Fire Department Apparatus Fleet Review

For

West Barnstable, Massachusetts

Joseph Maruca
Fire Chief

Prepared by

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Joseph Maruca, Fire Chief
West Barnstable Fire Department
2160 Meetinghouse Way
West Barnstable, MA. 02668

Dear Chief Maruca,

East West Fire Apparatus Consultants (EWFAC) has inspected the heavy apparatus operated by the West Barnstable Fire Department. The apparatus were inspected for overall physical condition, general maintenance and compliance with current operating and safety standards. In conjunction with the inspections and maintenance records the annual test records were also reviewed.

The National Fire Protection Association (NFPA) publishes NFPA 1901 Standard for Automotive Fire Apparatus which sets the minimum design and construction standards that manufacturers must meet or exceed for any emergency service apparatus with a gross vehicle weight of 10,000lbs or more. In the 1991 version of the NFPA 1901standard, several design mandates that concentrated on operator and occupant safety were incorporated into the standard. As the standard continues to evolve safety has become a major focus of apparatus design and construction.

In 2007, NFPA 1911, Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus was published. This standard consolidated several older standards that governed in-service testing of apparatus and their major components into one standard. New to this standard is the inclusion of criteria on apparatus inspection and maintenance, guidelines to service life of apparatus, establishment of out-of-service conditions, and recommendations for the retirement of apparatus. In conjunction with and often referenced in the NFPA standards are Department of Transportation (DOT), Federal Motor Vehicle Safety Standards (FMVSS), Society Of Automotive Engineers (SAE), along with other nationally recognized standards. The Massachusetts state motor vehicle regulations must also be adhered to.

The inspections of the apparatus operated by West Barnstable Fire Department and recommendations made as to maintenance, retirement and replacement are based on these NFPA standards, several industry standards and generally accepted industry practices.

The Insurance Services Office (ISO) sets and grades Fire Departments on their ability to respond and mitigate emergencies in their community. They have wide ranging criteria that in part reviews response times, apparatus needed, location of fire houses, water supply, communications, written mutual aide agreements and miscellaneous other criteria. In addition to their own criteria, ISO relies heavily on NFPA standards, codes and other referenced national codes in their risk assessment. Based on this analysis, the ISO then creates what they consider to be the minimum necessary resources for the community to mitigate fire and other property damaging events. Insufficient grades received as a result of an ISO review can cause an increase in insurance costs for property owners and renters.

When purchasing new equipment and maintaining existing apparatus, it is important to make sure ISO recommendations are followed so that the community's rating is maintained or improved.

Detailed reports on each vehicle follow, and recommendations pertinent to each vehicle are at the end of their respective sections. Overall recommendations are in the summary are at the end of the report.

It is anticipated that this report will assist you with making fleet management decisions. If you have any question or need any additional information on any of the points illustrated in this report please do not hesitate to contact us. Thank you for selecting EWFAC to perform this inspection for you.

Sincerely,

Jeffrey D. Gaskin

Jeffrey D. Gaskin
Apparatus Consultant

West Barnstable Fire Department

Figure 1

Engine/Tanker # 296

1985 Pierce Arrow
Manufactured April 1985
Registration Number: E-2573

Mileage: 53,245
Engine Hours: N/A
Pump Hours: 919.0

Vehicle Weight Chart		
	Rated	**Actual**
Gross Vehicle Weight	67,500 lbs.	59,800 lbs.
Front Axle	17,500 lbs.	13,900 lbs.
Rear Axle	50,000 lbs.	45,900 lbs.

This vehicle is a Pierce custom cab and chassis assembly with an Arrow model cab that seats five (5), three (3) in the front and two (2) seats in the open rear cab area. The rear open seating area is a very dangerous seating position on fire apparatus and has not been allowed on any new equipment since 1991. Figures 2 & 3.

The apparatus body is an extruded aluminum pumper/tanker body carrying 3000 gallons of water, powered by a Detroit Diesel 8V-92 Series motor and an Allison automatic transmission. Both the front and rear tandem axles are equipped with drum brakes. This apparatus was refurbished in 2005.

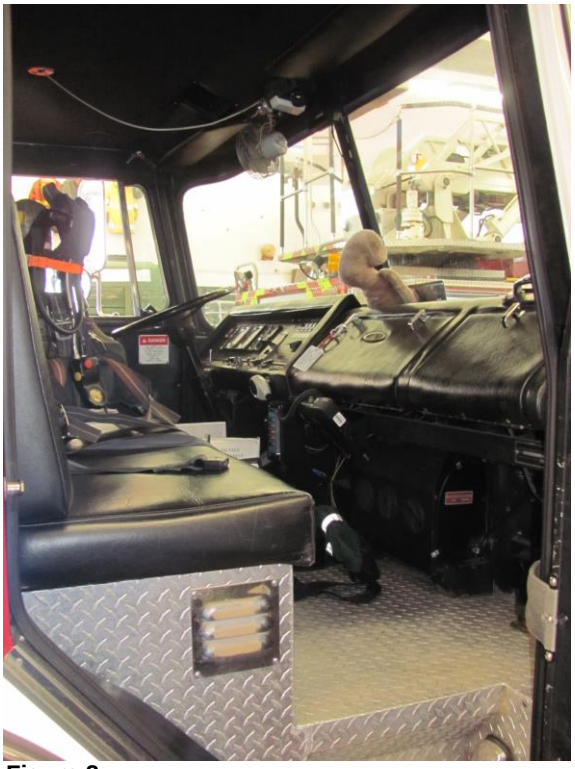


Figure 2

Figure 3

Inspection of this vehicle indicates that it is in overall good condition, most of the issues found on this apparatus are relatively minor and related to its age. The fact that this apparatus was refurbished in 2005 is a big contributing factor to the good condition this apparatus is in.

There is some rust beginning to show on various areas of the chassis and/or its components. This can be expected with a vehicle of this age and none of the rust observed appeared to be structural in nature. Removing the rust scales with a wire brush and sealing the rusted spots with good oil base paint like Rustoleum's Damp Proof Red primer will help keep the rust in check. Figures 4, 5 & 6.

Figure 4

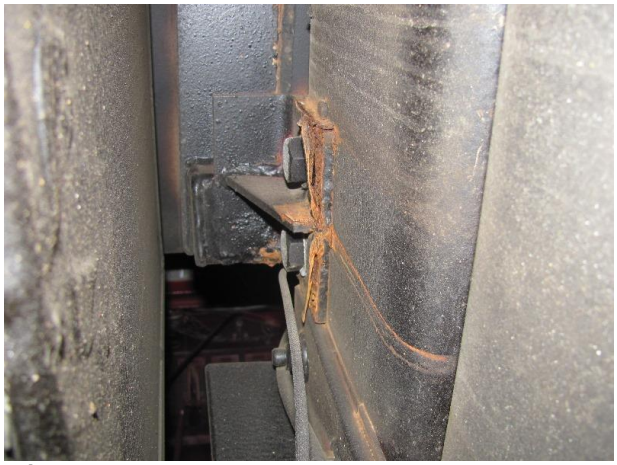


Figure 5

Figure 6

The drag link on the steering system hits one of the left front leaf spring shackles when the steering is exercised. The contact point does not appear to be too old or too severe. Inspection of the leaf spring did not show any cracked leaves. The drag link joints, pitman arm, and steering arm should be checked for wear and alignment. Figures 7 & 8.

Figure 7

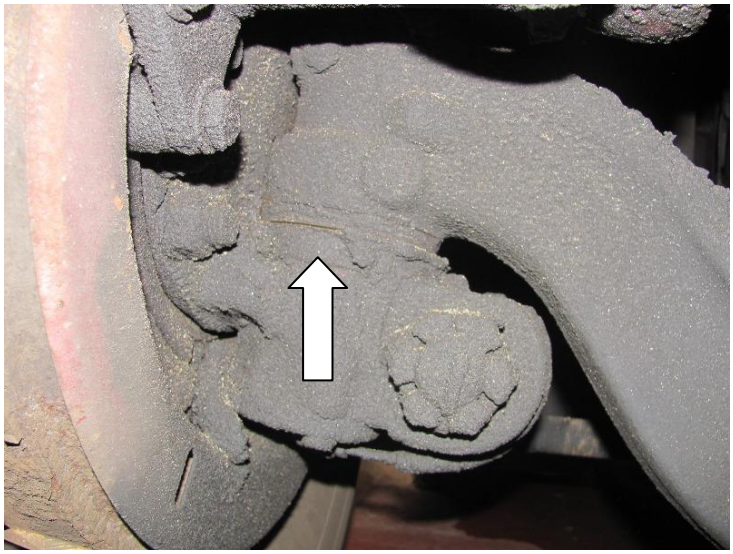
Figure 8

There is some evidence that the Vogel (now SKF) auto lube system is not working. Many of the grease fittings that are connected to the system show a lack of fresh grease in the joints. Other joints show some more recent grease being present, an improvement but still not what you expect to see. Compounding the situation is that there is an accumulation of road dirt in and around grease areas that make it harder to observe exactly what is happening. The auto lube system should be checked for the proper grease (a critical point) and proper operation. The chassis should be cleaned, especially in areas where there are components that need to be greased and are hooked up to the auto lube system so that the operation can be monitored. Figures 9 & 10.

Figure 9

Right front wheel lower king ping.

Notice: The lack of grease and the dry nature of the pivot joint located above the arrow.



