

**An Analysis of Euclid Fire Department's Apparatus Maintenance Program**

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## CERTIFICATION STATEMENT

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## ABSTRACT

The problem this research examined was that frequent malfunctions have caused apparatus shortages that resulted in service reductions and threats to both public safety and Euclid Fire Department personnel.

The purpose of this study, and the corresponding research questions, was to identify and describe how the Euclid Fire Department maintains fire apparatus, what processes other agencies use to maintain their fire apparatus, and what can be done to improve the Euclid Fire Department's apparatus maintenance program.

A literature review involved four textbooks, four National Fire Protection Association standards, three Executive Fire Officer papers, the Commission on Fire Accreditation International self-assessment manual, City of Euclid documents, City of Euclid demographics, a line-of-duty death investigation, and a private investigation of the apparatus maintenance program of the Boston (MA) Fire Department.

Descriptive research was the research methodology for this paper. Procedures to obtain data included interviews with 15 comparably-sized agencies. In addition, 15 fire departments within Cuyahoga County were assessed. While the results were inconclusive about which methodology of apparatus maintenance is best, those agencies with their own mechanic(s) reported they were "very satisfied" with their maintenance program.

It is recommended that the Euclid Fire Department consider modifying its existing methods of apparatus maintenance. In addition, City of Euclid mechanics should be trained and certified as Emergency Vehicle Technicians. Furthermore, the Euclid Fire Department should increase their fleet of reserve apparatus and consider training at least one member as an Emergency Vehicle Technician to assist City mechanics in minor maintenance issues that occur.

By taking steps to improve the apparatus maintenance program and building the reserve fleet of vehicles, the Euclid Fire Department will help ensure there are no service reductions to a community that relies heavily on emergency services.

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## INTRODUCTION

A key component to an efficient fire department operation is dependable, well-maintained fire apparatus. Every fire department should “establish a preventive maintenance program for their fire apparatus and follow it regularly” (Marinucci, 2015, p. 745). Despite this recommendation, data would show the Euclid Fire Department has experienced frequent vehicle malfunctions, some of which have caused disruption and decreased service delivery.

### **Problem Statement**

The problem this research addressed was that frequent apparatus malfunctions have caused sudden and unpredictable apparatus shortages that resulted in emergency service reductions and threats to the safety of both the public and members of the Euclid Fire Department.

### **Purpose of Study**

The purpose of this descriptive study was to identify and describe how the Euclid Fire Department maintains fire apparatus, what processes other comparable agencies use to maintain their fire apparatus, and what can be done to improve the Euclid Fire Department’s fire apparatus maintenance program.

The research questions this study investigated are:

1. How does the Euclid Fire Department currently maintain fire apparatus?
2. What are the apparatus maintenance programs used by some other fire departments comparable in call volume, total staffing and population protected to the Euclid Fire Department?
3. What are some measures the Euclid Fire Department can take to improve its fire apparatus maintenance program?

## BACKGROUND AND SIGNIFICANCE

The Euclid Fire Department is a career organization currently comprised of 80 sworn personnel. All but five are assigned equally among three platoons. The 2016 operating budget was \$8.23 million and 98 percent of this total was set aside for salaries and personnel. During 2016, the department responded to 10,307 calls for service from three firehouses with a minimum daily staffing of 16 on duty. The median response time for a Euclid Fire Department fire apparatus in 2016 was six minutes four seconds (Euclid Fire Department, 2017). On-duty personnel are assigned as follows:

- **Station 1** – One shift commander (Car 1353), two firefighter/paramedics assigned to an ambulance (Medic 1341) and two firefighters plus one company officer assigned to an aerial apparatus (Truck 1321);
- **Station 2** – Two firefighter/paramedics assigned to an ambulance (Medic 1342) and two firefighters plus one company officer assigned to a fire pumper (Engine 1312); and
- **Station 3** – Two firefighter/paramedics assigned to an ambulance (Medic 1343) and two firefighters plus one company officer assigned to a fire pumper (Engine 1313).

The typical Euclid Fire Department deployment model for a reported building fire, fire alarm, or interior odor investigation includes two pumpers, one aerial apparatus, one ambulance, and the on-duty shift commander. In all, 12 personnel are dispatched on the initial call to an incident type mentioned above. If the incident dictates, the remaining four personnel are dispatched in addition to mutual aid from nearby fire departments. All Euclid Fire Department apparatus respond in emergency mode for confirmed fires. For other call types (alarms and

interior odor investigations with no smoke or flames seen), only the first due unit responds in emergency mode. All others respond with the flow of traffic (Euclid Fire Department, 2009). This policy is a method of risk reduction to Euclid firefighters, civilian motorists, and pedestrians. Moreover, this practice is designed to conserve fuel, minimize unnecessary “wear-and-tear” on the apparatus, keep a unit closer to its first-due area, and reduce the likelihood of experiencing a collision.

In addition to fire and public service responses, a fire apparatus is dispatched to advanced life support (ALS) emergencies to assist an ambulance crew. This tiered response helps the Euclid Fire Department meet the recommendations of Chapters 4 and 5 of NFPA 1710 (2016).

For the 10,307 incidents in 2016, 5,006 required the use of at least one fire apparatus (Ohio Department of Commerce, 2017). This figure includes 3,086 emergency medical assists where a fire apparatus responded with an ambulance (Euclid Fire Department, 2017). Emergency medical assists accounted for over 61 percent of all fire apparatus responses in 2016 and this figure is consistent with percentages from previous years (Ohio Department of Commerce, 2017).

Figure 1 shows that the Euclid Fire Department has seen a total increase in annual responses of 30 percent since 2011 (Euclid Fire Department, 2017). The vertical axis represents annual responses while the horizontal axis represents the year. Demographic information from the United States Census Bureau (2014) lists a poverty rate of 21 percent; a minority population of over 56 percent; a median household income of \$35,797, which is 30 percent below the Ohio average; and a zoned-residential population density of over 6,000 people per square mile.



