Apply the service brake repeatedly without the engine running. The low air warning light and buzzer should activate at 60 psi.*			
Check maxi-brake application valve *for functionality. Continue to apply the service brake without the engine running and note when the parking brake applies. The parking brake should set between 20-45psi.*			
Check the air compressor recovery rate. *Start the engine and bring the revolutions per minute to operating range. The air should build to 85-100 psi in 45 seconds. Any time lapse greater than that should be checked by a technician.*			
Check the parking brake. *Reapply the parking brake remove the chock blocks. Return to the cab start the engine, build the air pressure until the governor cuts out, shift into a low gear and apply gentle pressure against the parking brakes to assure the parking brake will hold.*			
Check service brakes. *With a fully charged air system; release the parking brake and pull the apparatus forward at approximately 5mph. Apply the service brakes firmly and notice any pulling to the left or right or delayed stopping.*			
ZONE THREE:			
Left Side Front (Driver's Side)			
Check mud flaps *for torn or missing flaps.*			
Check tires *for tread depth, cuts, bulges, and unusual wear patterns. Reset pressure to original equipment manufacturers' specification. Check valve stems for damage and missing caps. Assure tires are evenly matched.*			
Check wheels *for rim damage, missing or loose lug nuts, and rust trails on rims.*			
Check grab handles *to assure they are securely mounted.*			
Check body *for new damage such as scratches, dents, rust, cracks, and missing or bent parts.*			
Check doors *to assure they open, close, and latch properly. Also check for cracks, loose fasteners, broken straps, and worn hinges.*			
Check windows *for functionality, broken or chipped glass, and cleanliness.*			
ZONE FOUR:			
Left Side Rear (Driver's Side)			
Check mud flaps *for torn or missing flaps.*			
Check wheels *for rim damage, missing or loose lug nuts, and rust trails on rims.*			
Check axles *for fluid leaking.*			
Check body *for new damage such as scratches, dents and missing or bent parts rust and cracks.*			
Check tires *for tread depth, cuts, bulges, and unusual wear patterns. Reset pressure to original equipment manufacturers' specification. Check valve stems for damage and missing caps. Assure tires are evenly matched.*			
Check compartment doors *to assure they open, close, and latch properly. Also check for cracks, loose fasteners, broken straps, and worn hinges.*			
ZONE FIVE:	**ACTION**		

	OKAY	REPAIR	OKAY
Rear	✓	✓	✓
Check turn signal lights *for operation light out, light dim, light intermittent, lens cracked or missing.*			
Check tail lights *for operation light out, light dim, light intermittent, lens cracked or missing. Check license plate light for functionality.*			
Check brake lights *for operation light out, light dim, light intermittent, lens cracked or missing.*			
Check back-up lights *for functionality.*			
Check emergency flashers *for operation.*			
Check emergency lights *mounted on the rear of the truck for functionality.*			
Check all marker lights/reflectors *for functionality.*			
Check tailboard *for accident damage, cracks, and tightness.*			
Check rear of body *for accident damage such as scratches and dents. Check for cracks.*			
Check access doors *to assure they open, close, and latch properly. Also check for cracks, loose fasteners, broken straps, and worn hinges. Assure all items mounted to the tail board are properly secured.*			
ZONE SIX:			
Right Side Rear (Passenger's side)			
Check mud flaps *for torn or missing flaps.*			
Check tires Check tires *for tread depth, cuts, bulges, and unusual wear patterns. Reset pressure to original equipment manufacturers specification. Check valve stems for damage and missing caps. Assure tires are evenly matched.*			
Check wheels *for rim damage, missing or loose lug nuts, and rust trails on rims.*			
Check axles *for fluid leaks.*			
Check body *for new damage such as scratches, dents and missing or bent parts, rust and cracks.*			
Check compartment doors *to assure they open, close, and latch properly. Also check for cracks, loose fasteners, broken straps, and worn hinges.*			
ZONE SEVEN:			
Right Side Front (Passenger's side)			
Check seat belts *for broken latches, frayed belts, missing belt, and functionality.*			
Check seats *for damage, cuts, tightness, and frame cracks.*			
Check mud flaps *for torn or missing flaps.*			
Check wheels *for rim damage, missing or loose lug nuts, and rust trails on rims.*			
Check tires *for tread depth, cuts, bulges, and unusual wear patterns. Reset pressure to original equipment manufacturers specification. Check valve stems for damage and missing caps. Assure tires are evenly matched.*			
Check body *for new damage such as scratches, dents and missing or bent parts rust and cracks.*			
Check grab handles *to assure they are securely mounted.*			
Check doors *to assure they open, close, and latch properly. Also check for cracks, loose fasteners, broken straps, and worn hinges.*			
Check windows *for functionality, broken or chipped glass, and cleanliness.*			
ZONE SEVEN cont'd:	**ACTION**		
	OKAY	**REPAIR**	**OOS**

Right Side Front (Passenger's side)	✓	✓	✓
Check spot light *for functionality.*			
ZONE EIGHT:			
Front			
Check head lights *for functionality. Assure high beams and dimmer switch is functioning properly.*			
Check turn signals *for operation, light out, light dim, lens cracked or missing.*			
Check body *for new damage such as scratches, dents and missing or bent parts rust and cracks.*			
Check emergency flashers *for operation.*			
Check emergency lights *mounted on the front of the truck for functionality.*			
Check glass *for delaminating, cracks, chips, leaks, and cleanliness.*			
Check windshield wipers *for functionality, worn blades, and missing pieces.*			
ZONE NINE:			
Underside (Front)			
Check springs *for leaf damage, cracks, alignment, missing or loose bolts, and broken or cracked hangers. Check for lubrication at spring pins.*			
Check driveline *for leaks and damage to the engine and automatic transmission..*			
Check radiator *for leaks, debris, and damage. Visually inspect front of radiator through the grill for debris.*			
Check front brakes. *The slack adjusters should not travel more the .75 inches. This can be accomplished by applying the service brake and measuring the length of the actuator shaft or by manually moving the actuator shaft.*			
Check air leaks *audible.*			
Check hoses *for frayed or kinked hoses.*			
Check U-bolts *for abnormalities.*			
Check frame/cross members *for cracks. Cracks usually cause rust trails.*			
Check steering *for loose, worn, bent or damaged linkage. Items to check are steering gear box, pitman arm, drag link, tie rod, tie rods, and kingpins.*			
Check wires *for loose, frayed, or corroded wires and any other parts not securely fastened to the chassis.*			
Check for abnormalities. *Check under the vehicle for abnormalities.*			
ZONE TEN:			
Underside (Rear)			
Check rear brakes. *The slack adjusters should not travel more the 1.25 inches. This can be accomplished by setting the parking brake and measuring the length of the actuator shaft.*			
Check the exhaust system *for leaks, looseness, and damage. Also check for excessive smoke while running.*			
Check springs *for leaf damage, cracks, alignment, missing or loose bolts, and broken or cracked hangers. Check for lubrication at spring pins.*			
Check driveline *for leaks and damage to the pump transmission and differential. Visually inspect the drive shaft for abnormalities.*			
ZONE TEN cont'd:	**ACTION**		
	OKAY	**REPAIR**	**OOS**
Underside (Rear)	✓	✓	✓

Check fuel tank/lines *for leaks, loose mounting straps, missing bolts, and fuel cap.*			
ZONE ELEVEN:			
Aerial Device (Inspected weekly)			
Check hydraulic tank *for fluid level, leaks, and high pressure hose condition.*			
Check cylinders *for leaks, abrasions, dents, pits, and abnormalities.*			
Check ladder *for visible cracks, dents, loose rungs, missing rung covers, lubrication, dirt and other abnormalities.*			
Check outriggers *for leaks, and functionality. Also check warning lights and override system.*			
Check auxiliary override system *for operation.*			
Check ladder operation *Fully extend ladder, rotate 360 degrees, and return to cradle. Time this operation and record for future reference. Also record pressures. Check throttle to assure it accelerates properly during ladder test. After performing rotation test raise the ladder and visually inspect for twist. Check for turntable play. Inspect rotation gears.*			
Check ladder/cylinder locks *for operation.*			
Check safety devices *for abnormalities and missing parts.*			
Check controls *for functionality and smooth operation.*			
Check hydraulic tank *for fluid level, leaks, and high pressure hose condition.*			

Comments:
NOTE: By signing this report it demonstrates you reviewed the previous day's report and approve as to condition and repairs of the truck.