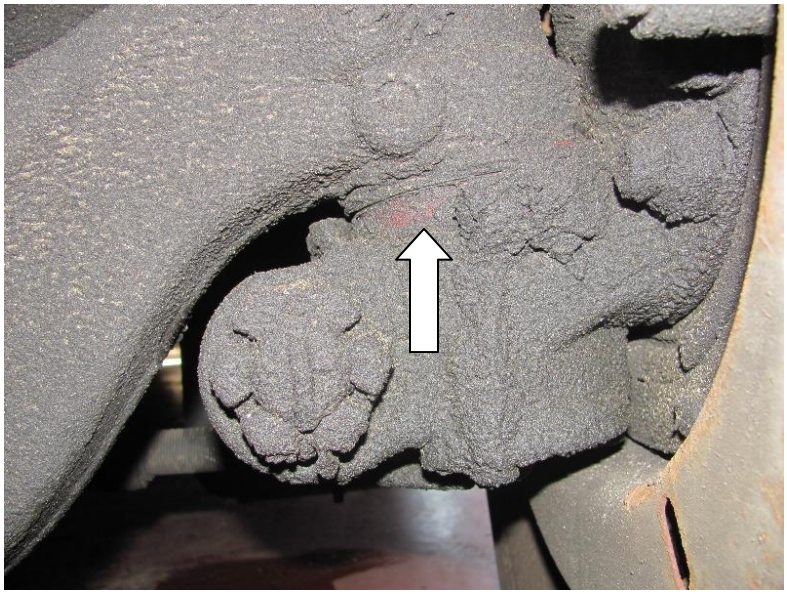


Figure 10

Left front wheel lower king ping.

Notice: The lack of grease and the dry nature of the pivot joint located above the arrow.

The power steering box is wet from oil, but there was no dripping observed. This should be cleaned of the oil residue and checked periodically to determine where the residue is coming from and whether or not it is an indication of a developing problem. Figure 11.

Figure 11

ET-296 is equipped with a Waterous Model CMU fire pump rated at 2000 gallons per minute (GPM). Review of pump test records for years 2012 – 2014 inclusive shows that ET-296 easily passes its annual pump test and pump performance is consistent and strong. There are three (3) fire pump items that should be addressed. Water is leaking from the main (steamer) intakes on both the left and right side of the apparatus. Figures 12 & 13.

Figure 12

Figure 13

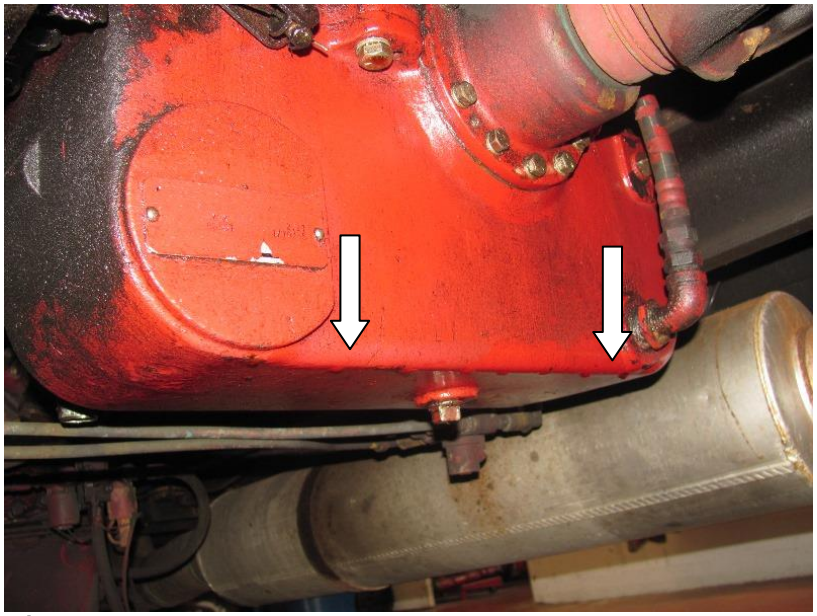


Figure 14

Though difficult to see in the picture because both the fluid and the pump transmission are red in color, there appears to be a hydraulic fluid leak in the pump transmission. Droplets of hydraulic fluid used are forming along the bottom edge of pump transmission. This leak could be as simple as the pump transmission being overfilled when cold and then as the transmission fluid warms up and expands the excess is pushed out of the breather or there may be a leak in pump transmission. The outside of the pump transmission should be cleaned and the situation observed. Figure 14.

The manufacturer date code on the front tires are 0108 meaning that the tires were made during the first week of 2008. The tire date code on the rear tires is 0909, manufactured during the ninth week of 2009. The NFPA recommends that tires on fire apparatus be replaced after seven (7) years of service regardless of the mileage. The tires on ET-296 are due to be replaced with new tires.

On the rear tandem axle the one brake chamber was recently changed and the other side was not. Best industry practices would have both brake chambers changed at the same time. Whatever brake component repair or replacement is done to one side of the axle should be done to the other. As long as the brake components match, by manufacturer and model numbers DOT regulations are met.

The air pack brackets, and any tools or equipment mounted inside the apparatus cab or crew areas have been required to be mounted to withstand a 9G force since 1997. This is to reduce the number of injuries and fatalities to personnel from flying equipment. Additional benefit is that it helps protect the equipment from damage in the event is get knocked out of its mount. All of the air pack brackets on ET-296 should be equipped with a positive latching restraint strap such as the Ziamatic Corp. Model LSS.

For the open seating area on rear of the cab, the seat belts should be regularly inspected for proper operation and repaired as needed. If a seat belt is found to need repair that seat should be taken out of service until the needed repairs are complete. Strict compliance to the seated and belted policy at all times should be enforced. Additionally EWFAC recommends the installation of mansaver bars on the open cab seating as an additional safety device.

Engine # 294

Figure 15

2002 Pierce Dash
Manufactured April 2002
VIN: CF795F1035

Mileage: 14,335
Engine Hours: See Text
Pump Hours: 773.8

Vehicle Weight Chart		
	Rated	**Actual**
Gross Vehicle Weight	46,500 lbs.	43, 680 lbs.
Front Axle	19,500 lbs.	18,380 lbs.
Rear Axle	27,000 lbs.	25,160 lbs.

This vehicle is a Pierce custom cab and chassis assembly with a Dash model cab that seats six (6) in a fully enclosed cab. The apparatus body is an extruded aluminum pumper body carrying 750 gallons of water and 40 gallons Class A foam. The vehicle is powered by a Caterpillar C-12 diesel motor and an Allison 4060P automatic transmission. There was conflicting information on the various engine hour meters, with the best information indicating the vehicle has 3,100 hours on the motor.

There are several issues with this apparatus that in the overall picture are relatively minor and one that has the potential to be costly. The bigger problem with this apparatus is its general physical condition and the fact that it appears to be almost literally eating itself alive through extensive corrosion.

First let's look at the more minor items. There is a leak coming from the steering miter box. Figure 16. The miter box allows the steering column actuation to change direction. Since this leak meets the NFPA criteria for a Class 3 is does create an out of service condition. The steering miter box should be checked and repaired as needed.

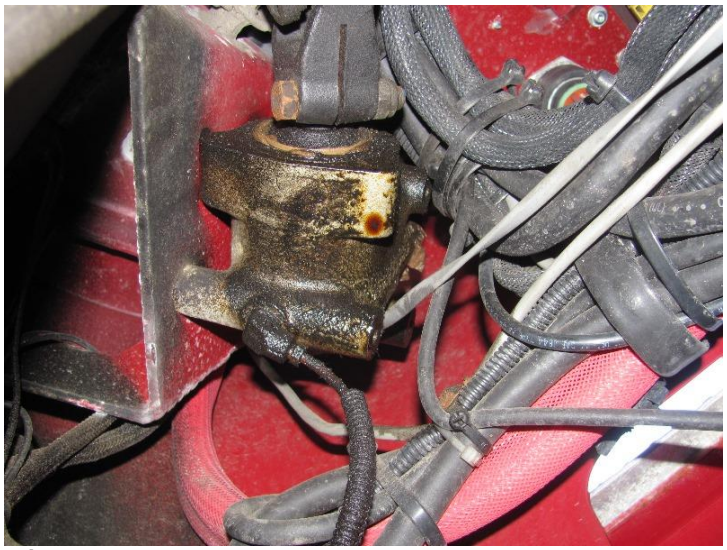


Figure 16

Figure 17

Figure 17 shows a front shock absorber with oil darkening taking place on the lower tube. This was apparent on both front shocks when the apparatus was inspected. This condition usually means that the shock absorbers have developed an oil leak and are in need of replacement.

The Vogel (now SKF) auto lube system in this apparatus is also not working. Many of the grease fittings that are connected to the system show a lack of fresh grease in the joints. The

auto lube should be checked for proper grease (a critical point), proper operation, and repaired as needed. Figures 18 & 19.