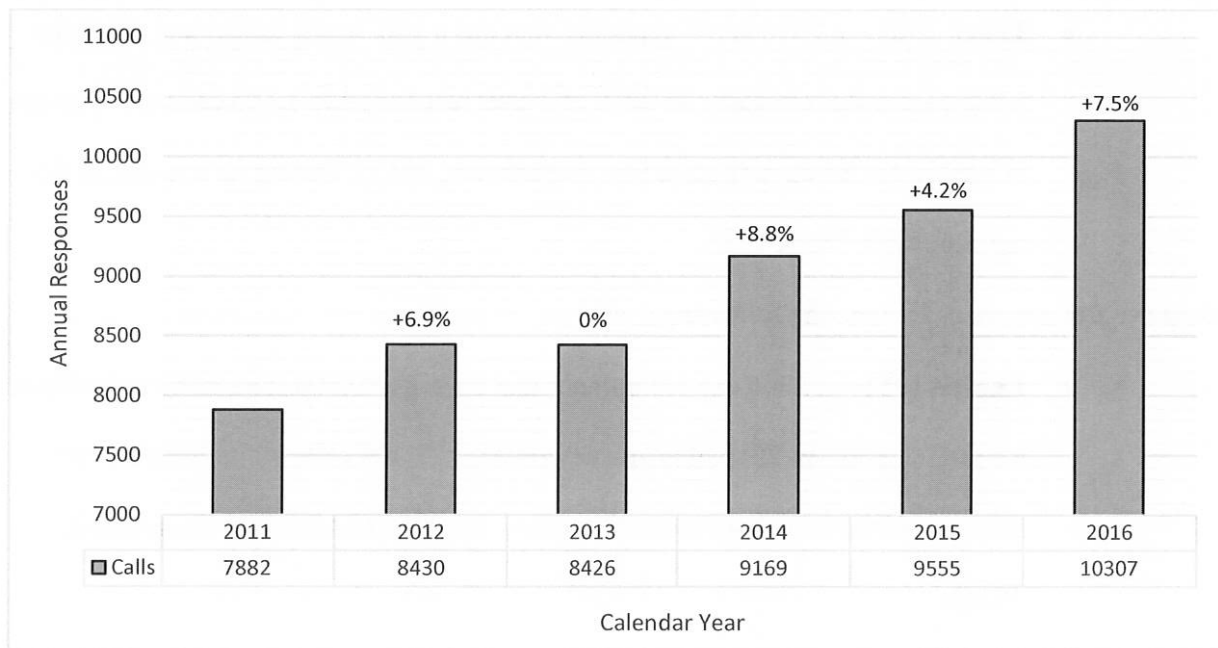


Figure 1. Euclid Fire Department annual responses from years 2011 through 2016.

The Euclid Fire Department uses 19 vehicles within its fleet. Line personnel utilize seven apparatus which include two fire engines, one aerial apparatus, three ambulances, and one command vehicle assigned to the shift commander. Auxiliary units include four staff vehicles, three ambulances, one pumper, one aerial apparatus, and one command vehicle. The department also uses a pick-up truck for snow removal and miscellaneous needs along with an ambulance repurposed as a fire investigation vehicle. Although the Euclid Fire Department has 19 total vehicles, this applied research project focused exclusively on an analysis of fire apparatus maintenance. Frontline fire apparatus include:

- **Engine 1312** – a 2016 custom pumper that will average 9,400 road miles annually. This unit was placed in service on November 14, 2016.
- **Engine 1313** – a 2011 custom pumper that averages 8,200 road miles annually. In 2016, this unit responded to 1,731 calls (Euclid Fire Department, 2017).

- **Truck 1321** – a 2010 aerial apparatus that has a 100’ aerial ladder and averages 5,700 road miles annually. In 2016, this unit responded to 1,195 calls and was out of service for 89 days (Euclid Fire Department, 2017). During its absence, it was replaced with Truck 1325.

Reserve fire apparatus include the following:

- **Engine 1314** – a 2006 custom pumper that averaged 9,400 road miles annually as a frontline unit. In 2016, this unit responded to 1,404 calls while frontline and was moved to reserve status on November 14, 2016 (Euclid Fire Department, 2016).
- **Truck 1325** – a 1998 aerial apparatus that has a 75’ aerial ladder and averages 2,500 miles annually in reserve status. During its time as a frontline apparatus in 2016, it responded to 450 incidents while filling in for Truck 1321.

Since fire apparatus are intricate pieces of machinery, they are subjected to performance tests. One example is pump testing. The fire pumps on each vehicle are required to be tested annually or whenever major repairs or modifications to the pump or any component of the apparatus that is used in pump operations have been made (National Fire Protection Association, 2012). Pump testing is arguably the most imperative task performed by government fleets operating fire apparatus, according to Brent Wahl, the superintendent of the Fleet Management Department for San Bernardino County, California. The results of an agency’s pump testing program can affect everything from firefighting performance to home insurance rates for community residents (Wahl, 2014). The pump testing process is designed to “push the engine and pump to their limits while being closely evaluated for any signs of potential failure” (Zimmerman, 2015, p. 159).

To create enough pressure to supply water to hoses, the pump and transmission must work together. To develop the revolutions per minute required for full use of the pump, the transmission must be placed in the correct gear based on the manufacturer's recommendations (International Fire Service Training Association, 2015). A strong maintenance program can decrease the likelihood of pump and/or transmission problems at the scene of a fire.

Prior to 2014, all pump testing had been done internally by the Euclid Fire Department's training officer, however this individual had not received any formal certification or training to properly conduct such tests. According to records on file, all pumps had passed their annual tests before 2014. Pump testing in 2014 was performed by a private company that offers full service emergency vehicle services. That year, each Euclid fire apparatus failed its pump test. It was then determined that no preventive pump maintenance service had ever been performed. At the expense of the City's Motor Maintenance Department, each fire apparatus received extensive pump work conducted by an outside company, and then passed pump retesting. In 2015, all fire apparatus again failed their annual pump tests, although when preventive pump maintenance was performed by the same outside company, the required pump repairs were less costly than the previous year. Total repair costs for each fire apparatus between 2013 and 2015 are provided as Table 4 in Appendix A.

For nearly 50 years, Euclid Fire Department vehicles have been maintained and serviced by the Motor Maintenance Department, a division of the City of Euclid Public Service Department. This department, under the supervision of Foreman Dennis Barnes and managed by Superintendent Chris Grant, is responsible for the maintenance and repair work of 175 City-owned vehicles and another 180 pieces of motorized equipment (D. Barnes, personal communication, June 30, 2015). Motor Maintenance manages its own budget which includes all

repair work needed for fire department vehicles. For 2016, the Motor Maintenance Department was provided a budget for vehicle parts/equipment of \$140,000.00, a 19 percent reduction since 2014 and an overtime budget of only \$2,000.00 (City of Euclid, 2016).

Staffing in the Motor Maintenance Department is down to seven. This includes six mechanics and one foreman and is a reduction of 50 percent since 2007. However, the number of City-owned vehicles and motorized equipment has remained the same (D. Barnes, personal communication, June 30, 2015). Currently, Motor Maintenance has four employees who have received emergency vehicle technician training, but none are certified or perform any continuing education (D. Barnes, personal communication, January 14, 2016). Based on this information, it appears that the City of Euclid does not meet the 2013 edition of NFPA 1071 according to the Secretary/Treasurer of the Ohio Association of Emergency Vehicle Technicians (P. Guhde, personal communication, April 25, 2016). The standard shall apply to personnel who are engaged in the inspection, diagnosis, maintenance, repair, and testing of emergency response vehicles. In addition, persons “shall furnish documentation showing that they have completed 20 hours of initial or continuing education on an annual basis” (National Fire Protection Association, 2011, p. 1071-5).