Appendix B – Preventive and Predictive Maintenance

System	Inspection Item	Weekly Inspection to be performed by Fleet Technician on site at house.	Monthly Inspection to be performed by Fleet Technician on site at house.	Quarterly Inspection to be performed by Fleet Technician at fleet garage. Unit will be out of service.	Annual Inspection to be performed by Fleet Technician at fleet garage. Unit will be out of service.	Special Instruction
Aerial	CLEAN, INSPECT AND LUBRICATE AERIAL					10.2 The aerial device shall be inspected in accordance with Chapter 19. 10.3 The aerial device and its associated systems shall be maintained in accordance with the aerial device manufacturer's recommendations'. 10.4.1 If the aerial device has an air storage system, the air storage tanks shall be inspected to verify that hydrostatic test dates are within the periods specified by the manufacturers and the applicable governmental agencies. 10.4.2 Test reports shall be reviewed to verify that the air has been tested and is in accordance with NFPA 1989, Standard on Breathing Air Quality for Fire and Emergency Services Respiratory Protection.
Aerial	CHECK MANUFACTURER'S INSTRUCTIONS					19.1.4.1 Since each manufacturer's unit will be somewhat different, specific attention shall be given to the manufacturer's instructions concerning periodic maintenance and inspection checks.
Aerial	CHECK TORQUE ON AERIAL TURNTABLE BOLTS					19.8.4.1 The rotation-bearing mounting bolts shall be inspected as follows: (1) Inspect all accessible bolts for proper grade and installation as specified by the apparatus manufacturer. (2) Using a properly calibrated torque wrench, verify that the bolt torque on all accessible bolts meets the apparatus manufacturer's specifications. (3) (+) Inspect all accessible bolts for internal flaws.
Aerial	CHECK AERIAL BED REST ALIGNMENT MARKER					19.8.4.22 When the aerial device is stowed in the cradle, the presence and accuracy of the turntable alignment indicator shall be verified.
Aerial	CHECK, LUBRICATE, AND ADJUST AERIAL PULLEYS AND CABLES					19.9.7.10, 19.9.8.9 All cables, chains, and rods shall be inspected for signs of wear and for proper adjustment. 19.9.7.11, 19.9.8.9 All sprockets, pulleys, and hooks shall be inspected for lubrication, signs of wear, distortion, and proper operation.
Aerial	CHECK AERIAL CRADLE BOLTS AND RAM PINS					As recommended by the manufacturer.
Aerial	CHANGE AERIAL HYDRAULIC FILTER(S)					As recommended by the manufacturer.
Aerial	CHANGE AERIAL HYDRAULIC FLUID					As recommended by the manufacturer.
Aerial	CLEAN RELIEF VALVE SCREEN					As recommended by the manufacturer.
Aerial	CHECK OUTRIGGERS - MOUNTING AND OPERATION CHECK FOR LEAKS					Follow 19.8.5 Visually inspect for defects and welds for fractures. If bolted, inspect bolts for proper fastener grade and torque. Inspect lines and hoses for kinks, cuts, abrasions, and leakage at connectors and fittings.
Aerial	INSPECT AND LUBRICATE ALL PIVOTS AND PINS					Follow manufacturer's recommendations. Inspect all pivots and pins for wear, flaws, proper installation, lubrication, operation, and retention.

System	Inspection Item	Weekly Inspection to be performed by Fleet Technician on site at house.	Monthly Inspection to be performed by Fleet Technician on site at house.	Quarterly Inspection to be performed by Fleet Technician at fleet garage. Unit will be out of service.	Annual Inspection to be performed by Fleet Technician at fleet garage. Unit will be out of service.	Special Instruction
Aerial	INSPECT AERIAL RUNG COVERS					Follow manufacturer's recommendations. Inspect for straightness, ladder lock damage, damaged or loose rung covers and run cap castings, and signs of cracks or missing rivets, if applicable.
Aerial	INSPECT AERIAL SLIDE BLOCKS, ROLLERS					Follow manufacturer's recommendations. Inspect slide blocks for proper installation and signs of wear. Inspect rollers for proper lubrication and operation and signs of wear.
Aerial	INSPECT AERIAL TURNTABLE					Follow manufacturer's recommendations. See 19.8.4.
Aerial	CHECK AERIAL HOLD DOWN DEVICE					Visually inspect for defects and proper operation following the manufacturer's recommendations. Inspect all welds. See 19.5, Weld Inspection.
Aerial Test	ANNUAL AERIAL TEST				X	19.1.1 All inspections and tests specified in this standard, except those specifically designated as nondestructive test (NDT), shall be conducted at the following times: (1) At least annually (2) After major repairs or overhaul (3) Following the use of the aerial device when the aerial device could have been subjected to unusual operating conditions of stress or load (4) When there is reason to believe that usage has exceeded the manufacturer's recommended aerial device operating procedures.
Aerial Test	NDT AERIAL TEST				X	19.1.2 The inspections and tests specified in this chapter as NDT shall be conducted as follows: (1) At least every 5 years (2) Whenever visual inspection or load testing indicates a potential structural or safety problem (3) When there is a desire to further confirm continued operational safety. Follow test in Chapter 19. See Annex A for additional information.
Air Conditioning	CHECK A/C AND HEATER OPERATION					8.11 All electrical accessories including, but not limited to, the following shall be diagnostically checked: (1) Heater and defroster (2) Air-conditioning system (3) Windshield wipers and washers (4) Instrumentation (5) Traffic preemption (6) Other electrical accessories on the apparatus not otherwise specified in 8.11(1) through (5).
Air Intake	INSPECT AIR INTAKE SYSTEM					7.7.1 The engine air intake system shall include, but not be limited to the following: (1) Air cleaner element (2) Piping (3) Turbocharger (4) Air after-cooler (5) Intercooler (6) Air-to-air cooler (7) Blower (8) Ember separator 7.7.2 The engine air intake system shall be maintained in accordance with the manufacturer's severe service recommendation. If no severe service recommendation exists, the shortest service interval recommended by the engine manufacturer, based on time or mileage, shall be followed. 7.7.3 Where engines are equipped with a charged air after-cooler, it shall be inspected visually for outward signs of damage or deformation. 7.7.4 All hoses, tubes, and fittings shall be inspected for deformation and leakage. 7.7.5 The airflow shall be monitored for restriction greater than that recommended by the engine manufacturer.
Air Intake	CHANGE AIR FILTERS					7.7.2 The engine air intake system shall be maintained in accordance with the manufacturer's severe service recommendation. If no severe service recommendation exists, the shortest service interval recommended by the engine manufacturer, based on time or mileage, shall be followed.