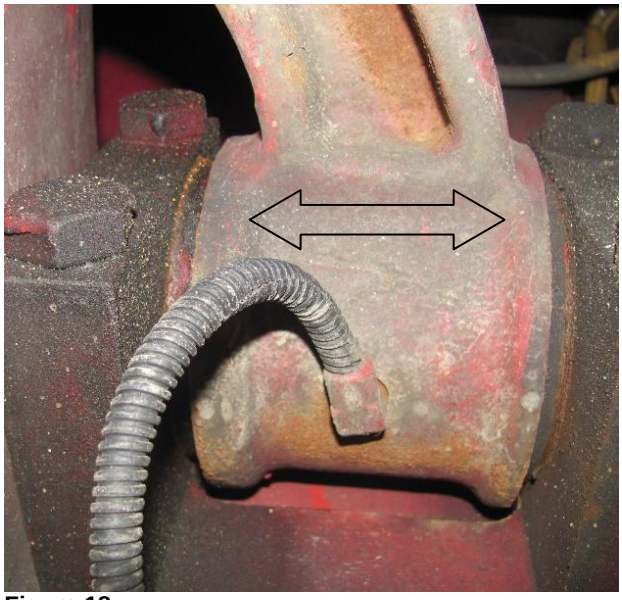


Figure 18

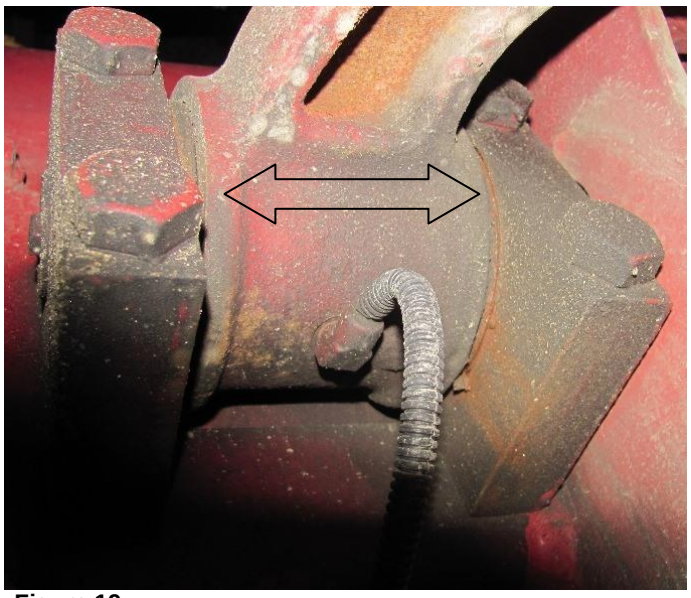


Figure 19

Figure 20

The right rear leaf spring has a broken retention strap (rebound clip). Figure 20.

“When a truck wheel hits a bump, the main leaf of the spring is strongly assisted by all the shorter leaves of the spring in resisting the shock. But, after the bump has been passed, the main leaf would ordinarily have to absorb most of the rebound all-by-itself, if the main leaf was not assisted in absorbing the rebound by the other leaves, attached to the main leaf by means of rebound clips.”

“Spring clips prevent breakage due to fanning.”

“The secondary function of the rebound clips is to prevent spreading or "fanning out" of the leaves, which might result in eventual breakage. For these two reasons, it is obviously important that broken rebound clips be replaced by "properly adjusted" rebound clips.” Reprinted from Suspension Specialists, Inc.

Engine 294 is equipped with a Westerbek 8 kilowatt diesel generator that needs preventative maintenance, oil changed, filters replaced, etc. Generators should have their voltage and Hertz (cycles) output checked at least a couple of times a year. A variation in Hertz even by a relatively small amount (2 or 3 cycles) can significantly reduce the service life of everything from light bulbs to electric motors to electronic devices.

This apparatus has a Waterous Model CM fire pump rated at 1250 GPM that is equipped with a Husky Compressed Air Foam System (CAFS). Review of pump test records for years 2010 – 2014 inclusive shows that E-294 easily passes its annual pump test and pump performance is consistent and strong. The CAFS foam system was out of service when the apparatus was inspected pending the completion of ongoing repairs. The Husky foam system is a proprietary brand to Pierce manufacturing. While it is a quality unit anytime you have a proprietary component it narrows the availability of parts and technicians to do repairs. Repairs to the CAFS systems have the potential to be moderately expensive.

Engine 294 has extensive rust and rot conditions, much more extensive than you would expect to see on a vehicle this age and also much more extensive than can be attributed to the chemical deicing agents used on public roads during the winter months. The rust and rot conditions do not seem to affect a particular component or area of Engine 294 but are spread virtually throughout the vehicle in varying degrees. The following pictures will illustrate the nature and extent of the corrosion problems on Engine 294. Recommendations on what type of work needs to be done to mitigate some of these issues will be addressed later in the report since the corrosion problems aren't confined to a single vehicle.

Figure 21

Figure 21 shows a chassis component that has paint blistering off some sections. The paint on the component is clean and free of any road deposits. Since the chassis was not cleaned and there was no special preparation prior to the picture being taken this would reinforce the theory that deicing chemicals are not the cause of all the rust/rot problems.

Figure 22 shows other chassis components with rust damage. The arrow is pointing to an area where the paint is blistered and rust is forming under the paint but has not yet broken through.

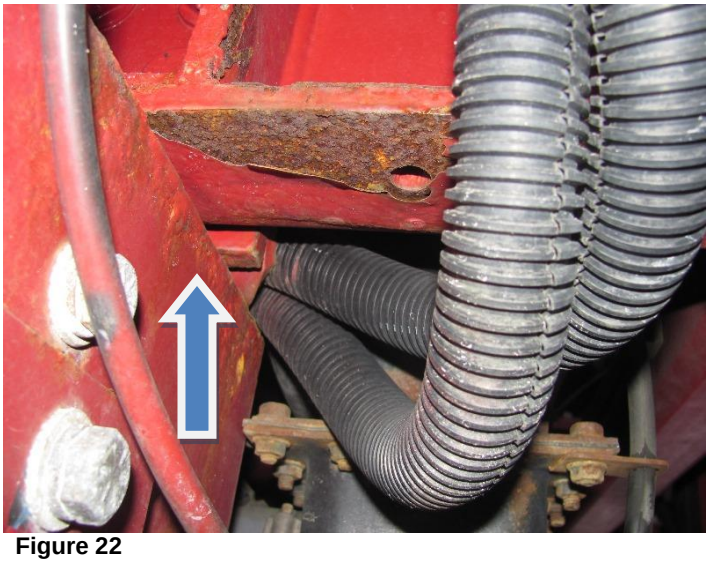


Figure 22

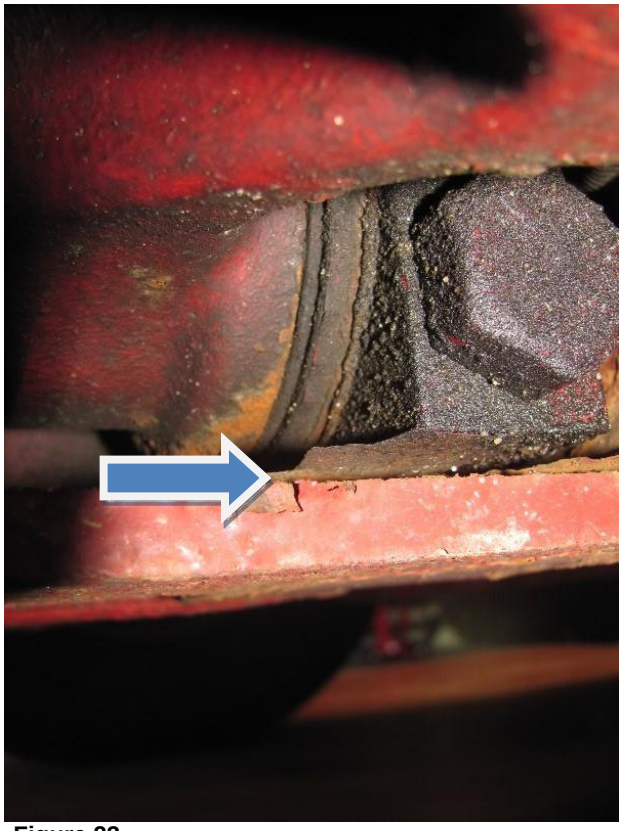


Figure 23

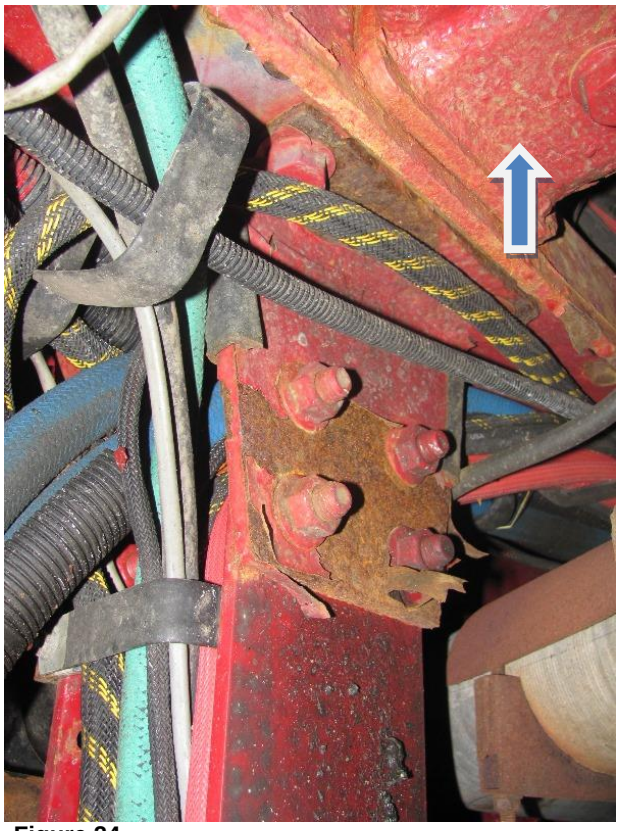


Figure 24

Figures 23 & 24 show more rusting problems. The arrow in figure 23 is pointing to some paint that is delaminating from the surface it is applied to. Delamination (defined by Merriam-Webster as: separation into constituent layers), is a common condition on Engine 294 and in my opinion indicates more problems than can be related to road chemicals. The arrow in figure 24 is pointing to an area previously repaired.