While the City of Euclid is not required to follow the recommendations of the National Fire Protection Association, the liability associated with a lack of certified emergency vehicle technicians should raise concerns. In some instances, maintenance records have been summoned to court as evidence after serious accidents, and worker qualifications have been subpoenaed in the investigation phase of lawsuits (Gilsrud, 2006).

When a vehicle deficiency is found, Euclid Fire Department personnel have been trained on how to report a problem. This includes completing an electronic report contained within the

emergency medical reporting software utilized by the Euclid Fire Department. When a problem with a fire apparatus is found, the firefighter or officer finding the deficiency electronically submits the report to the foreman of the Motor Maintenance Department. The foreman determines the severity of the vehicle deficiency and can either bring the apparatus in for immediate inspection or wait until a time that is convenient for his staff to inspect.

When routine maintenance is performed, it is based on road miles only. Engine hours are not tracked by the Motor Maintenance Department (D. Clinton, personal communication, June 29, 2016). According to Dan Herb, a representative for a major fire apparatus manufacturer, engine hours are very important relative to maintenance on fire apparatus. He also states, “Keeping track of the amount of time the engine is running is of major importance regarding preventive engine maintenance” (D. Herb, personal communication, August 10, 2016). In addition, since the Motor Maintenance Department services all City-owned vehicles, the Euclid Fire Department has very little direct control over the preventive maintenance scheduling and apparatus repair, little input into the parts inventory, and no input into the wages or overtime paid for the mechanics to keep the fleet in service.

The impact of losing one frontline fire apparatus in a city with the call volume of the Euclid Fire Department is worrisome when one considers local statistical data. One particular district, which had no fire apparatus for eight days in 2015, experienced 140 fires from 2013-2015. These fires resulted in damages of \$1,480,745 (Euclid Fire Department, 2017). Fortunately, no fires were reported in this district during the time this fire apparatus was out of service. At that time, no reserve apparatus was available, as the only reserve unit had been placed in frontline status due to another apparatus breakdown. If a serious fire had been reported, one of two nearby fire departments (Richmond Heights or South Euclid) would have

been dispatched while Euclid units responded. Any delay in applying water to a fire could have led to casualties to firefighters or citizens since a fire can become life-threatening in just two minutes. In five minutes, a residence can be engulfed in flames (Department of Homeland Security, 2016).

The absence of this one fire apparatus also took away advanced life support capabilities since each frontline unit is equipped with advanced airway equipment and intravenous supplies. During the same three-year period, this frontline fire apparatus responded to 2,541 rescues and emergency medical incidents including 2,323 advanced life support emergencies, 92 motor vehicle accidents, 64 elevator rescues, and another 62 miscellaneous rescues. The advanced life support equipment is used by Euclid firefighters cross-trained as paramedics to initiate patient care while an ambulance responds.

A three-year analysis of out-of-service frontline fire apparatus is provided in Table 1. This data was researched to determine possible trends with information being obtained from daily checklists completed by Euclid firefighters.

Table 1

*Out-of-Service (Downtime) Days with Corresponding Annual Percentage for Primary Euclid Fire Department Fire Apparatus Due to Vehicle Malfunctions*

Primary Unit	2013		2014		2015		Averages	
	Days	% Year	Days	% Year	Days	% Year	Days	% Year
Engine 1313	28	7.7	43	11.8	37	10.1	36	9.9
Engine 1314	31	8.5	70	19.2	37	10.1	46	12.6
Truck 1321	66	18.1	71	19.5	79	21.6	72	19.7
<b>Totals</b>	<b>125</b>	<b>11.4</b>	<b>184</b>	<b>16.8</b>	<b>153</b>	<b>13.9</b>	<b>154</b>	<b>14.1</b>

*Note.* These data include days when at least one and no more than two fire apparatus was out of service. There are no documented instances of all three primary fire apparatus being out of service simultaneously during the three-year period.

The information in Table 1 far exceeds data provided in another applied research project on this same topic. Rooney (2001) states that the average downtime for fire apparatus in the Phoenix (AZ) regional area is 5.3 percent. Of the departments and districts surveyed, “those with their own apparatus mechanics, the average is four percent” (Rooney, 2001, p. 23). Through his research, it was determined the acceptable amount of downtime is five percent and that lower percentages raise the service delivery to citizens (Rooney, 2001).

The potential impact this study could have on the Euclid Fire Department includes the designation of at least one Motor Maintenance mechanic certified as an emergency vehicle technician. Only the certified emergency vehicle technician(s) would perform preventive maintenance and repair work on fire apparatus. In addition, enhancing vehicle maintenance training could both prolong the life of current and future fire apparatus and offer more efficient use of taxpayer dollars.

Ultimately, the goal is to reduce the downtime of fire apparatus, reduce overall expenses, and increase service delivery to internal and external customers. In the end, these benefits ensure the Euclid Fire Department has reliable and safe apparatus to provide fire and advanced life support capabilities to a community that relies heavily on emergency services.

## LITERATURE REVIEW

To accurately compare how the Euclid Fire Department maintains its vehicles, several hours of research were conducted exploring industry standards pertaining to fire apparatus maintenance. This includes independent analyses of previous fire apparatus crashes and maintenance programs, applied research projects of Executive Fire Officer students, investigations conducted by the National Institute for Occupational Safety and Health, the Fire Apparatus Manufacturer's Association, and interviews with 15 comparably-sized Ohio fire departments.

The importance of proper fire apparatus maintenance became more evident once the author began his research. According to the Federal Energy Management Program, nearly 50 percent of all companies in the United States employ a "reactive" maintenance program for their vehicles and equipment (Hart, 2008, p. 17). This method of maintenance addresses problems as they arise rather than taking a proactive or preventive approach to maintaining vehicles. It has been the author's experience that a reactive method is most commonly used by the Motor Maintenance Department, not due to a lack of cooperation, but rather due to a lack of staffing and heavy workload. This workload, combined with reduced staffing and contractual time off specified in a collective bargaining agreement, may limit mechanics' availability to attend continuing education relating to apparatus maintenance.

The Commission on Fire Accreditation International emphasizes the role fire apparatus maintenance plays in an efficient, safe, and effective fire department. Progressive fire departments use this criterion as a benchmark for determining the best and safest service possible. Specifically, *Criterion 6D: Apparatus Maintenance* exists to ensure the inspection, testing, preventive maintenance, replacement schedule, and emergency repair of all apparatus is



well established and meets the emergency apparatus service and reliability needs. While this criterion has eight performance indicators, three specifically apply to the Euclid Fire Department and include (Commission on Fire Accreditation International, 2009, p. 98):

- An adequate number of trained and certified maintenance personnel available to meet the objectives of the established program.
- Current standard operating procedures or general guidelines are in place to direct the apparatus maintenance program.
- The reserve fleet is adequate or a documented contingency plan with another agency is in place for the event that apparatus must be taken out of service.