System	Inspection Item	Weekly Inspection to be performed by Fleet Technician on site at house.	Monthly Inspection to be performed by Fleet Technician on site at house.	Quarterly Inspection to be performed by Fleet Technician at fleet garage. Unit will be out of service.	Annual Inspection to be performed by Fleet Technician at fleet garage. Unit will be out of service.	Special Instruction
Air Intake	CHECK AND CLEAN AIR INTAKE SPARK ARRESTER					7.7.2 The engine air intake system shall be maintained in accordance with the manufacturer's severe service recommendation. If no severe service recommendation exists, the shortest service interval recommended by the engine manufacturer, based on time or mileage, shall be followed.
Air Intake	INSPECT CRANK CASE BREATHER TUBES					7.7.2 The engine air intake system shall be maintained in accordance with the manufacturer's severe service recommendation. If no severe service recommendation exists, the shortest service interval recommended by the engine manufacturer, based on time or mileage, shall be followed.
Air Intake	INSPECT ENGINE DRIVE BELT(S)					7.7.2 The engine air intake system shall be maintained in accordance with the manufacturer's severe service recommendation. If no severe service recommendation exists, the shortest service interval recommended by the engine manufacturer, based on time or mileage, shall be followed.
Air Intake	INSPECT TURBO CHARGER CONNECTION					7.7.2 The engine air intake system shall be maintained in accordance with the manufacturer's severe service recommendation. If no severe service recommendation exists, the shortest service interval recommended by the engine manufacturer, based on time or mileage, shall be followed.
Air-Powered Accessories	CHECK WINDSHIELD WASHER, WIPER OPERATION					7.13 All chassis air-powered accessories including, but not limited to, the following shall be diagnostically checked: (1) Air horn (2) Windshield wiper and washer (3) Air-ride seats (4) Air-powered steps and cab tilting systems (5) Fire pup shift and valves.
Alternator Test	ANNUAL ALTERNATOR TEST				X	17.5 Tests shall be conducted at least annually and whenever major repairs or modifications to the low voltage electrical system or any component of the system have been made. Follow alternator test 17.5. This test verifies the output of the alternator and the alternator wiring.
Apparatus Lighting	CHECK HEADLIGHT ADJUSTMENT					8.9 All fire apparatus lighting including, but not limited to, the following shall be inspected for security of mounting and deformation and shall be diagnostically checked: (1) Headlights (2) Marker lights (3) Clearance lights (4) Turn signals and hazard lights (5) Brake lights (6) Backup lights (7) Dash lights (8) Other fire apparatus lighting equipment on the apparatus not otherwise specified in 8.9(1) through (7).
Apparatus Lighting	CHECK INSTRUMENT PANEL LIGHTS, GAUGES					8.9 All fire apparatus lighting including, but not limited to, the following shall be inspected for security of mounting and deformation and shall be diagnostically checked: (1) Headlights (2) Marker lights (3) Clearance lights (4) Turn signals and hazard lights (5) Brake lights (6) Backup lights (7) Dash lights (8) Other fire apparatus lighting equipment on the apparatus not otherwise specified in 8.9(1) through (7).
Apparatus Lighting	CHECK OEM LIGHT OPERATION					8.9 All fire apparatus lighting including, but not limited to, the following shall be inspected for security of mounting and deformation and shall be diagnostically checked: (1) Headlights (2) Marker lights (3) Clearance lights (4) Turn signals and hazard lights (5) Brake lights (6) Backup lights (7) Dash lights (8) Other fire apparatus lighting equipment on the apparatus not otherwise specified in 8.9(1) through (7).
Automatic Electrical Load Mgmt System	TEST AUTOMATIC ELECTRICAL LOAD MANAGEMENT SYSTEM					8.7.1 If so equipped, all components of the automatic electrical load management system including, but not limited to, the following shall be inspected for security of mounting and deformation: (1) Electronic hardware (2) Associated wiring and cables (3) Relays, controls, and indicators (4) Low voltage warning devices. 8.7.2* The system shall be checked for activation and operation of low voltage warning devices in accordance with the manufacturer's recommendations. See A.8.7.2 for test.
Axle	CHECK AND LUBRICATE KING PINS OR BALL JOINTS					7.3.1 All axle components including, but not limited to, the following shall be inspected for security of mounting, structural integrity, deformation, abnormal wear, and leakage, shall be functionally operated, and shall be lubricated: (1) Ball joints (2) King pins (3) Spindles and bushings (4) Attaching hardware (5) Axle beams and housings (6) Axle shafts (7) Axle power dividers (8) Differentials and controls (9) Two-speed axle shift units (10) Upper and lower control arms.
Axle	CHECK TANDEM AXLE SPACING AND ALIGNMENT					Check axles for tightness and leaks
Axle	CHECK DIFFERENTIAL FLUID LEVEL, CLEAN VENTS					Check differential fluid level and fill or replace following manufacturer's recommendations.
Axle	TWO SPEED AXLES AND CONTROLS					Inspect for security of mounting, structural integrity, deformation, abnormal wear, leakage, and functional operation.

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Axle	UPPER AND LOWER CONTROL ARMS					Inspect for security of mounting, structural integrity, deformation, abnormal wear, leakage, and functional operation.
Battery Charger/Conditioner Test	ANNUAL BATTERY CHARGER/CONDITIONER TEST				X	17.7 Tests shall be conducted at least annually and whenever major repairs or modifications to the low voltage electrical system or any component of the system have been made. If the apparatus is equipped with a battery charger or conditioner, it shall be tested as described in 17.7.2 and 17.7.3.
Battery Test	ANNUAL BATTERY LOAD OR CONDUCTIVITY TEST				X	17.3 Performance tests shall be conducted at least annually and whenever major repairs or modifications to the low voltage electrical system or any component of the system have been made. 17.3.2 Each battery shall be individually tested using either the procedure specified in 17.3.2.1 or 17.3.2.2. A.17.3.2.1 Conductivity testing is preferred to load testing because it does not stress the battery, it is a more accurate indication of the state of health of the battery, and it provides values that can be recorded and tracked for trend analysis. Follow Chapter 17 for test.
Body	SERVICE ROLL UP DOORS/TRACKS					7.15.1 All compartments and storage areas shall be inspected for structural integrity, deformation, and leaks. 7.15.1.1 Hinges, latches, and seals shall be diagnostically checked and shall be lubricated. 7.15.1.2 Doors shall be diagnostically checked for correct operation and position.
Body	PERFORM BODY LUBRICATION SERVICE					7.15.1.1 Hinges, latches and seals shall be diagnostically checked and shall be lubricated.
Body	INSPECT DOOR LATCHES, HINGES, LOCKS					7.15.1.1 Hinges, latches, and seals shall be diagnostically checked and shall be lubricated. 7.15.1.2 Doors shall be diagnostically checked for correct operation and position. 7.15.1.3 The hazard warning light and interlocks associated with, but not limited to, the following conditions shall be diagnostically checked: (1) Open passenger or equipment compartment doors (2) Ladder or equipment rack not in the stowed position (3) Deployed stabilizer system (4) Extended powered light tower.
Body	INSPECT MOUNTED STEPS, PLATFORMS, HANDRAILS AND LADDERS.					7.15.2 All steps, platforms, handrails, and access ladders shall be inspected for security of mounting, structural integrity, and deformation. 7.15.2.1 All slip resistant surfaces shall be inspected for security of mounting and condition. 7.15.2.2 All mechanical steps shall be diagnostically checked, and shall be lubricated.
Body	INSPECT FINISHES, STRIPING, SIGNS AND LABELS					7.15.4* All finishes and reflective striping shall be inspected for defects, corrosion, and damage. 7.15.5* Where required, all signs and labels shall be inspected for their presence and any defects, corrosion, and damage. If apparatus does not have reflective striping, or warning labels, consider adding in accordance with applicable sections of current NFPA 1901.
Body	INSPECT POWERED EQUIPMENT RACKS					7.16.1 All locks used to hold equipment racks in the road travel position and all interlocks to prevent operation of equipment racks when the fire apparatus is in motion shall be inspected for security of mounting and deformation. 7.16.2 Racks and interlocks shall be diagnostically checked. 7.16.3 All warning lights and visual signals for the equipment racks shall be diagnostically checked. 7.16.4 Reflective striping or reflective paint shall be inspected for defects, corrosion, and damage. 7.16.5 Equipment-holding devices shall be inspected for security of mounting and deformation, shall be diagnostically checked, and shall be lubricated.
Body	INSPECT FOR SHIELDS AND GUARDS					Inspect that all shields and guards are installed and tighened properly.
Body	WAX COMPLETE EXTERIOR OF UNIT					Wax body.