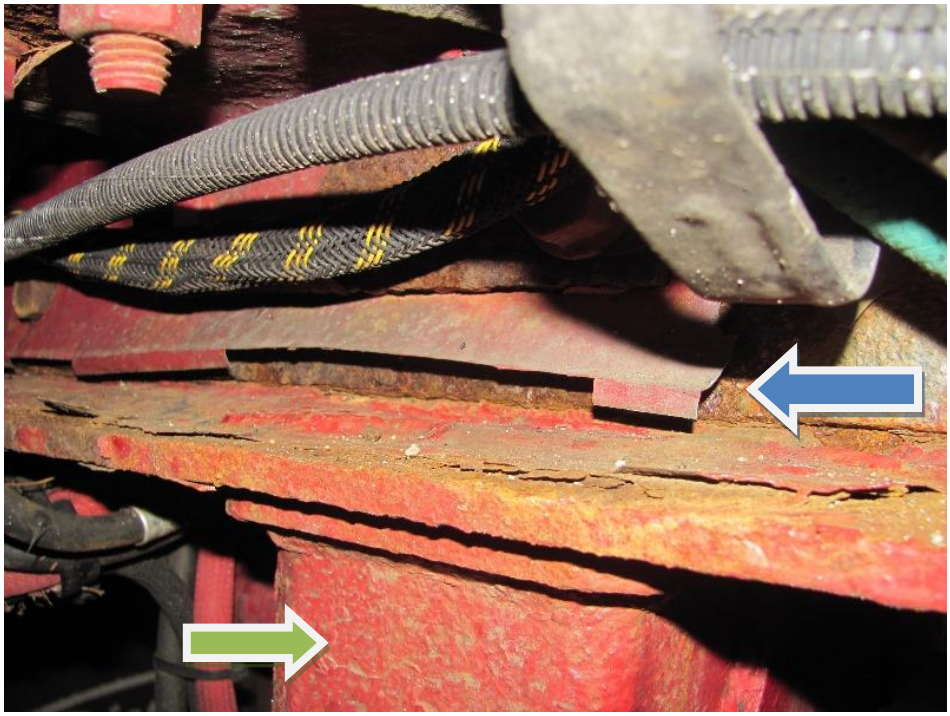


Figure 25

The blue arrow in figure 25 is pointing to the worst area of delamination observed in Engine 294. This actually looks more like a piece of sheet metal peeling away. The green arrow points to another area that had previously been repaired.

Figure 26

Figure 27

Figures 26 & 27 show the deterioration of the suction piping on the right side of the apparatus. There is rust visible on the shoulders for the butterfly valve and deep material loss to a suction pipe. Failure of the suction pipe is only a matter of time.

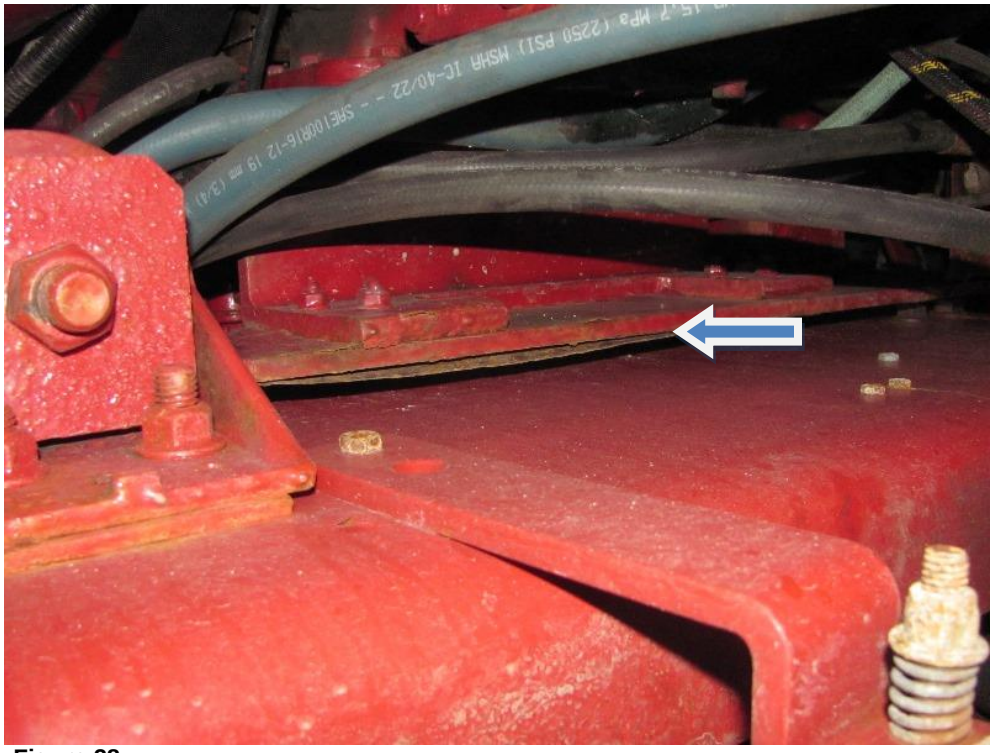


Figure 28

Another example of delamination is highlighted by the blue arrow in figure 28.

Some of the corrosion that is visible on the exterior of the apparatus body is shown in figures 29 & 30. Difficult to see in the photograph the blue arrows are pointing to areas on the hard suction trays where the paint is blistering from rust but it has not broken through. The rust damage is worse than currently visible.

Figure 29

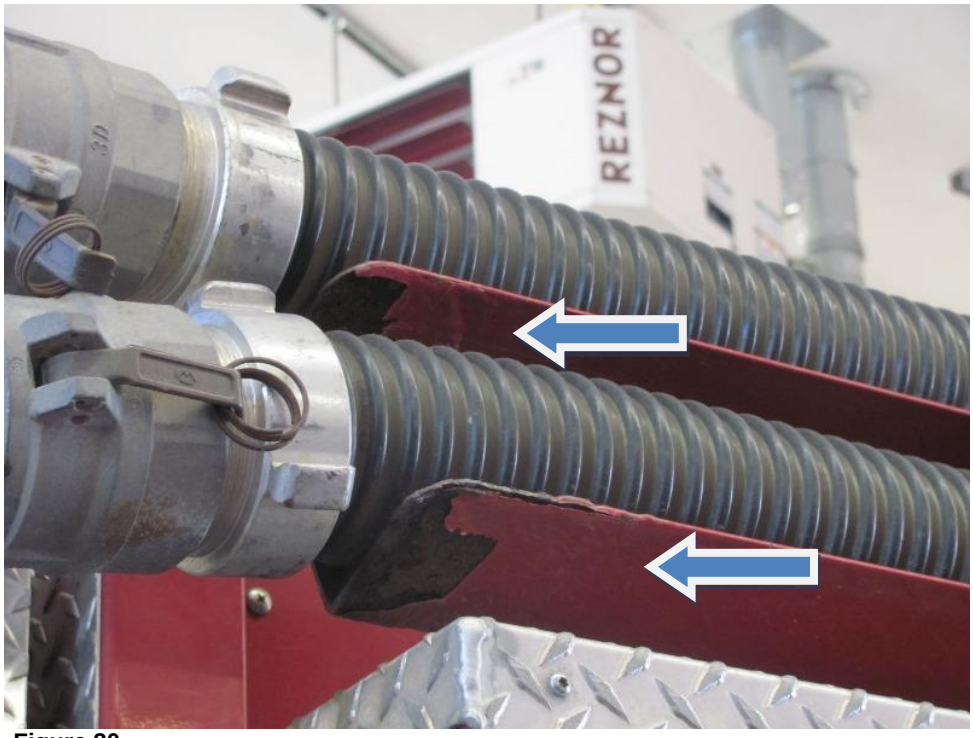


Figure 30

Figure 31

Figure 32

Figure 31 shows rust damage in a compartment interior. The problem is caused by a long standing water leak. This type of leak should be discovered and repaired long before the rust gets to this point. There was no apparent reason for the rust shown in figure 32.

Figure 33

Figure 34

Figures 33 & 34 show two (2) electrical connections points that are not well or properly terminated. This type of connection was not uncommon when Engine 294 was built. It is not something that you would find on apparatus today.

Ladder # 297

Figure 35

2002 Pierce Quantum
Manufactured: 2002
VIN: 4P1CT02E52A002599

Mileage: 43,771.1
Engine Hours: 3734.9

Vehicle Weight Chart		
	Rated	**Actual**
Gross Vehicle Weight	52,500 lbs.	48,660 lbs.
Front Axle	21,500 lbs.	18,800 lbs.
Rear Axle	31,000 lbs.	29,840 lbs.

This vehicle is a Pierce custom cab and chassis assembly with a Quantum model cab that seats six (6) in a fully enclosed cab. The apparatus body is an extruded aluminum rear mount aerial body carrying 400 gallons of water and is powered by a Cummins ISM diesel motor and an Allison 4060P automatic transmission. Equipped with a 75' rear mount aerial ladder and Waterous fire pump Ladder 297 carries 73' of ground ladders. Ladder 297 falls just short of the 85' ground ladder compliment that is needed for a designation as a "Quint".