In addition, certain Executive Fire Officer applied research projects were referenced to complete this assignment. Three projects were specifically selected based on similarities between the issues each author encountered and the problems being experienced by the Euclid Fire Department.

Rooney (2001) examined issues within the Peoria (AZ) Fire Department and how the city's fleet maintenance division could not keep up with the workload of a growing community. This growth resulted in decreased service delivery and excessive apparatus downtimes (Rooney, 2001). While Euclid is not a growing community, but an older community with aging vehicles and equipment, it has been the author's experience that the Motor Maintenance Department has, at times, had trouble keeping up with the workload they must manage.

Gilsrud (2006) submitted a project that explored the reasons why his fire department was experiencing excessive apparatus downtimes due to mechanical failures. The City of Coon Rapids (MN) did not have anyone assigned to specialize in fire apparatus nor did the department

have direct control over the maintenance of their fleet. A similar issue is occurring within the Euclid Fire Department.

Hart (2008) analyzed the practices of the Waterbury (CT) Fire Department. His research was completed due to deaths and career-ending injuries of five Waterbury, CT firefighters in two separate motor vehicle accidents. Through an investigation, it was determined that these casualties were a direct result of a lack of preventive maintenance within the department. The largest similarity between Waterbury and Euclid is the lack of certified mechanics, a lack of a defined plan of maintenance, and a lack of thorough preventive maintenance.

On February 26, 2010, the National Institute of Occupational Safety & Health (NIOSH) released a report which examined a Boston (MA) Fire Department line of duty death in 2009. This investigation revealed contributing factors which led to a lieutenant being killed and three firefighters being injured when an aerial apparatus crashed. Contributing factors included deficiencies in the apparatus maintenance program, deficiencies in the apparatus braking system, and insufficient training for fire apparatus operators and fleet maintenance personnel (Centers for Disease Control and Prevention, 2010).

An additional resource relating to the Boston, MA incident was examined and was conducted by Mercury & Associates, Inc. (2009). This report provided additional insight into the then-current state of the Boston (MA) Fire Department fleet of fire apparatus. It was determined that Boston did not have a professional fleet manager or professional apparatus maintenance technicians. The maintenance of the fleet was overseen by a combination of career firefighters and civilians. While there was an organizational chart for the Maintenance Division, the roles, responsibilities, and authority of the positions had not been clearly defined.

A number of industry-specific textbooks were referenced to help provide worthwhile data on the topic. Carter and Rausch (2008) addressed the importance of fire apparatus and the role each plays in serving a community. Marinucci (2015) suggested a key component to an efficient fire department is dependable and well-maintained fire apparatus. The International Fire Service Training Association (2015) provided an explanation of the importance of the pump and transmission working together to provide adequate water flow. Last, Zimmerman (2015) explained the purpose and significance of proper pump testing.

Other references were obtained from an Internet search which provided information about Euclid, Ohio demographics from the United States Census Bureau; statistical data utilizing the incident reporting software (FIREHOUSE and emsCharts) used by the Euclid Fire Department; historical Euclid Fire Department incident data submitted to the Ohio Fire Incident Reporting System; and six separate personal communications including the Motor Maintenance foreman, the secretary of the Motor Maintenance Department, the secretary/treasurer of the Ohio Association of Emergency Vehicle Technicians, a sales representative for a major fire apparatus manufacturer, a fire chief from Northeast Ohio, and a Euclid firefighter.

## PROCEDURES

Descriptive research was the primary research methodology for this paper. This methodology was chosen because the author intended to present the current state of apparatus maintenance within the Euclid Fire Department. It remains the author's intent to improve the apparatus maintenance program by increasing reliability, reducing apparatus downtime, and improving service delivery to both internal and external customers.

Vehicles are "the most frequently used tool, the heaviest piece of equipment, and the most technically dependent device utilized in today's fire service" (Rooney, 2001, p. 10). Virtually every response that is made involves operating an ambulance or fire apparatus. Pat Guhde serves as the Secretary/Treasurer of the Ohio Association of Emergency Vehicle Technicians. He is also a firefighter/paramedic and mechanic of the Bedford (OH) Fire Department. He states, "A fleet of vehicles is so important to what we do. Fire apparatus are the most complicated, expensive, and intricate pieces of machinery in the whole city" (P. Guhde, personal communication, January 28, 2016). A fire department must continually assess the efficiency and effectiveness of its apparatus for combatting the wide array of emergencies it is called to (Carter and Rausch, 2008).

The Euclid Fire Department had been experiencing frequent malfunctions with its apparatus for several years, but the situation was getting significant enough that service delivery was being negatively impacted. To accurately assess how the Euclid Fire Department could improve its apparatus maintenance program, the author needed to learn specifics relating to national standards for emergency vehicle maintenance and requirements set forth by the Commission on Fire Accreditation International. Furthermore, the author had to be educated about the City of Euclid Motor Maintenance Department, its internal processes, and certification

levels of mechanics. The author also wanted to learn from the lessons of other fire departments throughout the United States who have had similar issues or experienced casualties to civilians or firefighters due to vehicle maintenance deficiencies before a similar incident happens in Euclid, Ohio.

Beyond national data, the author asked certain Ohio fire departments to participate in an interview to assess how their agency maintains its fire apparatus. Interview questions assessed 10 different categories. The fire departments that were asked to participate are listed in Table 2.

Table 2

*Alphabetical Listing of Ohio Fire Departments Asked to Participate in Apparatus Maintenance Interview.*

<b>Fire Department</b>	<b>County</b>	<b>Official Interviewed</b>
Beavercreek Township	Greene	N/A
Cuyahoga Falls	Summit	Chief Paul Moledor
Elyria	Lorain	Chief Rich Benton
Kent	Portage	Chief John Tosko
Kettering	Montgomery	Battalion Chief Brian Beaver
Lakewood	Cuyahoga	Chief Scott Gilman
Lancaster	Fairfield	Assistant Chief Jack Mattlin
Massillon	Stark	Chief Tom Burgasser
Mentor	Lake	Deputy Chief Joe Busher
Middletown	Butler	Assistant Chief Tom Snively
Newark	Licking	Chief Patrick Connor
Sandusky	Erie	Chief Dave Degnan
Springfield Township	Lucas	Chief Barry Cousino
Sylvania Township	Lucas	Deputy Chief Mike Ramm
Washington Township	Montgomery	Deputy Chief Scott Kujawa
Zanesville	Muskingum	Chief Eric Waltemire

*Note.* For this study, “comparable” was defined by total fire department staffing, budget, overall response population, and the total number of annual responses.