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Brake	INSPECT ACCESSORIES CONNECTED TO AIR BRAKE SYSTEM					7.12.10.1 If air accessories are connected to the chassis air brake system, then perform the next 2 items. 7.12.10.1.1 The air brake system pressure protection valve's) shall be diagnostically checked to the shutoff point. 7.12.10.1.2 The pressure protection valve shall prevent the air accessories from drawing air from the air brake system when the air pressure drops below 80 psi (552 kPa) to ensure adequate air pressure for the braking system.
Brake	SERVICE AIR DRYER					7.12.10.2 Air reservoir tanks, air dryers, and drains shall be inspected for security of mounting, deformation, and leakage and shall be maintained in accordance with the manufacturer's recommendations.
Brake	INSPECT BRAKE LINES					7.12.10.3 All valves, lines, cylinders, and chambers shall be inspected for security of mounting, deformation, and leakage and shall be diagnostically checked.
Brake	CHECK AIR BRAKE COMPRESSOR					7.12.10.4 The compressor and inlet filter system shall be inspected for security of mounting and shall be maintained in accordance with the manufacturer's recommendations'.
Brake	CHECK CHASSIS AIR SYSTEM BELTS					7.12.10.5 All chassis air system belts shall be inspected for wear and deformation and shall be maintained at the manufacturer's recommended adjustment.
Brake	PERFORM COMPLETE BRAKE INSPECTION					7.12.10.6 The cut-in and cut-out pressure settings of the air compressor governor shall be tested and maintained at the manufacturer's recommended settings.
Brake	CHECK LOW AIR PRESSURE WARNING SYSTEM					7.12.10.7 The low-air warning systems shall be tested to ensure that activation occurs at the manufacturer's recommended setting.
Brake	CHECK AIR PRESSURE INDICATORS					7.12.10.8 Air pressure indicators shall be diagnostically checked.
Brake	PERFORM NFPA AIR BRAKE SYSTEM TEST					7.12.10.9 Leak-down rate (time) of the applied side of the air brake system shall be tested with the engine stopped and the service brakes applied, and the air pressure shall not drop more than 3 psi (20.7 kPa) in 1 minute for a straight vehicle or more than 4 psi (27.6 kPa) in 1 minute for a combination vehicle. 7.12.10.10 Leak-down rate (time) of the supply-side of the chassis air system shall be tested with the engine stopped and the service brakes released, and the air pressure shall not drop more than 2 psi (13.8 kPa) in 1 minute for a straight vehicle or more than 3 psi (20.7 kPa) in 1 minute for a combination vehicle.
Brake	CHECK PARKING BRAKE OPERATION					7.12.2 The parking brake shall be inspected for structural integrity, security of mounting, missing or broken parts, and wear and shall be diagnostically checked. 7.12.3 The parking brake controls and activating mechanism shall be inspected for structural integrity, security of mounting, and missing or broken parts, shall be diagnostically checked, and shall be lubricated.

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Brake	INSPECT BRAKE LINING, DRUMS OR ROTORS					7.12.4 The brake linings shall be replaced in accordance with the brake manufacturer's severe service recommendation when they are contaminated, when the lining is worn to the minimum thickness for safe operation as defined by the brake manufacturer, or when the brake drum or rotor is replaced. 7.12.5 The drums or rotors shall be inspected during scheduled maintenance, when there is a suspected problem or at the time of brake lining replacement, and the inspection shall consist of, but not be limited to the following: (1) Evidence of extensive heat or heat cracking (2) Out of round (3) Wear beyond manufacturer's specifications (4) Rust (5) Taper (6) Rotor parallelism (7) Metal fatigue. 7.12.6 Machining of brake drums or rotors shall be done only in accordance with manufacturer's recommendations. 7.12.7 All components of the braking system shall be inspected for damage and wear when performing a brake overhaul.
Brake	TEST ABS SYSTEM					7.12.8.1 Antilock braking systems (ABS) including the electronic control unit, cables, switches, relays, sensors, and valves shall be inspected for any deficiencies and shall be diagnostically checked. 7.12.8.2 The ABS electronic control unit (ECU) diagnostic codes shall be reviewed for types and frequency of error codes that have been logged.
Brake	PERFORM COMPLETE BRAKE INSPECTION					7.12.9 If the fire apparatus has a hydraulic brake system, the components to be inspected and maintained shall include, but not be limited to, the following: (1) Pedal and linkage (2) Brake switches (3) Master cylinder (4) Brake booster (5) Hydraulic lines (6) Valves (7) Wheel cylinders or calipers (8) Brake shoes or pads (9) Brake drums or rotors (10) Warning devices (11) Mounting hardware (12) Fluid level and contamination. 7.12.10 If the fire apparatus has an air brake system, the components to be inspected and maintained shall include, but not be limited to, the following: (1) Air compressor (2) Pedal assembly (3) All valves (4) Hoses and lines (5) Brake switches (6) Brake air chambers (7) Slack adjusters (8) Cams and wedges (9) Brake shoes or pads (10) Brake drums or rotor (11) Calipers (12) Air dryers (13) Drain valves (14) Air tanks (15) Warning devices (16) Mounting hardware.
Brake	CHECK DISC BRAKE TORQUE PLATE BOLTS					Check for security of mounting and deformation.
Brake	INSPECT CALIPER RETAINING RING AND BOLTS					Check for security of mounting and deformation.
Brake	CHECK SLACK ADJUSTERS					Inspect on a severe duty schedule for freedom of movement, security of mounting, and deformation and should be tested for proper operation. Lubricate on severe duty schedule.
Brake	LUBRICATE SLACK ADJUSTERS AND S-CAMS					Lubricate on severe duty schedule.
Brake System Test	ANNUAL BRAKE SYSTEM TEST				X	16.3 Braking System test. Testing of the braking system, including antilock brake systems and auxiliary brake system, shall be conducted at least annually and whenever adjustments, repairs, or modifications have been performed on any component that can affect the proper operation of the braking system or systems. Follow instructions in Chapter 16.
Braking System	CHECK BACKING PLATE BOLTS					7.12.1 The braking system shall be inspected and maintained in accordance with the manufacturer's severe service recommendation. If no severe service recommendation exists, the shortest interval recommended by the braking system manufacturer, based on time or mileage, shall be followed. If the vehicle is equipped with backing plates on the brakes the bolts should be checked on every B maintenance.
Breathing Air Compressor System Test	ANNUAL TEST OF BREATHING AIR COMPRESSOR SYSTEMS				X	23.1 If the apparatus is supplied with a breathing air compressor system, the compressor system shall be tested annually by the manufacturer or the manufacturer's authorized representative to verify that the system still meets the manufacturer's requirements for the system when it was new. Follow Chapter 23 for test.