Inspection of Ladder 297 showed it to be in fair physical condition and good mechanical condition with some issues that need to be addressed. Like its counterpart Engine 294 the biggest problem with this apparatus is its general physical condition and the fact that it also has significant rust and rot issues. While the rust and rot issues are not as extensive as Engine 294 they are certainly problematic and need to be addressed sooner rather than later. Also similar to Engine 294 the rust and rot conditions are more extensive than you would expect to see on a vehicle this age and more extensive than can be attributed to the chemical deicing agents used on public roads during the winter months. Also with this apparatus the rust and rot conditions do not seem to affect a particular component or area but are spread virtually throughout the vehicle in varying degrees.

Ladder 297 is equipped with a Waterous Model CSU fire pump rated at 1500 gallons per minute (GPM). Review of pump test records for years 2011 – 2014 inclusive shows that Ladder 297 easily passes its annual pump test and pump performance is consistent and strong. There are two (2) items on the fire pump that need to be addressed. There is a leak at the pump packing which may be able to be corrected with an adjustment.

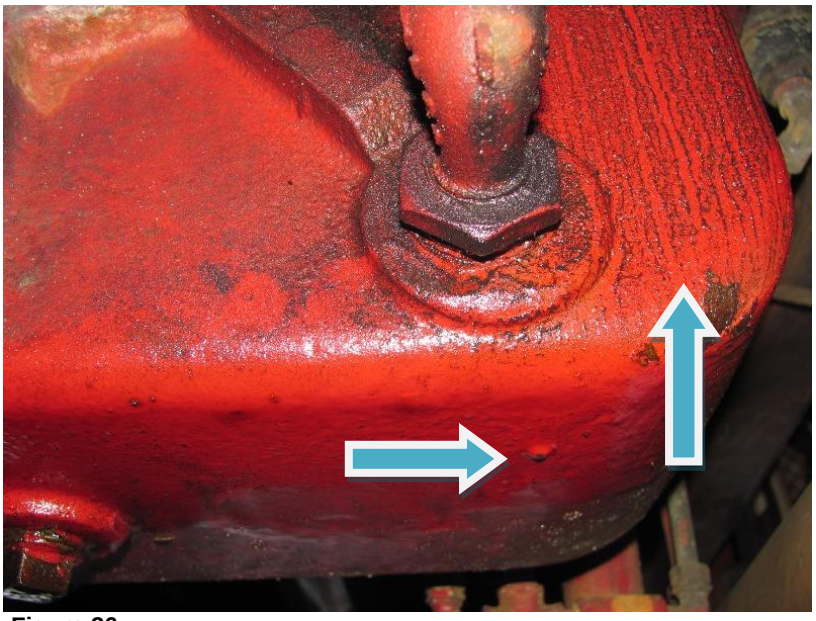


Figure 36

Like ET-296 there is a hydraulic fluid leak in the pump transmission. There is streaking on the rear of the pump transmission case and droplets of hydraulic fluid are forming along the bottom edge of pump transmission. This leak could be as simple as the pump transmission being overfilled when cold and them as the transmission fluid warms up and expands the excess is pushed out of the breather or there may be a leak in pump transmission. The outside of the pump transmission should be cleaned and the situation observed. Figure 36.

Review of the ladder test reports from 2011 – 2014 inclusive show that the aerial device and its support structures are in generally good condition. Where defects have been reported, they are in-line and typical with the age of the vehicle and the type of problems often seen. The outriggers and the aerial device operated well and the hydraulics were smooth. The aerial PTO for the hydraulic system activated easily with no engagement problems. Hydraulic system pressure was good throughout the range of movement and there was no indication of excessive drift in the aerial device.

The sheave wheel located on the left side, top, of the aerial bed section is worn and should be replaced. Figure 37.

Figure 37

Figure 38

There is some wear on the slide pad contact areas along the aerial device, figures 38 & 39. This is exactly where you expect to find wear. There are some spots that the paint coatings have worn through and some minor surface rust visible.

Figure 39

Figure 40

None of the wear observed appears to be extensive but there is some grease that is heavily discolored by rust and these areas will need to be more closely inspected after they are cleaned, figures 40, 41, & 42.

Figure 41

Figure 42

The aerial ladder has been lubricated and while greasing is an important part of the aerial device maintenance, it is also a bit of a double edge sword. Grease latches on to airborne dust, dirt and sand particles prevalent when driving down the street in in beach front communities. On dry winter days the deicing materials used on the roadways can create a dust condition. As these particles mix with the grease it begins to transform from a lubricating agent into a grinding compound causing wear rather than reducing it. That is why it is critical to periodically remove the old grease before added new.

The aerial device on Ladder 297 including the cabling and sheaves needs to be cleaned, degreased, and lubricated. This should actually be done annually, generally in the spring months. This is something that can be done in house, but it is a messy job. Tasks like this could be accomplished by on duty personnel or handled through a couple of special work details. Hiring an outside vendor is also an option.

This would be an excellent opportunity for the West Barnstable Fire Department to check with the manufacturer about the recommended procedures for cleaning and lubricating the aerial device and its components. It would be prudent to enquire about the proper cleaning chemicals and different lubricating products that should be used and what are the recommended intervals that this type of maintenance. Being able to properly clean and maintain the aerial device should translate to less downtime and repair cost over the life of the apparatus.

Ladder 297 is equipped with a Winco 6 kilowatt diesel generator that needs preventative maintenance, oil changed, filters replaced, etc. The exhaust system piping is heavily corroded and should be replace and reinsulated to protect personnel. Generators should have their voltage and Hertz (cycles) output checked at least a couple of times a year. A variation in Hertz even by a relatively small amount (2 or 3 cycles) can significantly reduce the service life of everything from light bulbs to electric motors to electronic devices.

The following pictures will illustrate the nature and extent of the corrosion problems on Ladder 297, which are spread throughout the vehicle from the chassis rails to the aerial device. Recommendations on what type of work needs to be done to mitigate some of these issues will be later in the report since the corrosion problems aren't confined to a single vehicle.

Figures 43, 44, 45, & 46 show various locations and degrees of rust and corrosion on the apparatus chassis.

Figure 43

Figure 44

Figure 45

Figure 46

Figure 47

Figure 47 shows some delaminating rust condition on portions of the pump enclosure support framing where it attaches to the apparatus chassis.

Some of the corrosion visible on the outriggers and their components are detailed in figures 48, 49, & 50.

Figure 48

Figure 49

Figure 50

The rust and corrosion is not confined to the chassis. It extends to the upper surfaces of Ladder 297 including the aerial device and its components. Figures 51, 52, & 53

Figure 51

Figure 52

Figure 53

In figures 54, 55, and 56 there are two (2) points being illustrated. The first is dry leaf spring shackles with a fair amount of road dirt collected on the grease fittings. The chassis is not getting the level of preventative maintenance that it should. Broken leaf springs are almost epidemic in the fire service and the main reason is that preventative maintenance is missing, and in this case good and thorough lubrication. Each of these photos shows to some degree road, dirt, sand, and salt deposits on different surfaces of the undercarriage. This is exactly what you want to get rinsed off the apparatus on an ongoing and regular basis. Road dirt holds moisture, contains road salts and other corrosive chemicals that promote rust and rot.

Figure 54

Figure 55

Figure 56

Tanker # 286

Figure 57

1990 Oshkosh
Repurposed and Refurbished Military Fuel Tanker
Manufactured: November 1990

Mileage: 14,740
Engine Hours: 6,795.0

Vehicle Weight Chart		
	Rated	**Actual**
Gross Vehicle Weight	68,200 lbs.	59,800 lbs.
Front Axle	16,200 lbs.	14,300 lbs.
Rear Axle	52,000 lbs.	45,500 lbs.

Tanker 286 is an Oshkosh cab and chassis that began its life as a military fuel tanker and has been repurposed into a fire department water tanker. While repurposed tankers are something that has been utilized in the fire service for a long time they are also something that generally come with more than their fair share of problems. Fortunately and thankfully West Barnstable's avoids many of the issues normally associated with repurposed tankers.

Since the vehicle was originally designed as an airport fuel tanker height was critical so this vehicle was designed with low profile square style tank that is fitted low to the chassis rails. This eliminates the high center of gravity that plagues many tankers and contributes to many tanker rollovers. The people who worked on the refurb of this vehicle took in account the weight difference between aviation fuels and water (something that is often overlooked) and reduced the tank size by 1000 gallons. This keeps the weight of the fully loaded vehicle well within the design loads for the axles and braking system.

Finally and to the credit of the fire department are the operational restrictions under which this vehicle is utilized. Not equipping this vehicle with a siren and having it respond to alarms in a non-emergency mode is one of the most safety minded and forward thinking decisions that could be made. It is something that many fire departments could learn from. Given the number of firefighters hurt or killed in tanker accidents this is a protocol that is certainly saving lives. Tanker 286 is generally in good condition and powered by a Cummins diesel motor and equipped with an automatic transmission. The front tire date code is 4807meaning that these tires were manufactured during the 48th week of 2007, the rear tire date code is 0708. The tires on this apparatus are due to be replaced because of their age.

The pump is a low pressure pump left over from this truck's life as an aircraft fueler. It is not ratable as a fire pump and has not undergone annual testing. Since this pump is used only to off load the tanker and not for any firefighting it is adequate for its mission. It would be a good idea to test it in house once a year and record the results.

Inspection of Tanker 286 showed it to be in good overall condition with some rust on the chassis that is commensurate with age of the vehicle, figures 58 & 59.

Figure 58

Figure 59

There are three (3) items on Tanker 286 that should be addressed. The department is in the process of fitting the tank with sacrificial anodes, three of which were installed at the time the inspection with the fourth to be completed.