For an accurate comparison, the author asked respondents the same specific interview questions. A full listing of the interview questions is provided in Appendix B. Respondents were emailed a brief introduction along with the 10 interview questions. Included in the email was a read receipt that the author received. Each respondent was asked to highlight the most appropriate answer(s) and reply back upon completing the interview. A follow-up email was sent after 10 business days if no reply had been received. When this occurred, respondents were offered the same email with an additional read receipt. If, after 20 business days, there still had been no response, the author called the remaining respondents to ask for their input. An agency was excluded if, after 20 business days of no return email, the author had to leave a message and no return call was made after an additional 10 business days. Those agencies that replied were included in this report.

In addition to these interviews, the author learned of an assignment being completed by Chief William D. Freeman of the Cleveland Heights Fire Department. His graduate school research was related to apparatus maintenance programs and included various fire departments within Cuyahoga County. Those agencies that he obtained information from, along with notes and maintenance costs, are listed as Table 5 in Appendix C.

The author also wanted to accurately determine how Euclid firefighters view the apparatus maintenance program for the Euclid Fire Department. Over a three-day period in January 2017, the author received feedback from 57 Euclid firefighters. These data are explained in more detail in the “Results” section of this paper.

### **Limitations of Study**

This applied research project was limited to fire apparatus only. Ambulances, staff vehicles, and other motorized equipment operated by the Euclid Fire Department were not

included. Moreover, this study did not include interviews about the apparatus maintenance programs of any volunteer fire departments. The author did not find a volunteer agency with the call volume and demographics like the Euclid Fire Department. However, the author believes the findings can be used by any fire department regardless of size or staffing.

## RESULTS

The author has determined that the Euclid Fire Department vehicle maintenance program has areas where improvement should be strongly considered to promote firefighter and civilian safety while simultaneously reducing apparatus shortages.

### Research Question 1

The first research question explored how the Euclid Fire Department currently maintain fire apparatus. Research has identified that staffing in the Motor Maintenance Department has been reduced by 50 percent but the number of City-operated vehicles has remained the same (D. Barnes, personal communication, June 30, 2015). In addition, it does not appear that fire apparatus are receiving preventive maintenance according to the schedules provided by the apparatus manufacturer. When maintenance is performed, it is done using road miles rather than engine hours (D. Clinton, personal communication, June 29, 2016).

Euclid Fire Department personnel have been trained on how to report a problem with any fire department vehicle when a vehicle deficiency is found. This includes an electronic report submitted directly to the foreman of the Motor Maintenance Department. The foreman then determines the seriousness of the vehicle deficiency and can either bring the apparatus in for immediate inspection or wait until a time that is convenient for his staff to inspect. If necessary, Euclid Fire Department personnel may take a vehicle out of service if they suspect an apparatus may be unsafe to operate.

Prior to 2014, all annual pump testing had been done internally by the Euclid Fire Department and records on file indicate all apparatus passed. Since that year, pump testing has been done by an outside company and all apparatus have failed pump testing. It was then determined that no pump preventive maintenance had ever been performed. After costly repairs



by outside companies and a seemingly high number of “out-of-service” days, all apparatus again failed pump testing in 2015 but pump repairs were less costly than in 2014. Table 1 also indicates that there were less “out-of-service” days in 2015 compared to 2014 for Euclid Fire Department pumpers (Engine 1313 and Engine 1314).

### **Research Question 2**

The second research question determined the apparatus maintenance programs used by other fire departments comparable to the Euclid Fire Department. To accomplish this, the author provided a 10-question multiple choice interview which used a minimum four-point Likert scale. Agencies that were asked to participate are listed alphabetically on page 21. All but one agency provided thorough feedback to the author.

The first interview question asked respondents to identify their fire department operating budget. While no respondents had an operating budget less than \$5 million, those respondents with a budget between \$5 million and \$7 million included Kent, Massillon, Sandusky, Springfield Township (Lucas County), and Zanesville. Agencies with an annual operating budget between \$7 million and \$9 million included Elyria, Lancaster, Middletown, Newark, and Sylvania Township (Lucas County). Those departments with an annual operating budget between \$9 million and \$11 million included Cuyahoga Falls and Lakewood. Respondents with an annual fire department budget over \$11 million were Kettering, Mentor, and Washington Township (Montgomery County). All respondents provided an answer to this interview question.

The second interview question inquired about the number of annual responses made. Respondents were provided four choices to answer. Those departments responding to 5,000 calls or less annually were Elyria, Kent, Springfield Township (Lucas County), and Zanesville.

Massillon and Sandusky reported annual responses between 5,001 and 7,000. Nine respondents, or 60 percent, reported responding to more calls than this. The following agencies respond to between 7,001 and 9,000 calls per year: Cuyahoga Falls, Kettering, Lakewood, Lancaster, Mentor, Sylvania Township (Lucas County), and Washington Township (Montgomery County). Only two departments answer more than 9,000 calls annually and include Middletown and Newark. All respondents provided an answer to this question.

The third interview question asked respondents to answer how many fire apparatus (pumpers and aerials only) their agency maintained and included both frontline and reserve apparatus. Those agencies maintaining four or less include Kent and Lakewood. Lancaster and Sandusky maintain five fire apparatus while Massillon, Springfield Township (Lucas County), and Zanesville maintain six. The remaining 53 percent of respondents maintain seven or more and include Cuyahoga Falls, Elyria, Kettering, Mentor, Middletown, Newark, Sylvania Township (Lucas County), and Washington Township (Montgomery County). All respondents provided an answer to this question.

The fourth interview question asked respondents about how many approximate miles a primary fire apparatus travels during the year. Respondents were instructed to not consider reserve apparatus for this question. Middletown reported they track annual engine hours instead of mileage and Sandusky did not provide an answer to this question. Of the 13 remaining respondents, Kent reported an annual mileage of less than 4,000 miles per year, while Cuyahoga Falls, Elyria, Lakewood, Massillon, Springfield Township, and Sylvania Township reported annual miles accumulated between 4,000 and 5,999. Those agencies traveling between 6,000 and 7,999 miles per year include Kettering and Lancaster. Newark, Washington Township; and

Zanesville reported annual mileages of between 8,000 and 9,999. Only Mentor reported annual mileage of 10,000 or more.

The fifth interview question requested that respondents provide information on who performs their fire apparatus maintenance. This question allowed for multiple answers to be selected. Elyria, Mentor, and Washington Township reported a fire department mechanic performs maintenance while Massillon reported both a fire department mechanic and private company share maintenance duties. Three respondents reported that fire apparatus maintenance is the responsibility of private companies not affiliated with the fire department and include Lancaster, Kettering, and Newark. Two agencies (Lakewood and Springfield Township) stated their maintenance was shared by a combination of fire department mechanics, another municipal department (Service Department, etc.), and private companies not affiliated with their fire department. However, 40 percent of respondents stated that they do not use a fire department mechanic in any way for fire apparatus maintenance. These agencies include Cuyahoga Falls, Kent, Middletown, Sandusky, Sylvania Township, and Zanesville.