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Cab	CHECK GLASS/MIRRORS FOR DELAMINATION, CHIPS, AND CRACKS					7.14.1 All glass, windows, and mirrors shall be inspected for condition and shall be diagnostically checked.
Cab	CHECK AIR RIDE SEAT SYSTEM					7.14.2 All seats shall be inspected for security of mounting and condition and shall be diagnostically checked.
Cab	CHECK SEAT FOR CUTS AND TEARS					7.14.2 All seats shall be inspected for security of mounting and condition and shall be diagnostically checked.
Cab	CHECK SEAT FRAME FOR CRACKS					7.14.2 All seats shall be inspected for security of mounting and condition and shall be diagnostically checked.
Cab	CHECK SEAT BELTS					7.14.3 All seat belts shall be inspected for security of mounting and condition and shall be diagnostically checked.
Cab	CHECK COMPARTMENT DOORS					7.14.4 Doors, door hinges, latches, and door stops shall be inspected for security of mounting and condition, shall be diagnostically checked, and shall be lubricated.
Cab	CHECK CAB MOUNTING SYSTEMS					All components of the cab mounting system including but not limited to, the following shall be inspected for security of mounting and deformation: (1) Mounting brackets (2) Cab base structure (3) Resilient cushions (4) Securing fasteners. 7.14.6* All equipment mounting systems including, but not limited to, mounting systems for the following shall be inspected for security of mounting and deformation and shall be maintained free of corrosion: (1) Radios, computers, and siren controls (2) Self-contained breathing apparatus (SCBA) (3) Portable lights (4) Hand tools (5) Emergency medical service (EMS) equipment (6) Books, street directories, and maps. For the safety of personnel, equipment should be mounted in accordance with the requirements of NFPA 1901.
Cab	INSPECT CAB INTERIOR CONDITION					Inspection to include, but not limited to, pedals, knobs, handles, headliner, interior door covers, and lights, for security of mounting, deformation and proper operation.
Cab Tilting System	CHECK CAB JACK FLUID AND OPERATION					7.14.7.1* All components of the cab tilting system shall be inspected for security of mounting, leaks, and shall be diagnostically checked. 7.14.7.2 Fluids shall be inspected for contamination and maintained to the levels recommended by the manufacturer.
Charging	CHECK CHARGING SYSTEM					8.5.1 All components of the charging system including, but not limited to, the following shall be inspected for security of mounting, deformation, and alignment and shall be diagnostically checked: (1) Alternator, regulator, and associated wiring and cables (2) Isolators (3) Alternator drive belts (4) Solenoids, relays, switches, and instrumentation (5) Interlock systems.
Charging	CHECK VOLTAGE REGULATOR					8.5.1 All components of the charging system including, but not limited to, the following shall be inspected for security of mounting, deformation, and alignment and shall be diagnostically checked: (1) Alternator, regulator, and associated wiring and cables (2) Isolators (3) Alternator drive belts (4) Solenoids, relays, switches, and instrumentation (5) Interlock systems.

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Cooling	CHECK COOLANT LEVEL					7.5.1 The engine coolant shall be inspected for contamination and maintained at the level specified by the manufacturer.
Cooling	INSPECT AUXILIARY HEAT EXCHANGERS					7.5.10 Auxiliary heat exchangers installed in the engine cooling system shall be inspected for security of mounting, deformation, and leaks.
Cooling	INSPECT AND CLEAN RADIATOR FINS					7.5.2 The radiator assembly shall be inspected and cleaned of dirt, debris, and obstructions to airflow.
Cooling	CHECK COOLING SYSTEM HOSES AND BELTS					7.5.3 All hoses and fittings shall be inspected for condition and leakage. 7.5.6 All belts shall be inspected for wear, deformation, and proper adjustment.
Cooling	CHECK WATER PUMP					7.5.4 The water pump's) shall be inspected for condition and leakage.
Cooling	PRESSURE TEST COOLING SYSTEM					7.5.5 The cooling system shall be pressure tested for leakage.
Cooling	LITMUS TEST COOLANT					7.5.7 The chemical components of the coolant shall be tested and maintained at the proper balance.
Cooling	INSPECT GAUGES					7.5.8 Cooling system temperature indicators and gauges shall be diagnostically checked.
Cooling	CHECK FAN CLUTCH					7.5.9 Temperature control devices including, but not limited to, the following shall be diagnostically checked: (1) Thermostats (2) Clutch fans (3) Radiator shutters (4) Electric cooling fans.
Cooling	CHECK RADIATOR CAP(S)					Check to see if missing or not sealing properly.
Cooling	INSPECT RADIATOR AND MOUNTS					Inspect for security of mounting, structural integrity, deformation, abnormal wear, leakage, and functional operation.
Cooling	CHANGE COOLANT FILTER					Replace coolant filter as recommended by the manufacturer.
Crew Compartment	INSPECT CAB AND BODY MOUNTS					7.14.7.1* All components of the cab tilting system including,shall be inspected for security of mounting and leaks and shall be diagnostically checked. 7.14.7.2 Fluids shall be inspected for contamination and maintained to the levels recommended by the manufacturer.
Dielectric Voltage Test	5 YEAR DIELECTRIC VOLTAGE WITHSTAND TEST				X	22.8 At least every 5 years, and after a vehicle accident or body repair, a dielectric test shall be performed on the line voltage electrical system. Follow Chapter 22 for test. Also see Annex A for additional information.
Driveline	CHECK DRIVELINE CENTER SUPPORT BEARING					7.10.1 All drive shafts, universal joints, carrier bearings, flanges, bearing cap bolts, and slip yokes shall be inspected for alignment, security of mounting, and wear and shall be lubricated.
Driveline	CHECK DRIVE SHAFTS AND U JOINTS					7.10.1 All drive shafts, universal joints, carrier bearings, flanges, bearing cap bolts, and slip yokes shall be inspected for alignment, security of mounting, and wear and shall be lubricated.
Driveline	CHECK AND LUBRICATE U-JOINTS, FLANGES					7.10.1 All drive shafts, universal joints, carrier bearings, flanges, bearing cap bolts, and slip yokes shall be inspected for alignment, security of mounting, and wear and shall be lubricated. 7.10.2 Driveline retarding systems shall be cleaned, shall be inspected for security of mounting, shall be diagnostically checked, and shall be lubricated.
Electrical	ELECTRICAL SYSTEM					13.1 If the apparatus has a line voltage electrical system, it shall be inspected and maintained in accordance with this chapter, and with the manufacturers recommendations.

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Engine	CHECK ENGINE COVER BOLTS					7.4.2 The engine shall be inspected for security of mounting and fluid leaks.
Engine	INSPECT ENGINE MOUNTS					7.4.2 The engine shall be inspected for security of mounting and fluid leaks.
Engine	CHANGE ENGINE OIL AND FILTERS					7.4.3 Engine oil and filters shall be serviced in accordance with the engine manufacturer's severe service. If no severe service recommendation exists, the shortest interval recommended by the engine manufacturer, based on time or mileage, shall be followed. 7.4.1 The engine oil shall be inspected for contamination and maintained at the level specified by the engine manufacturer.
Engine	CHECK ALL DIAGNOSTIC CODES					7.4.4 The diagnostic codes for electronically controlled engines shall be reviewed for types and frequency of error codes that have been logged.
Engine	CHECK ENGINE PERFORMANCE					7.4.5* The engine performance shall be maintained in accordance with the engine manufacturer's recommendations.
Engine	TEST ENGINE BRAKE					7.4.6 Engine braking systems shall be maintained in accordance with the manufacturer's recommendations.
Engine	CHECK ENGINE IDLE SPEED					Inspect for proper operation and adjust as recommended by the manufacturer.
Engine	PRESSURE WASH ENGINE					Pressure wash as needed to inspect engine.
Engine	TEST ENGINE SHUT DOWN MECHANISM					Test as recommended by manufacturer.
Engine Coolant System	INSPECT FREEZE PLUGS AND OIL COOLER AND LINES					7.5.3 All hoses and fittings shall be inspected for condition and leakage.
Exhaust	CHECK EMISSION CONTROL LINES, FITTINGS, BRACKETS					7.8.1 The engine exhaust system shall include, but not be limited to, the following: (1) Exhaust manifolds) (2) Exhaust pipes (3) Mufflers) (4) Tailpipes) (5) Exhaust clamps, brackets, and mounting hardware (6) Turbocharger (7) Catalytic converters) (8) Exhaust filtration system 7.8.2 The exhaust system shall be inspected for security of mounting, deformation, and exhaust leaks and shall be maintained in accordance with the engine manufacturer's recommendations.
Exhaust	INSPECT EXHAUST SYSTEM					7.8.1 The engine exhaust system shall include, but not be limited to, the following: (1) Exhaust manifolds) (2) Exhaust pipes (3) Mufflers) (4) Tailpipes) (5) Exhaust clamps, brackets, and mounting hardware (6) Turbocharger (7) Catalytic converters) (8) Exhaust filtration system 7.8.2 The exhaust system shall be inspected for security of mounting, deformation, and exhaust leaks and shall be maintained in accordance with the engine manufacturer's recommendations.
Frame	INSPECT FRAME AND SUPPORTS					7.2.1 All frame rails and members shall be inspected for defects, structural integrity, corrosion, perforations, cracks, and missing or loose parts.
Fuel	CHANGE FUEL FILTER(S)					7.6.1 Fuel filters and fuel-water separators shall be maintained in accordance with the manufacturer's recommendations.
Fuel	CHANGE FUEL/WATER SEPARATOR					7.6.1 Fuel filters and fuel-water separators shall be maintained in accordance with the manufacturer's recommendations.
Fuel	CHECK FUEL TANK DRAIN PLUG					7.6.2 The fuel tank, lines, and all connections shall be inspected for security of mounting, deformation, and leakage.