On the rear of the tank on the upper left hand corner there is a water leak through the welded seam. This should be cleaned, ground out and re-welded. The water is causing some corrosion to the aluminum which the longer it goes it will only make performing a successful repair harder. The leak is also staining the paint and will in time cause more extensive paint damage. Figure 60.

Figure 60

On the left side of the chassis, the forward support arm for the rear axle fender is broken. The fenders over the tandem rear wheel are a fairly thin sheet metal and need the extra support to keep from breaking themselves apart from road vibration. Since the broken side of the support arm is on the chassis side it also is causing more stress on the thin fender which will cause it to crack even faster. The broken support should be removed right away and replaced sooner rather than later. Note: This type of tubular support is pretty easily fabricated from a piece of electrical EMT tubing readily available at most hardware stores or home centers. Figure 61.

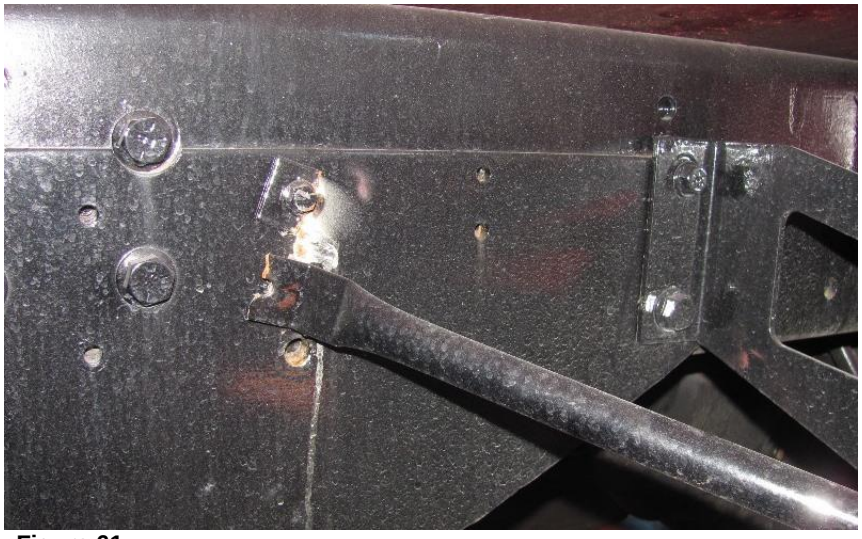


Figure 61

General Observations and Recommendations

Engine 294 & Ladder 297

Both of these vehicles have rust and rot conditions beyond what could be considered normal for their age. Engine 294 rust and rot is more substantial than what was observed on Ladder 297. It is easy to dismiss the rusting conditions as something that is being caused by the winter driving conditions especially since these apparatus are in use in the north east. But it really is not a fair or accurate statement to make. The chemicals and salts, in particular magnesium chloride, being used on roads today are contributing factors to some rusting and rot conditions. The problems that are being caused by road deicing chemicals are being increasingly well documented. Along with that comes a better understanding of the maintenance requirements needed to combat the damage caused. Much of the damage cited in reports and the types of conditions found are coming from the over the road trucking industry who's vehicles see a much greater exposure to road chemicals than fire apparatus. The lessons learned from this trucking industry can be very valuable to the fire service.

West Barnstable Fire Department operates other apparatus that is older than either Engine 294 or Ladder 297. None of these vehicles have rust or rot conditions anywhere near as extensive as either Engine 294 or Ladder 297. Since these vehicles are older it is reasonable to conclude that they have been exposed more often and over a longer period of time to winter road conditions. Since the rust and rot conditions observed on the older vehicles isn't as extensive as Engine 294 or Ladder 297 it is also reasonable to conclude that road deicing chemicals are not the sole source of the rust/rot conditions but a contributing factor. This would be especially true with Engine 294 which has already undergone repair and repaint for rust and still has very serious rust and delamination.

Rust and rot in fire apparatus has been a problem since the late 1960s. At that point the quality of steel was being cited as the problem. The reality is that the design and assembly of the body components probably contributed just as much to the rust and rot as did the quality of the of the steel. Booster tanks were another weak link in the fire apparatus body. They were always wet and often made of steel, tank rot was common. As the fire service moved to poly tanks rust and rot damage moved to other parts of the apparatus, primarily the fire pump and plumbing system. This is when it became apparent that electrolysis played a major part in the booster tank rot, the tank being the sacrificial surface. The use of sacrificial anodes in the fire pump has relived some of the problems as has the move from galvanized pipe to stainless steel and high pressure rubber.

The first electronic diesel engine controls were introduced in the late 1980s. At that point the electrical systems in fire apparatus were still reasonably basic, complex in layout but simple in form and function. Through the next fifteen years electronics have become a major component of fire apparatus. From the single electronic control module used on the diesel engine in the 1990s a fire truck today can have upwards of ten (10) control modules, more lights than ever, and increased communication equipment. As the electronics in fire apparatus grew so did issues that presented themselves, components out-of-service, ground problem, elctro-mechanical interference, radio frequency interference, and the list goes on. Talking with anyone involved in the care and maintenance of fire apparatus and you will find that there is certainly no shortage of wiring/electrical horror stories around. Manufacturers reacted to the problems and worked on improving electrical systems, which is in some ways on-the-job training.

Many lessons have been learned through the evolution of fire apparatus. Electric systems and electrical problems make up a majority of the problems/lessons learned. Some lessons were learned thought testing, some through problems that became apparent as apparatus were put into service and others through observation over a period of time. Each time the fire service was presented with problem, solutions were sought and implemented. The solutions often treated the symptoms rather than the disease. As changes were made to the methods and materials being used in the construction of apparatus the corrosion issues moved to different components of the apparatus.

Beginning in the mid-1990s the use of electronics in fire apparatus grew exponentially and possibly in some ways improperly from the standpoint of what some of the side effects are. As the use of electronics has increased the amount of electrical current flowing around the vehicle body has also significantly increased. Some industry personnel are not sure that even now the industry has a complete understand of how the increase in electrical components has effected and increased the metal deterioration associated with electrolysis. What has become apparent is that the electrical systems need to be much more stable and that stray voltage and electrical interference needs to be better managed.

Improper or inadequate grounding was having a much greater affect than anyone realized and may be a factor in the significant corrosion/electrolysis that has been observed in fire apparatus, especially those built between the late 1990s and mid-2000s. As the grounding of apparatus electrical systems has improved other issues have lessened, corrosion being one of them. Corrosion and electrolysis will always be with the fire service and continue to be something that needs to be managed on fire apparatus, with no complete fix. The solution or solutions will involve understanding the electrical, corrosion, and electrolysis issues better and how these issues are interrelated with each other. Making changes to the design and installation of the electrical system and components to limit problems caused by these issues along with better management of the maintenance part of the equation will be beneficial. Grounding of the chassis and body including the fixtures and components is critical. Grounding needs to be well installed and just as importantly well maintained.

All of this brings us back to Engine 294 and Ladder 297 and their corrosion problems. It is entirely possible that the corrosion issues are being exacerbated by electrical issues and electrolysis further compounded by grounding problems. EWFAC recommends that all West Barnstable fire apparatus, Engine 294 and Ladder 297 being the first, be retrofitted with ground straps to the following specifications:

- There shall be a minimum of two (2) ground straps installed between each chassis section; ie: cab, pump enclosure, compartment body and the chassis. NOTE: On apparatus with tilt cabs the ground straps have to be installed around the cab pivot point.

- Each ground strap shall be rated to carry a minimum of 125% of the electrical load for the vehicle section it is attached to. If you are unable to calculate the electrical load of any body section then use a 4 gauge or larger battery cable.

- All grounding straps and/or grounding wires shall be either un-insulated or black in color. Black should NOT be used for any power application other than grounding throughout the vehicle.

- Wherever/whenever a ground strap connection or attachment point is located on a painted surface the paint shall be removed to the bare metal and the ground strap(s) installed and the connection point sealed with a marine grade electrical sealer.

- Parallel ground straps are designed to be redundant in nature and therefore shall NOT share common connection points.

- Check battery terminals and make sure they are clean and tight.

- Check the battery ground cable to frame connection points make sure they are clean and tight. Check between the various ground strap to frame connection points and the negative battery cable terminal(s) with an ohm meter to make sure that there is little or no resistance on the ground path.

- Ground straps and/or ground studs should be connected by wire directly to the battery negative terminals and not reply on the body or chassis material to make the connection.

The type of paint, both primer and finish coats should be confirmed with Pierce for both of these vehicles. The information sought should be the paint manufacturer and type of paint, along with the color numbers. Once West Barnstable has this information the paint manufacturer should be contacted and ask to inspect the vehicles. Explain to them that two (2) of your apparatus has large scale delamination and other rusting issues. Also explain that the department is considering have the vehicles refurbished and that you are trying to get some definitive answers as to what is causing this problem so that the refurb specifications can properly address a solution.

Most of paint companies will have their area representative check a reported problem like this. They may even take samples to send to their lab for further analysis. Either way you get an independent and authoritative source as to what may be causing or contributing to the delamination issues.

Apparatus Maintenance

West Barnstable utilizes outside vendors to perform annual aerial ladder and fire pump testing. The department is very good about following up on repairing the deficiencies noted in the reports. EWFAC recommends that this process be continued with the following modification:

- NFPA 1911, Section 18.7.7.6 requires that the information gained from pump testing be taken and recorded a number of different times during each testing phase. If this information is being captured during the testing program it is not included in the reports. Speak to your vendor and explain to them that the fire department wants the pump test readings as mandated in NFPA 1911 included in the test reports.