For those respondents who utilize private contractors, the sixth interview question was meant to identify the most common types of maintenance performed by those private companies. This question allowed for multiple answers to be selected. Only Lakewood, Sandusky, Springfield Township, and Washington Township use private companies for aerial testing and repairs while Massillon, Middletown, and Zanesville utilize private companies for aerial and pump maintenance and testing. Five agencies reported they use private companies for aerial testing and repairs, pump testing and repairs, and chassis preventive maintenance. These departments include Cuyahoga Falls, Kent, Kettering, Lancaster, and Newark. Only Mentor and

Sylvania Township reported that they do not use a private company for any maintenance. Elyria did not provide an answer to this question.

The seventh interview question was designed to provide the author with information about the professional qualifications achieved and maintained by mechanics who perform maintenance on fire apparatus. These data are provided in Table 3.

Table 3

*Analysis of Vehicle Maintenance Certifications Achieved and Maintained by Interview Respondents*

<b>Fire Department (County)</b>	<b>ASE</b>	<b>EVT-1</b>	<b>EVT-2</b>
Cuyahoga Falls (Summit)	X	X	X
Elyria (Lorain)	X	X	X
Kent (Portage)	X		
Kettering (Montgomery)			X
Lakewood (Cuyahoga)		X	
Lancaster (Fairfield)	X		X
Massillon (Stark)	--	--	--
Mentor (Lake)			X
Middletown (Butler)	X		
Newark (Licking)	X		
Sandusky (Erie)		X	
Springfield Twp. (Lucas)	X	X	
Sylvania Twp. (Lucas)			X
Washington Twp. (Montgomery)		X	X
Zanesville (Muskingum)	X		

*Note.* Massillon Fire Department did not provide an answer to this interview question, but stated it is their goal to eventually have mechanics certified as both EVT-1 and EVT-2 (T. Burgasser, personal communication, March 24, 2016). ASE is an abbreviation for Automotive Service Excellence. Two levels of Emergency Vehicle Technicians are shown above as EVT-1 and EVT-2.

The eighth interview question identified what method(s) is/are used to schedule preventive maintenance. One respondent (Lakewood) did not provide an answer to this question. When preventive maintenance is performed for Euclid Fire Department apparatus, they are brought in based on road miles or when an apparatus is brought in for an unanticipated malfunction. Road mileage determines preventive maintenance in Cuyahoga Falls, Newark, and

Zanesville. Elyria, Mentor, and Washington Township schedule maintenance based on both road miles and engine hours. Six respondents state their preventive maintenance is scheduled based on engine hours and include Kent, Kettering, Lancaster, Middletown, Sandusky, and Springfield Township. Additional communications with subject matter experts mentioned previously in this report confirm that preventive maintenance should be based on engine hours rather than road miles. Massillon noted their preventive maintenance could be scheduled based on road mileage, engine hours, or when an apparatus is out of service for other maintenance. Sylvania Township stated their preventive maintenance is scheduled by the mechanic.

The ninth interview question inquired about the total time that preventive maintenance accounts for all maintenance. Beginning with the least amount, Elyria and Newark state preventive maintenance accounts for zero to 25 percent of total time maintaining apparatus. However, Cuyahoga Falls, Kent, Kettering, Lakewood, Massillon, Mentor, Sylvania Township, Washington Township, and Zanesville state that total time spent on preventive maintenance equates to 26 to 50 percent. An increased amount of time (51 to 75 percent) is spent on preventive maintenance in Lancaster, Middletown, Sandusky, and Springfield Township.

The tenth and final interview question asked respondents to offer their level of satisfaction with their apparatus maintenance program. Nearly 47 percent of respondents stated they were “very satisfied” with their program. These agencies included Elyria, Kettering, Mentor, Middletown, Sandusky, Washington Township, and Zanesville. Forty percent of respondents, which include Cuyahoga Falls, Kent, Lakewood, Lancaster, Massillon, and Springfield Township, stated they were “somewhat satisfied” with their apparatus maintenance program. The remaining 13 percent of respondents, Newark and Sylvania Township, reported they were “very unsatisfied” with their apparatus maintenance programs.

The answers provided by 87 percent of interview respondents are in direct contrast to the results of the same question asked to Euclid firefighters. Over a three-day period in January 2017, the author received 53 responses from Euclid firefighters which revealed over 73 percent were “very unsatisfied” or “somewhat unsatisfied” with the Euclid Fire Department’s apparatus maintenance program. Another 15 percent rated the maintenance program as “neutral” with only 12 percent rating the program as “somewhat satisfied” or “very satisfied.” One officer stated about the Motor Maintenance Department that the “Garage’s hands are tied” (P. Bernacki, personal communication, January 3, 2017). It appears most Euclid firefighters empathize with the Motor Maintenance Department and are appreciative of their efforts to keep Euclid Fire Department apparatus in a ready state as much as possible. However, the frequency of vehicle breakdowns and out-of-service days leave personnel questioning their safety and their ability to perform their duties with unreliable fire apparatus.

### **Research Question 3**

The purpose of the last research question was to identify measures the Euclid Fire Department can take to improve its fire apparatus maintenance program. Historically, Euclid Fire Department vehicles have been maintained and serviced by the Motor Maintenance Department, a division of the City of Euclid Public Service Department. Motor Maintenance manages their own budget which includes all repair work needed for fire department vehicles. Staffing in this department has been reduced 50 percent despite the number of City-owned vehicles remaining unchanged (D. Barnes, personal communication, June 30, 2015). Moreover, the Euclid Fire Department had at least one fire apparatus out-of-service an average of 154 days each year over a three-year period from 2013 through 2015 (Euclid Fire Department, 2016).

In addition to the interview sent to 16 comparably-sized fire departments within Ohio, the author obtained information from 15 fire departments within Cuyahoga County. This information was provided to the author by Cleveland Heights Fire Chief William D. Freeman. This listing and corresponding data is provided as Table 5 in Appendix C.

One potential measure this research could have on the Euclid Fire Department includes the creation of at least one Motor Maintenance Department mechanic certified as an emergency vehicle technician. Through policy, only the certified emergency vehicle technician(s) would perform preventive maintenance and repair work on fire apparatus.

An additional measure could also be the creation of an engineer's program within the Euclid Fire Department. Only select personnel could serve as fire apparatus drivers/operators. These engineers could receive training from the Motor Maintenance emergency vehicle technician(s) on the proper way to inspect the apparatus and troubleshooting for minor issues before they become larger and more costly problems.