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Fuel	CHECK FUEL TANK MOUNTING AND TIE DOWNS					7.6.2 The fuel tank, lines, and all connections shall be inspected for security of mounting, deformation, and leakage.
Fuel	INSPECT FUEL LINES					7.6.2 The fuel tank, lines, and all connections shall be inspected for security of mounting, deformation, and leakage.
Fuel	INSPECT FUEL PUMP(S)					7.6.2 The fuel tank, lines, and all connections shall be inspected for security of mounting, deformation, and leakage.
Fuel	INSPECT INJECTORS					7.6.3 The carburetor or the injection pump and injectors shall be maintained in accordance with the engine manufacturer's recommendations.
Fuel	INSPECT GAUGES, INDICATORS, AND SENDING UNITS					7.6.4 Gauges, indicators, and sending units shall be diagnostically checked.
Fuel	CHECK ENGINE THROTTLE					7.6.5* All mechanical throttle linkage and stops shall be inspected for proper adjustment and diagnostically checked. A.7.6.5 All linkage should be inspected for freedom of movement, adjustment, full throttle position, idle position, and smooth operation. 7.6.6 All electronic throttle components and throttle position sensors (TPS) shall be inspected for counts and diagnostically checked.
Line Voltage Electrical System Test	ANNUAL LINE VOLTAGE ELECTRICAL SYSTEM TEST				X	22.1 If the fire apparatus is equipped with a line voltage electrical system, the system and components shall be tested as required by this chapter. 22.2 Performance tests shall be conducted at least annually, unless otherwise noted, and whenever major repairs or modifications to the line voltage electrical system or any component of the system have been made.
Miscellaneous Electrical Components	CHECK MISCELLANEOUS ELECTRICAL COMPONENTS					8.8 Miscellaneous electrical components including, but not limited to, the following shall be inspected for security of mounting and deformation and shall be diagnostically checked: (1) Battery conditioners and chargers (2) Shoreline receptacles (3) Radios and intercoms (4) Converters and inverters (5) Fast idle system (6) Interlock system(s) (7) Operator alert devices (8) Other electrical components on the apparatus not otherwise specified above.
Parking Brake Test	ANNUAL PARKING BRAKE TEST				X	16.4 The parking brake system shall be tested at least annually. Follow instructions in Chapter 16. See A.16.4.1 and A.16.4.2.
Pump	CHECK PUMP					9.2.1 All fire pumps, auxiliary pumps, industrial pumps, and transfer pumps shall be inspected for security of mounting, structural integrity, and leakage and shall be diagnostically checked. 9.2.2 All pump shaft packing or mechanical seals shall be inspected and maintained in accordance with the manufacturer's recommendations.
Pump	CLEAN PUMP TRANSMISSION STRAINER					9.2.3 Renewable anodes, intake strainers, or any other means to prevent galvanic corrosion shall be inspected for condition and replaced if necessary.
Pump	TEST PUMP SHIFT UNIT					9.2.4.1 The pump drive system shall be inspected for security of mounting and leakage, shall be diagnostically checked, and shall be lubricated as required by the component manufacturer. 9.2.4.2 All pump shift controls, pump shift indicators located in the driving compartment and on the operator's panel, engine speed advancement interlocks, and any other interlocks of the pump drive system shall be inspected for security of mounting and leakage, shall be diagnostically checked, and shall be lubricated as required. See A.9.2.4.1 and A.9.2.4.2
Pump	CHECK COMPONENTS OF DRIVE SYSTEM					A.9.2.41 Components of the pump drive system could include, but are not limited to, the following: (1) Split-shaft power takeoff (PTO) (2) Pump transmission (3) Pump transfer case (4) PTO (5) Pump clutch (6) Pump drive shafts (7) Hydraulic drive systems (8) Auxiliary drive engine.
Pump	CHECK PUMP SHIFT CONTROLS A					A.9.2.4.2 Pump shift controls can include electrical, pneumatic, or mechanical components working individually or in combination to shift the pump drive system into and out of pump mode. Some pumps have manual backup shift controls. Pump shift indicators in-cab and on the operator's panel on split-shaft PTO pump drive systems typically reuire an electromechanical device, such as a switch mounted on the pump transmission, to sense pump shift status. The controls need to be inspected, diagnostically checked, and lubricated as part of a preventive maintenance program.

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Pump	CHECK PUMP TRANSMISSION CASE FLUID LEVEL AND CONTAMINATION					9.2.4.3 All fluids in the pump drive system shall be inspected for contamination and maintained at the level and condition specified by the component manufacturer.
Pump	CHECK ALL PIPING AND VALVES					9.2.5 All pump piping, valves and valve controls, fire hose connections, caps, chains, and gaskets shall be inspected for security of mounting, structural integrity, proper valve operation, deformation, corrosion, and leakage and shall be lubricated as required by the component manufacturer.
Pump	CHECK INSTRUMENTATION AND GAUGES					9.2.6 All instrumentation, gauges, and lighting shall be inspected for security of mounting and condition and shall be diagnostically checked.
Pump	TEST PUMP PANEL THROTTLE OPERATION					9.2.7 All pump control systems including, but not limited to, the following shall be diagnostically checked: (1) Engine speed control and interlock (2) Pressure control devices (3) Transfer valve (4) Transmission lockup system.
Pump	CHECK PRIMING SYSTEM					9.2.8.1 The pump priming system shall be inspected for security of mounting and leakage and shall be diagnostically checked. 9.2.8.2 The priming fluid, if required, shall be inspected for contamination and proper type and shall be maintained at the level recommended by the component manufacturer.
Pump	TEST PUMP PRIMER MOTOR					9.2.9 If the pump has a separate drive engine, that engine shall be inspected and maintained in accordance with Sections 7.4 through 7.8, as applicable, and in accordance with the manufacturer's recommendations.
Pump	CHECK FOR WATER LEAKS					9.3 If the apparatus is equipped with a water tank, the tank shall be inspected for security of mounting, structural integrity, deformation, and leakage and shall be maintained in accordance with 9.3.1 and 9.3.2 and the component manufacturer's recommendations. 9.3.1 The tank sumps, if equipped with a sump cleanout, shall be cleaned. 9.3.2 Where so equipped, anodes and other means to prevent galvanic corrosion shall be inspected and maintained as recommended by the manufacturer.
Pump Test	ANNUAL PUMP TEST				X	18.1 If the fire apparatus is equipped with a fire pump or an industrial supply pump, the pump shall be inspected and tested as required by this chapter. 18.2 Service test shall be conducted at least annually and whenever major repairs or modifications to the pump or any component of the apparatus that is used in pump operations have been made. Follow Chapter 18 for the test. See Annex A and Annex B for additional information.
Regulator Test	ANNUAL REGULATOR TEST				X	17.6 Tests shall be conducted at least annually and whenever major repairs or modifications to the low voltage electrical system or any component of the system have been made. Follow regulator test 17.6
Road Test	ANNUAL ROAD TEST				X	16.5 A road test of the fire apparatus shall be conducted at least annually, after each scheduled maintenance interval, and after repair, adjustment, or modification of the engine, transmission, drivetrain, suspension, brakes, or steering. Follow instructions in Chapter 16.
Solenoid and Relay Test	ANNUAL SOLENOID AND RELAY TEST				X	17.9 Tests shall be conducted at least annually and whenever major repairs or modifications to the low voltage electrical system or any component of the system have been made. Follow 17.9 for the solenoid and relay test.
Starter Wiring Test	ANNUAL STARTER WIRING TEST				X	17.4 Tests shall be conducted at least annually and whenever major repairs or modifications to the low voltage electrical system or any component of the system have been made. Follow 17.4 for test.
Starting	INSPECT STARTER					17.4.1 The wiring from the battery to the starter shall be inspected for corrosion, loose connections, worn insulation, or potential chafing points.
Starting	TEST ON BOARD BATTERY CHARGER					17.7.1 If the apparatus is equipped with a battery charger or conditioner, it shall be tested as described in 17.7.2 and 17.7.3.
Starting	INSPECT AND CLEAN BATTERY CABLES					8.2 All components of the starting system including, but not limited to, the following shall be inspected for security of mounting and deformation and shall be diagnostically checked: (1) Batteries, cabling, and connections (2) Cranking motor (3) Solenoid, relays, and switches (4) Interlock systems.