Review of apparatus work order, maintenance records, and testing records show that West Barnstable supports an active apparatus preventive maintenance and repair program. The recording and tracking of work orders, current status and completion is better than many departments and should be continued. The program is not without the need for some adjustments. Some of the issues the fire department has no control over, some are just because the department does not know. Part of the equation is refining what is already being done to

improve the type and level of information being gained and to improve the maintenance program and its compliance with industry standards.

A copy of the current edition of NFPA 1911 Standard for the Inspection, Maintenance, Testing and Retirement of In-Service Automotive Fire Apparatus (1911) should be added to the Fire Department Library. Department personnel who are responsible for both the planning and tracking of maintenance and repairs along with those who are actually preforming the work should become familiar with the 1911 document so they understand the type and scope of work and record keeping that is codified. 1911 should also be routinely used as reference document for guidance when making apparatus repair decisions.

All of the apparatus inspected had some level of needed repairs and out-of- service conditions. Some of the conditions noted were apparently not new. Others like the grease fittings that did not get grease (auto-lube not working), or the rotted fuel tank straps on Ladder 297 were just oversights. Some such as minor leaks that are known and waiting repair are just a function of available personnel or funds to make the repairs. Many are relatively minor deficiencies but they can become costly if not addressed.

Part of the problem is that both Engine 294 and Ladder 297 have conditions that cause an inordinate strain on the apparatus repair program both in terms of financial expense and man-hours. Solutions to the problems with these two (2) vehicles should help with being able to better address some of the other repairs needed.

Most departments have some inspection protocol and a mechanism in place to report needed repairs. West Barnstable's reporting program is very good but the inspection side of the protocol needs to be improved and expanded. In addition to daily and weekly checks a more complete apparatus inspection program that will look at the apparatus on a quarterly, semiannual, and annual basis. Parts of these inspections can and should be done by the apparatus operators but other parts need to be performed by a mechanic with the practical knowledge and understanding of heavy vehicles and with the training and expertise to be able to recognize deficiencies that a layman might overlook. Documentation is a key factor. There must be written check lists, ways to document deficiencies, apparatus repair orders, and apparatus driver reports should be used and maintained on file.

NFPA 1911 codifies the guidelines and recommendations on apparatus inspections, inspection cycles (daily, weekly, monthly, etc), maintenance, out-of-service criteria, and retirement. NFPA 1911 is the standard that must be adhered to and should be used for guidance in establishing or modifying an apparatus inspection and maintenance program. There is room in the NFPA standard as well as manufacturers recommendations to customize the inspection and maintenance cycles to fit the needs of the community and their duty cycles of their apparatus. There is no room in today's liability driven world for not having a program in place that meets recognized standards.

West Barnstable gets hit by a one/two punch environmental conditions that complicate and increase the need for apparatus preventative maintenance. Being a northeast community the apparatus is subjected the corrosive actions of the different chemicals used on public roadway during the winter months. Being a Cape Cod community the apparatus is subjected the corrosive conditions caused by the salt air. To help combat these conditions EWFAC recommends that the following procedures be implemented. During the winter months when the roads are wet and the apparatus returns to quarters they should be given a quick rinse

concentrating on the lower sections. The wheel well areas, along the bottom of the compartment body, under the rear steps, etc. Taking less than 10 minutes to complete it removes a fair amount of the material that contributes to corrosion. At the very least in the spring after the winter season has concluded the apparatus should be sent to a truck washing facility that has chassis washing capabilities. Each vehicle should be run through the chassis wash was a minimum of two (2) times. If a chassis wash could be arranged about half way through the winter season for each vehicle that would be even better. EWFAC does not recommend power washing the apparatus chassis.

Each spring for each vehicle, the department should implement an apparatus cleaning program. This should encompass a complete and thorough cleaning of each vehicle beginning at the front bumper and ending at the rear step. This type of cleaning includes a complete washing of the apparatus, inside and out. The pump panels should be opened and the pump and plumbing rinsed. All of the tools, equipment, and floor matting should be removed from each compartment. Compartments, swept, washed, and allowed to dry. The tools, equipment, and floor matting should be washed or wiped down as needed. As this is being done, tools and equipment should be inspected for any deficiencies (dull cutting edges, cracked handles, refinishing needed) and tended to as needed. This work can be done in segments by on-duty personnel. The goal here is a complete and very thorough cleaning to remove salt residue, sand, and dirt from the vehicles and is not something that should be rushed through. Top of the compartment body should be cleaned, the aerial device hosed off and ground ladders done as part of this.

When the exterior washing is completed on a vehicle it should be waxed. Given West Barnstable's ocean exposure apparatus getting waxed in the spring and in the fall would be ideal but may not be feasible.

Maintenance Personnel

Whether it is a fire department or a fire apparatus repair shop a universal challenge is finding and keeping good quality mechanics. West Barnstable is fortunate to have one. He is however a part-time employee and this needs to be addressed so that the risk of losing a valuable asset is reduced. Does a small department like West Barnstable need a full-time mechanic? No, it probably does not. Does West Barnstable need someone at the fire department working on their apparatus more often? Yes, it certainly does. Chief Maruca has an excellent plan to secure full time employment for a mechanic but it requires a combined effort between West Barnstable and some of its neighboring departments. EWFAC encourages the governing board of West Barnstable to work with their counterparts in other departments to create a shared, full-time, mechanic position.

Training and certification(s) of maintenance personnel is critical in today's liability driven world. Beyond the legal reasons for making sure your maintenance personnel and also the outside vendors used are properly trained and certified, there are very real practical reasons. Fire apparatus are very complex in nature often employing different systems (12 volt electrical, 120 volt electrical, pump and plumbing, hydraulic system) on a single chassis. They also represent a large capital investment and as an emergency vehicle needs to be ever ready and reliable. Having well trained personnel working on these vehicles is really the only practical decision and it protects your investment.

There are several sources for training on fire apparatus. Manufacturers' training conducted by apparatus manufactures specializes in their particular apparatus. Trade association training, Fire Department Safety Officer's Association Annual Apparatus Symposium, training by various component manufacturers, and Spartan's Fire Truck Training Conference are a few of the opportunities. The cost varies from relatively low to some that are expensive. Personnel should concentrate on getting training for the scope of work they are performing.

Certification for training is usually issued at the conclusion for each course successfully completed. In addition the Emergency Vehicle Technician Commission, Inc. (EVTCC) has a testing and certification program that builds in steps. In addition to any course certificates personnel working on emergency equipment should be EVTCC certified in the areas of work they perform.

For a department in New England being a member of and attending training/meetings as possible in the New England Fire Apparatus Maintenance Association is recommended.

Using an outside vendor or vendors, especially one that specializes in emergency apparatus, is a must. There is work that just can't and in some cases should not be done in house. Other work needs to be done by a vendor to keep warranties valid. The fire department needs to have outside vendors that they can rely on to work on their apparatus. Unfortunately finding reliable, quality vendors is often a hit and miss process. Once vendors are identified the fire department needs to make sure they are qualified and certified in the scope of work and services being offered.

The investigation into the brake failure of Boston Fire Department ladder truck that led to a fatal accident in January of 2009 brought to light many problems with the way Boston handled their apparatus maintenance program. However, there are lessons to be learned by everyone involved with the care and maintenance of emergency apparatus. One of the things that investigators took Boston to task over was not following up on the scope, completeness and quality of the work being done by the outside vendors performing work on their fire apparatus fleet.

It is assumed that a vendor especially one that specializes in fire apparatus is performing up to the standards demanded by the industry. But this isn't always the case. The Boston report made it pretty clear that the responsibility for the condition of fire apparatus is the fire department's. If there is evidence or the fire department suspects that work isn't being done to a level demanded by the industry they should meet with the vendor to express their concerns and make sure the vendor understands the level of quality that is expected. If this does not lead to improvements then other options should be considered.

Apparatus Replacement

Normally this would be an easy recommendation to make, since Engine-Tanker 296 was manufactured 1985 well before the benchmark 1991 NFPA Standard that really mandated many operator/occupant safety and all of safety improvements than have been incorporated in fire apparatus (anti-lock brakes, improved seat belts, electronic stability control, enclosed seating, etc.) EWFAC would say that 296 is the vehicle to replace.

However West Barnstable is has significant problems with both Engine 294 and Ladder 297 that need to be addressed first. Both of these vehicles suffer from delaminating rust and rot conditions in varying degrees with Engine 294 be the worst. The rust/rot conditions of these vehicles dictate that they need to be the first priority repair/replace cycle. The question then becomes what should be done. Should one or both be refurbished or should one or both be replaced?

Refurbishment should be looked at as a method to extend the life of apparatus and control cost since it is less expensive than replacing a vehicle. Since the department already owns the vehicle(s) there is no upfront cost and the service/repair history is also familiar. Refurbishment also has its drawbacks because you are not getting a new vehicle, which may eliminate the ability to take advantage of the new technology that is available. There is a substantial out-of-service time for the apparatus while it under goes refurbishment which means the department is without the unit. Some apparatus may not be good candidates for refurbishment or the refurbishment cost is just too high to justify. Refurbishment has to be considered on case by case basis and carefully analyzed before the decision is made.

The cost of ownership to West Barnstable for Engine 294 is inordinately high and this appears to be largely driven by the rust/rot conditions. The cost of ownership is what it costs to keep that apparatus in service on a day to day basis. Part of the equation is out-or-service time, either for the apparatus as a whole or a particular component of the apparatus. Another part of the equation needs to be the cost of refurbishment that is after all something that will need to be paid for.