A third measure could be following the apparatus manufacturer's recommendations for preventive maintenance at defined and pre-established intervals using engine hours as the benchmark for maintenance. According to Dan Herb, a sales representative for a major fire apparatus manufacturer, engine hours are very important relative to maintenance on fire apparatus. He also states, "Keeping track of the amount of time the engine is running is of major importance regarding preventive engine maintenance" (D. Herb, personal communication, August 10, 2016).

The goal of improving the apparatus maintenance program is to reduce the downtime of fire apparatus, reduce overall expenses, and increase service delivery to internal and external customers. In the end, each of these measures would help ensure the Euclid Fire Department has

reliable and safe apparatus to provide fire and advanced life support capabilities to a community that relies heavily on emergency services.



## DISCUSSION

Based on the author's research, it appears there are not enough mechanics within the Motor Maintenance Department to effectively and proactively maintain Euclid Fire Department fire apparatus. This may be a contributing factor to the problems being experienced involving frequent breakdowns and interruptions in service delivery. In addition, the author uncovered similarities between his results and those contained within his references.

One example was provided in an applied research project of the Peoria (AZ) Fire Department's apparatus maintenance program. Peoria, like Euclid, was experiencing excessive apparatus downtimes. The Phoenix-area average was five percent while Peoria's was 16 percent (Rooney, 2001). The Euclid Fire Department has an average of 14.1 percent of apparatus downtime between 2013 through 2015. Rooney (2001) also asserted that fire departments in the Phoenix area that have their own mechanic have an average apparatus downtime of four percent.

Gilsrud (2006) examined the effectiveness of the Coon Rapids (MN) Fire Department's apparatus maintenance program. Coon Rapids, like Euclid, did not have a dedicated mechanic for the fire department. In addition, the Coon Rapids motor maintenance team "maintains over 200 pieces of city equipment" (Gilsrud, 2006, p. 7). Presently, the City of Euclid's Motor Maintenance Department is responsible for the upkeep and maintenance of 175 City-owned vehicles and another 180 pieces of motorized equipment (D. Barnes, personal communication, June 30, 2015). This is being done with a crew of six mechanics and one foreman.

Hart (2008) identified a lack of certified mechanics and a lack of a defined plan of maintenance. The same is being experienced by the Euclid Fire Department, not due to a lack of cooperation, but rather due to a heavy workload and lack of staffing. While the Euclid Fire Department has standard operating guidelines pertaining to vehicle operational safety and

industry best practices, the author was unable to locate or determine the existence of any written policies that guide vehicle maintenance within the Motor Maintenance Department.

Another similarity was discovered after reviewing the National Institute for Occupational Safety and Health report F2009-05. This analysis focused on the line of duty death of a career fire lieutenant after the ladder truck he was riding in crashed into a building. After an investigation, it was determined that a contributing factor to the crash resulted from deficiencies in the apparatus maintenance program (Centers for Disease Control and Prevention, 2010). Moreover, this division did not have policies or procedures for preparing, performing, and verifying work completed on department apparatus. In addition, “the maintenance division relied on hand written notes and informal logs for apparatus record keeping” (Centers for Disease Control and Prevention, 2010, p. 2). Currently, Euclid’s Motor Maintenance Department relies on handwritten logs for record keeping. However, at the request of the author, the foreman recently started sending copies of each log to the fire department administration for entry into the record keeping software utilized by the Euclid Fire Department. A recommendation of the report further stated that “records should be maintained via electronic means, through the use of fleet maintenance managing software, and maintaining paper records as a backup” (Centers for Disease Control and Prevention, 2010, p. 10).

While the author has focused on similarities to this point, it is equally important to highlight dissimilarities that exist between the current state of the vehicle maintenance program within Euclid Fire Department and three key performance indicators listed by the Commission on Fire Accreditation International. These are an adequate number of trained and certified maintenance personnel available to meet the objectives of the established program, the existence of current standard operating procedures or general guidelines to direct the apparatus

maintenance program, and an adequate reserve fleet (Commission on Fire Accreditation International, 2009).

These findings, coupled with the current staffing within the Motor Maintenance Department, reinforce to the author that improvements must be made to maintain fire apparatus properly and effectively. The Euclid Fire Department protects a population that relies heavily on emergency services. Safety and operational readiness must be the highest priority when inspecting and maintaining apparatus. Furthermore, preventive maintenance programs are designed to reduce apparatus downtime, breakdowns, and extend the life of an apparatus, and identify potentially life-threatening problems (Centers for Disease Control and Prevention, 2010).

Peters, through Marinucci (2015), offers requirements necessary to establish an effective maintenance program. Many of these criteria have been achieved within the Euclid Fire Department, but one area of improvement is a policy that clearly defines out-of-service criteria for fire apparatus. Currently, a policy of this type does not exist. A thorough template is provided within National Fire Protection Association Standard 1911.

Whether an apparatus responds to one incident or 15 incidents per day, it must be ready to respond and capable of performing its intended function with peak efficiency regardless of the time of day or year. The International Fire Service Training Association (2015) asserts that preventive maintenance programs can ensure that a “fire apparatus is maintained in the highest state of readiness and will operate safely and efficiently at emergency scenes” (p. 29). Furthermore, “the goal of preventive maintenance is to eliminate unexpected and catastrophic failures that may endanger firefighters and the general public” (International Fire Service Training Association, 2015, p. 29). The current state of Euclid Fire Department apparatus would

suggest improvements must be made when one examines the number of out-of-service days experienced between 2013 and 2015.

The importance of proper maintenance must be emphasized when one considers the number of annual responses, plus the mileage that a Euclid Fire Department fire apparatus accumulates each year. Department records indicate between 5,700 and 9,400 road miles accumulate annually in an urban setting where street conditions are less than optimal (Euclid Fire Department, 2016). Despite usage, engine hours, and road miles, there has not been a documented preventive assessment of any Euclid Fire Department fire apparatus by a certified emergency vehicle technician within the City of Euclid. While Euclid Fire Department apparatus drivers perform documented daily checks, none are certified emergency vehicle technicians. Moreover, deficiencies that are discovered during the daily check may not be inspected as quickly as Euclid Fire Department personnel would like. It is recommended that a fire department “continually assess the efficiency and effectiveness of its apparatus for combatting the wide array of emergencies it is called to” (Carter & Rausch, 2008, p. 145).

The implications of a defined apparatus maintenance program for the Euclid Fire Department would be the peace of mind that its fire apparatus are being properly maintained by professionals trained in emergency vehicle maintenance. Given the demographics of the community, the City of Euclid must ensure the useful life of its fire apparatus are extended as long as possible. This will preserve taxpayer dollars while also enhancing the quality of life for residents and business owners. According to the Ohio Association of Emergency Vehicle Technicians, “A fleet of vehicles is so important to what we do. Fire apparatus are the most complicated, expensive, and intricate pieces of machinery in the whole city” (P. Guhde, personal communication, January 28, 2016).