System	Inspection Item	Weekly Inspection to be performed by Fleet Technician on site at house.	Monthly Inspection to be performed by Fleet Technician on site at house.	Quarterly Inspection to be performed by Fleet Technician at fleet garage. Unit will be out of service.	Annual Inspection to be performed by Fleet Technician at fleet garage. Unit will be out of service.	Special Instruction
Starting	INSPECT STARTING SYSTEM					8.2 All components of the starting system including, but not limited to, the following shall be inspected for security of mounting and deformation and shall be diagnostically checked: (1) Batteries, cabling, and connections (2) Cranking motor (3) Solenoid, relays, and switches (4) Interlock systems. 8.3 All wiring and wire looms shall be inspected for security of mounting, tight connections, proper routing, presence of grommets, condition, and cleanliness.
Starting	SERVICE BATTERY					8.4 The battery(ies) shall be tested for storage and performance capabilities in accordance with the manufacturer's recommendations. 17.3.1.1 Batteries shall be cleaned of any accumulated dirt or corrosion, and the connections shall be checked to ensure that they are clean and tight,.17.3.1.2 Batteries shall be inspected for cracks, swelling, deformation, or other physical defects. 17.3.1.3 Batteries that are not sealed shall be checked to verify that the cells have the proper electrolyte level, and distilled water shall be added if necessary. 17.3.1.4 Batteries that are sealed shall be inspected to verify that any electrolyte level indicator indicates sufficient electrolyte.
Steering	CHECK STEERING SYSTEM					7.11.2 All steering system components shall be inspected for structural integrity, security of mounting, leakage, and condition, shall be diagnostically checked, and shall be lubricated. 7.11.2.1 The surrounding vehicle components shall be inspected for indications that the wheels or tires have been rubbing during steering.
Steering	CHECK AXLE STOPS					7.11.2.2 Both the left and right steering axle stops shall be diagnostically checked to ensure the steering gear hydraulics relieve before contacting the steering stops.
Steering	CHECK STEERING GEAR BOX, MOUNTING BRACKETS, AND LINKAGE					7.11.2.3.1 The steering gear mounting bracket shall be cleaned and inspected for cracks. 7.11.2.3.2 All steering gear mounting bracket fasteners shall be inspected for proper installation, grade, and torque. 7.11.2.4 The steering linkage assembly shall be inspected to ensure that the pinch bolts, cotter pins, and other retaining hardware are in place and properly secured. Lubricate as recommended by the manufacturer.
Steering	LUBRICATE STEERING COLUMN LINKAGE					7.11.2.4 The steering linkage assembly shall be inspected to ensure that the pinch bolts, cotter pins, and other retaining hardware are in place, properly secured and lubricated.
Steering	CHECK STEERING WHEEL					7.11.2.5 The steering wheel shall be rotated to check for steering backlash.
Steering	CHANGE GEAR BOX FLUID LEVEL					7.11.3 The steer gear box (es) and power steering reservoir lubricant levels shall be maintained in accordance with the manufacturer's recommendations.
Steering	CHANGE POWER STEERING FLUID					7.11.3 The steer gear box (es) and power steering reservoir lubricant levels shall be maintained in accordance with the manufacturer's recommendations.
Steering	CHECK GEAR BOX FLUID LEVEL					7.11.3 The steer gear box (es) and power steering reservoir lubricant levels shall be maintained in accordance with the manufacturer's recommendations.
Steering	CHECK POWER STEERING FLUID					7.11.3 The steer gear box (es) and power steering reservoir lubricant levels shall be maintained in accordance with the manufacturer's recommendations.
Steering	CHECK TIE RODS, DRAG LINK, PITMAN ARM					7.11.4 The steering valve(s), steering arms, drag links, pitman arms, tie rod ends, and steering column assembly shall be lubricated.
Steering	INSPECT POWER STEERING LINES, BELTS AND HOSES					7.11.5 All steering pump belts, hoses, and lines shall be inspected for wear, adjustment, and deformation.
Steering	CONTROLS AND INDICATORS					7.11.6 Electronic steering controls and indicators shall be maintained in accordance with the manufacturer's recommendations.
Steering	CHANGE POWER STEERING FILTER					Follow manufacturer's recommendation.
Suspension	CHECK AIR SUSPENSION BAGS, MOUNTING BRACKETS, ATTACHED HARDWARE AND CONTROLS					7.2.2 All suspension components including, but not limited to, the following shall be inspected for defects, missing or loose parts, and functional operation and shall be lubricated: (1) Springs and spring hangers (2) Air springs (bags), mounting brackets, and attaching hardware (3) Equalizer beams and torque arms (4) Shock absorbers
Suspension	CHECK EQUALIZER BEAMS AND TORQUE ARMS					7.2.2 All suspension components including, but not limited to, the following shall be inspected for defects, missing or loose parts, and functional operation and shall be lubricated: (1) Springs and spring hangers (2) Air springs (bags), mounting brackets, and attaching hardware (3) Equalizer beams and torque arms (4) Shock absorbers