Too often when municipal budgets are being done the information in one column does not get to mesh with the information in a different column. Typically the information on what it is actually costing a fire department to keep a vehicle in service is rarely applied to the calculation of the cost of replacement. A percentage increase in a maintenance or operations budgets often get passed with little or no question while a capital expense like apparatus replacement is questioned to death or dismissed as “something we could never afford”. Closer examination of the cost involved in fleet operation cost may prove otherwise.

Since routine operation and maintenance (grease, oil, filter, fuel and wear items) is basically a fixed cost for apparatus whether it is new or old, it is the cost of repairs that drives the expense of keeping a vehicle on the road. If it costs $ 30,000.00 a year (illustrative only) to keep a vehicle in service and $ 6,000.00 of that is operations cost, routine maintenance, and annual testing, that means that it is costing $ 24,000.00 a year in repairs to keep the vehicle in service. New apparatus can be purchased with a two (2) year warranty. So in theory there is no repair cost in the first two years of ownership of new apparatus meaning that there is $ 48,000.00 from saved operating cost that can be applied to capital purchase without any increase in the budget. When the repair cost, more accurately the reduced repair cost is extrapolated over the first five (5) or ten (10) years of vehicle ownership the savings due to reduced operating cost is even greater.

In the case of Engine 294, if the cost of refurbishment is $ 200,000.00 (illustrative only) that figure also has to be considered when establishing a budget because you are going to spend it whether it is for a new vehicle or repairs. How many lease or bond payments towards the cost of a new (or used) apparatus would this money pay for? Add to that any money realized by the sale of Engine 294 and the department could well find they are half way to the cost of a new pumper with the projected savings of the cost of keeping the current unit in service.

Given the extensive rust/rot conditions on Engine 294, the scope of the work needed to do a successful refurbishment and the anticipated costs both financially and in lost service EWFAC does not believe that Engine 294 is a good candidate to be refurbished. Because of the extensive rust/rot conditions of Engine 294 the replacement process should begin as soon as possible. It is and will continue to be an expensive vehicle to keep in-service. As time goes on the costs of operating this apparatus will only increase.

Since the rust/rot conditions on Ladder 297 are not as severe as Engine 294 and given the cost of Quint fire apparatus EWFAC does think that Ladder 297 is a candidate for refurbishment. A final decision should not be made until specifications for refurbishment are produced and bid because that is only time you will really have an idea of the costs involved. Having been involved in several refurbishment projects over the years one thing I can tell you is that you need to figure 20 to 25% more than the bid pricing when setting your budget. No one has x-ray vision and there are always things that become apparent as the apparatus is disassembled that was not visible beforehand that will inevitably add to the scope and cost of the project. Since the rust/rot conditions on Ladder 297 mirror the conditions on Engine 294 they will also get worse as time goes on and become more expensive to deal with. Refurbishment should not be put off for years doing so will only compound the problems and add to the cost.

Purchase of used apparatus can be considered as a solution and may be a good way to help reduce the cost of apparatus replacement. Used apparatus should not be purchased to replace front line equipment unless it is a good fit into and meets the fire departments operation methods and needs. It is very important that any used apparatus fit into the department's vehicle layout and functionality. There are always concerns when purchasing anything used so a thorough inspection, historical review of maintenance and repair records, and testing is critical.

Leasing fire apparatus is another option to explore and should be looked at as a method to spread the expense out over time when replacing apparatus. Unlike leasing a car the purchaser has much more input into the terms of the lease, which is a more customer friendly. Leasing can also be for shorter terms as opposed to using bonds for the purchase of apparatus.

Accepted apparatus life span has traditionally been 20 years for an engine (pumper) or rescue and 25 years for a truck (ladder) in departments with a moderate call volume. This has changed little in decades while call volumes and the type of services being required have consistently increased. Fire departments need to look at whether current life span standards are still practical for their needs. There is currently a robust used apparatus market and it can make sense for a municipality to consider shorter life spans and greater resale value with the funds offsetting the cost of newer apparatus.

Keeping apparatus past expected life expectancies, except as spare, is rarely a good idea, often more costly than municipalities estimate, and can lead to increased replacement costs. Keeping older apparatus also usually delays replacement, this negatively affects replacement cycles and usually costs more in the long-term.

It is anticipated that this information will help with fleet decisions. EWFAC is available to discuss this report in detail and answer any questions you may have.

WEST BARNSTABLE FIRE DEPARTMENT
APPARATUS MAINTENANCE EXPENDITURES
BUDGET TO ACTUAL FOR FY15
AS OF JUNE 30, 2015

APPARATUS NAME	MAKE/MODEL		FY15 BUDGET		FY15 ACTUAL	FY15 ENDING
A-293	2007 Chevy Lifeline		$ 3,000.00		$ 2,700.43	$ 299.57
E-294	2002 Pierce Pumper		$ 6,500.00		$ 13,260.17	$ (6,760.17)
B-295	1957/1974 Military Brush Breaker	a	$ 25,390.40		$ 1,320.20	$ 24,088.20
ET-296	1985 Pierce Pumper/Tender		$ 1,800.00		$ 1,478.20	$ 721.80
L-297	2002 Pierce Quint		$ 6,000.00		$ 16,420.27	$ (10,420.27)
C-280	2007 Chevy Pickup		$ 1,000.00		$ 1,293.86	$ (293.86)
P-290 *	2012 Ford F-450		$ 1,000.00		$ 650.45	$ 349.55
T-286	1991 Oshkosh Military 5,000 gallon tender		$ 1,200.00		$ 2,484.78	$ (1,284.78)
SH-287	2004 Ford F-350		$ 250.00		$ 519.58	$ (269.58)
F-288	Military Truck		$ 400.00		$ 761.67	$ (361.67)
MCI TRAILER			$ 50.00		$ -	$ 50.00
LIGHT TRAILER			$ 250.00		$ -	$ 250.00
AIR TRAILER			$ 1,000.00		$ 522.00	$ 478.00
GENERAL			$ 9,000.00		$ 2,748.40	$ 6,251.60
TOTAL			$ 56,840.40		$ 44,160.01	$ 13,098.39

a-Includes $24,640.40 special article to rehab B-295

WEST BARNSTABLE FIRE DEPARTMENT
APPARATUS MAINTENANCE EXPENDITURES
FY 11-FY 15
AS OF JUNE 30, 2015

APPARATUS NAME	MAKE/MODEL	MILEAGE	HOURS	FY 11	FY 12	FY 13	FY 14	FY 15	FY 11-FY 15 CUMMULATIVE	5 YEAR AVERAGE
A-293	2007 Chevy Lifeline	56,620	3316.0	$ 2,389.14	$ 5,304.40	$ 8,317.67	$ 3,304.09	$ 2,700.43	$ 22,015.73	$ 4,403.15
E-294	2002 Pierce Pumper	14,987	3069.0	$ 9,907.88	$ 10,511.85	$ 58,546.16 **	$ 14,482.89	$ 13,206.17	$ 106,654.95	$ 21,330.99
B-295	1957/1974 Military Brush Breaker			$ 1,103.21	$ 287.47	$ 683.90	$ 403.11 #	$ 1,320.20 @	$ 3,797.89	$ 759.58
ET-296	1985 Pierce Pumper/Tender	53,679	931.0	$ 587.94	$ 769.45	$ 3,832.79	$ 4,834.80	$ 1,478.20	$ 11,503.18	$ 2,300.64
L-297	2002 Pierce Quint	44,338	3806.0	$ 1,826.37	$ 6,702.54	$ 6,050.95	$ 4,199.43	$ 16,420.27	$ 35,199.56	$ 7,039.91
C-280	2007 Chevy Pickup	107,256		$ 888.34	$ 1,485.69	$ 1,260.48	$ 763.25	$ 1,293.86	$ 5,691.62	$ 1,138.32
P-290 *	2012 Ford F-450	3,715	37:14	$ 1,324.64	$ 1,121.41	$ 8,758.73 ***	$ 8,447.43 ****	$ 650.45	$ 20,302.66	$ 4,060.53
T-286	1991 Oshkosh Military 5,000 gallon tender	14,740	6836.0	$ 13,369.98 *	$ 600.81	$ 3,943.08	$ 3,045.02	$ 2,484.78	$ 23,443.67	$ 4,688.73
SH-287	2004 Ford F-350	43,146		$ 275.00	$ 1,169.79	$ 132.68	$ 3,163.31	$ 519.58	$ 5,260.36	$ 1,052.07
F-288	Military Truck							$ 761.67	$ 761.67	$ 761.67
MCI TRAILER		n/a		$ -	$ -	$ -	$ -	$ -	$ -	$ -
LIGHT TRAILER		n/a	420.6	$ 193.28	$ -	$ 42.63	$ -	$ -	$ 235.91	$ 47.18
AIR TRAILER		n/a	164.7		$ 525.00	$ 500.00	$ 587.46	$ -	$ 1,612.46	$ 322.49
GENERAL		n/a		$ 1,371.71	$ 587.90	$ 785.94	$ 1,860.83	$ 1,887.76	$ 6,494.14	$ 1,298.83
			TOTAL	$ 33,237.49	$ 29,066.31	$ 92,855.01	$ 45,091.62	$ 42,723.37		

** FY 11 Includes $12,912.46 Rehab Special Article*
*** FY 13 Special Article to repair rust and rebuild pump*
**** FY 13 includes purchase of pump for installation on truck*
***** FY 14 includes F-290 Modifications charged to FY 14 Special Article 13*
 # FY 14 includes special article 14-14 rehab B-295 of $359.60
@ FY 14-15 special article 14-14 to rehab B-295