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Suspension	CHECK TORQUE ON SUSPENSION U-BOLTS					7.2.2 All suspension components including, but not limited to, the following shall be inspected for defects, missing or loose parts, and functional operation and shall be lubricated: (1) Springs and spring hangers (2) Air springs (bags), mounting brackets, and attaching hardware (3) Equalizer beams and torque arms (4) Shock absorbers
Suspension	LUBRICATE SUSPENSION PINS AND BUSHINGS					7.2.2 All suspension components including, but not limited to, the following shall be inspected for defects, missing or loose parts, and functional operation and shall be lubricated: (1) Springs and spring hangers (2) Air springs (bags), mounting brackets, and attaching hardware (3) Equalizer beams and torque arms (4) Shock absorbers
Suspension	CHECK FRAME AND SUSPENSION FOR PROPER ALIGNMENT					7.2.3 The frame and suspension shall be inspected for proper alignment.
Tires/Wheels	INSPECT WHEEL BEARINGS AND SEALS					7.3.2 Wheel bearings and seals shall be cleaned, inspected for deformation, wear, cracks, and leakage, and shall be lubricated.
Tires/Wheels	INSPECT TIRES FOR WEAR, DAMAGE, INFLATION					7.3.3* Tires shall be inspected for damage and shall be inflated to the tire manufacturer's recommended pressure. 7.3.4* Tires shall be replaced at least every 7 years or more frequently when the tread wear exceeds state or federal standards as determined by measureing with a tread depth gauge. [See 6.3.1(4)] A.7.3.3 It is important that the cold tire inflation be maintained to the fire apparatus manufacturer's recommended tire pressure, which is based on the weight of the completed apparatus, and not to the maximum pressure shown on the sidewall of the tire. If the information from the fire apparatus manufacturer is not available for the tires on the vehice, each axle should be weighed with the vehicle fully loaded and the tires inflated to the tire manufacturer's inflation specification for the tire model, size, and axle load. A.7.3.4 Tire age can be determined by checking the DOT code on the sidewall of each tire.
Tires/Wheels	CHECK TREAD DEPTH					7.3.4* Tires shall be replaced at least every 7 years or more frequently when the tread wear exceeds state or federal standards as determined by measureing with a tread depth gauge.
Tires/Wheels	CHECK WHEEL STUDS AND LUG NUTS					7.3.5* Wheel-attaching nuts shall be torqued to the wheel manufacturer's recommendation. A.7.3.5 Wheel-attaching hardware should be torqued to the manufacturer's recommendation at the time of wheel installation. The wheel- or rim-attaching hardware should be re-torqued at 50 mi to 100 mi (80 km to 160 km) after installation and periodically thereafter. Wheel covers or nut covers might have to be removed for proper inspection.
Tires/Wheels	CHECK FOR WHEEL CRACKS DEFORMATION AND CORROSION					7.3.6 Wheels and rims shall be inspected for cracks, deformation, structural integrity, and corrosion.
Tires/Wheels	CLEAN AND POLISH OR PAINT WHEELS					Clean and polish or paint wheels as needed.
Tires/Wheels	INSPECT WHEEL CHOCKS					Inspect that wheel chocks are not missing and are easily accessible.
Total Continuous Electrical Load Test	ANNUAL TOTAL CONTINUOUS ELECTRICAL LOAD TEST				X	17.8 Tests shall be conducted at least annually and whenever major repairs or modifications to the low voltage electrical system or any component of the system have been made. 17.8.1 The total continuous electrical load test shall be permitted to be conducted simultaneously with other electrical or pumping tests. A.17.8 This test is designed to verify that the charging system, with the load management system, if supplied, is sufficient to supply the total connected load.
Trans	CHECK TRANSMISSION					7.9.1 The transmission shall be inspected for security of mounting, structural integrity, and leakage and shall be diagnostically checked.
Trans	CHECKS TRANSMISSION BRAKING SYSTEMS					7.9.10 Transmission braking systems shall be maintained in accordance with the manufacturer's recommendations.
Trans	CHECK AUXILIARY HEAT EXCHANGERS					7.9.11 Auxiliary heat exchangers installed in the transmission cooling system shall be inspected for security of mounting, deformation, and leaks.

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Trans	CHECK TRANSMISSION FLUID					7.9.3 Transmission lubricants and filters shall be inspected for contamination, and lubricants shall be maintained at the level specified by the manufacturer.
Trans	CHANGE TRANSMISSION OIL AND FILTERS					7.9.4 The lubricant and filters shall be serviced in accordance with the transmission manufacturer's severe service recommendation. If no severe service recommendation exists, the shortest interval recommended by the transmission manufacturer, based on time or mileage, shall be followed.
Trans	CHECK INDICATORS AND GAUGES					7.9.6 All transmission indicators and gauges shall be tested for proper operation and accuracy.
Trans	CHECK DIAGNOSTIC CODES					7.9.7 The diagnostic codes for all electronically controlled transmissions shall be reviewed for types and frequency of error codes that have been logged.
Trans	CHECK POWER TAKE OFF(S) MOUNTING AND LEAKS					7.9.8 PTO's shall be inspected for security of mounting and leakage and shall be diagnostically checked.
Trans	CHECK LOCKUP SYSTEM					7.9.9 The lockup system for pumps and other accessories shall be inspected for leakage and shall be diagnostically checked.
Transfer Case	CHANGE TRANSFER CASE FLUID					Inspect transfer case, check fluid level and change fluid as recommended by manufacturer.
Warning Devices	CHECK WARNING LIGHT OPERATION					8.12 All warning devices including, but not limited to, the following shall be inspected for security of mounting and deformation and shall be diagnostically checked: (1) Emergency warning lights (2) Electric and electronic sirens (3) Automotive traffic horn (4) Air horns (5) Backup alarm (6) Other warning devices on the apparatus not otherwise specified in 8.12(1) through (5).
Warning Devices	TEST HORNS, SIRENS, ALARMS					8.12 All warning devices including, but not limited to, the following shall be inspected for security of mounting and deformation and shall be diagnostically checked: (1) Emergency warning lights (2) Electric and electronic sirens (3) Automotive traffic horn (4) Air horns (5) Backup alarm (6) Other warning devices on the apparatus not otherwise specified in 8.12(1) through (5).
Warning Devices	TEST INSTRUMENT PANEL WARNING DEVICES AND GAUGES					8.12 All warning devices including, but not limited to, the following shall be inspected for security of mounting and deformation and shall be diagnostically checked: (1) Emergency warning lights (2) Electric and electronic sirens (3) Automotive traffic horn (4) Air horns (5) Backup alarm (6) Other warning devices on the apparatus not otherwise specified in 8.12(1) through (5).
Wear Points	CHECK AND LUBRICATE ALL WEAR POINTS					7.1 General. All components and systems commonly found on or in the chassis, driving compartment, crew compartment, and body shall be inspected and maintained in accordance with the manufacturer's instructions and this chapter. Special attention should be paid to steering stops, stricker plates, and hinges.
Weight Verification Test	ANNUAL WEIGHT TEST				X	16.2 Fire apparatus Axle Weight Test. The fully loaded fire apparatus shall be weighed following the procedure specified in 16.2.2 through 16.2.5 to ensure that the weight on the front and rear axles and the gross vehicle weight do not exceed the gross axle weight ratings (GAWRs) and the gross vehicle weight rating (GVWR) or gross combination weight rating (GCWR) as shown on the rating plate on the fire apparatus. Follow instructions in Chapter 16. Also see A.16.2.3, A16.2.4(3), A.16.2.4(4).
Winch Systems	INSPECT WINCH SYSTEM					15.1 Any winch or winch attachment point on a fire apparatus shall be inspected and maintained in accordance with this chapter and with the manufacturers recommendations.
Windshield Washer	FILL WINDSHIELD WASHER RESERVOIR					7.14.7.2 Fluids shall be inspected for contamination and maintained to the levels recommended by the manufacturer.
Work Lighting	CHECK EMERGENCY LIGHT OPERATION					8.10 All work lighting including, but not limited to, the following shall be inspected for security of mounting and deformation and shall be diagnostically checked: (1) Ground lights (2) Step lights (3) Flood, spot, and scene lights (4) Cab interior lights (5) Compartment lights (6) Other work lighting on the apparatus not otherwise specified in 8.10(1) through (5).
Work Lighting	CHECK WORK LIGHT OPERATION					8.10 All work lighting including, but not limited to, the following shall be inspected for security of mounting and deformation and shall be diagnostically checked: (1) Ground lights (2) Step lights (3) Flood, spot, and scene lights (4) Cab interior lights (5) Compartment lights (6) Other work lighting on the apparatus not otherwise specified in 8.10(1) through (5).