These intricate pieces of machinery require annual tests to ensure peak performance. One such examination is pump testing. Pump testing is arguably the most imperative task performed by government fleets operating fire apparatus, according to Brent Wahl, the superintendent of the Fleet Management Department for San Bernardino County, California. The impacts of an agency's pump testing program can affect everything from firefighting performance to home insurance rates for community residents (Wahl, 2014). The correlation between proper preventive maintenance and pump testing has become evident since 2014 when Euclid Fire Department fire apparatus received pump testing by an outside agency. Prior to 2014, all pumps passed their tests which were done internally by the training officer of the Euclid Fire Department. The only training this person received was what his predecessor taught him. Beginning in 2014, the author wanted to determine the true state of the fleet of Euclid Fire Department fire apparatus. In 2014 and 2015, each fire apparatus failed its respective pump tests.

Wahl (2014) suggests that after determining its compliance level, a fire department's challenge is to make the necessary adjustments in current practices and procedures to ensure results are maintained. This is currently an ongoing process within the Euclid Fire Department.

The interviews of comparably-sized fire departments throughout Ohio also highlighted areas which offer plausible solutions for the Euclid Fire Department moving forward. A noteworthy takeaway was the high percentage of respondents who base their preventive maintenance on engine hours rather than road miles.

Another notable takeaway was certification level held by those responsible for apparatus maintenance. Currently, City of Euclid mechanics are only certified to the Automotive Service Excellence (ASE) level, but nearly 67 percent of respondents have mechanics who possess

Emergency Vehicle Technician (EVT) certifications. The Motor Maintenance Department has four employees who have received emergency vehicle technician training, but none are certified or perform any continuing education (D. Barnes, personal communication, January 14, 2016). According to the Ohio Association of Emergency Vehicle Technicians, it would appear the City of Euclid does not meet the 2013 edition of NFPA 1071 (P. Guhde, personal communication, April 25, 2016).

The last interview question asked respondents to rate their level of satisfaction with their apparatus maintenance program. As a result, 87 percent of interview respondents stated they were either “very satisfied” or “somewhat satisfied” with their apparatus maintenance program. The results of the same question asked to Euclid firefighters offered the opposite answer. Over a three-day period in January 2017, the author received 53 responses which revealed over 73 percent were “very unsatisfied” or “somewhat unsatisfied” with the Euclid Fire Department’s apparatus maintenance program.

## RECOMMENDATIONS

Throughout this applied research project, the author has examined the apparatus maintenance program of the Euclid Fire Department, the maintenance programs used by agencies of comparable size within Ohio, and inside Cuyahoga County. Moreover, the author has examined industry best practices and has taken away lessons learned from other fire departments across the United States. In sum, there are measures the Euclid Fire Department can take to improve its apparatus maintenance program. Based on this research, the author recommends the following tasks to improve service delivery and act in the best interests of external customers:

1. The Euclid Fire Department administration should create a standard operating procedure which outlines what deficiencies would cause the need for a fire apparatus to be removed from service.
2. The City of Euclid should establish guidelines between the International Association of Machinists and Aerospace Workers Local 1363 and the International Association of Fire Fighters Local 337 to allow for minor repairs to be completed by a Euclid Fire Department Emergency Vehicle Technician. This should include clearly defining what constitutes a “minor” repair.
3. The City of Euclid Motor Maintenance Department should train at least one mechanic to a Level 1 Emergency Vehicle Technician and allow the individual to complete the necessary continuing education each year to maintain certification.
4. The City of Euclid Motor Maintenance foreman should only allow the certified Emergency Vehicle Technician to perform any type of maintenance on fire apparatus.

He/she could be assisted by another mechanic who possesses an Automotive Service Excellence certification.

5. After two years of certification as a Level 1 Emergency Vehicle Technician, the City of Euclid Motor Maintenance Department should provide training for that mechanic to become a Level 2 Emergency Vehicle Technician and allow the individual to complete the necessary continuing education each year to maintain certification.
6. The Euclid Fire Department should train at least one firefighter to a Level 1 Emergency Vehicle Technician and allow the individual to complete the necessary continuing education each year to maintain certification. This individual can work with the Motor Maintenance Department to keep fire apparatus on a regular preventive maintenance schedule. In addition, this individual could perform minor field maintenance so Motor Maintenance mechanics can focus on matters of higher priority among other City of Euclid vehicles.
7. The City of Euclid Motor Maintenance Department should adopt a policy that preventive maintenance should be based on engine hours rather than road miles.
8. The City of Euclid Motor Maintenance Department should clearly define what, if any, apparatus deficiencies would be sent to an outside repair facility for repair.
9. The City of Euclid Motor Maintenance Department should continue to provide copies of written work orders to the Euclid Fire Department so they can be entered electronically in the fire incident reporting software utilized by the firefighters. This practice allows Euclid firefighters to see what was repaired and allows for improved transparency and communication.



10. Once definitive processes have been implemented within the Motor Maintenance Department, the Euclid Fire Department should consider establishing a formal engineer's position. This would permit a specified number of apparatus driver/operators who would receive training from the Motor Maintenance certified emergency vehicle technician on how to properly inspect, troubleshoot, and operate a fire apparatus.

The Euclid Fire Department must act decisively to improve its apparatus maintenance program. This endeavor cannot be accomplished without the cooperation of the City of Euclid, the Motor Maintenance Department management team, the International Association of Fire Fighters Local 337, and the International Association of Machinists and Aerospace Workers Local 1363. The prevailing focus must be on maximizing service delivery to a community that relies heavily on emergency services. By working collaboratively to improve operational readiness and adhering to manufacturer's preventive maintenance recommendations, this concept of maximum service delivery can be achieved.

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## APPENDIX A: EUCLID FIRE APPARATUS MAINTENANCE COSTS

Table 4

*Annual Maintenance Costs for Euclid Fire Department Fire Apparatus between 2013 and 2015.*

<b>Apparatus</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>Totals</b>
Engine 1313	\$5,711.62	\$10,399.62	\$12,838.46	\$28,949.70
Engine 1314	\$5,869.13	\$14,289.10	\$11,749.30	\$31,907.53
Truck 1321	\$7,839.86	\$17,970.71	\$15,586.38	\$41,396.95
Truck 1325	\$765.14	\$8,901.95	\$15,119.06	\$24,786.15
	\$20,185.75	\$51,561.38	\$55,293.20	\$127,040.33

*Note.* These costs include parts and labor for internal work, but also work performed by outside vendors.

**APPENDIX B: INTERVIEW QUESTIONS**

1. What is your annual fire department budget?

- a. Less than \$5 million
- b. \$5-7 million
- c. \$7-9 million
- d. \$9-11 million
- e. Greater than \$11 million

2. What is your annual call volume?

- a. Less than or equal to 5,000
- b. 5,001 to 7,000
- c. 7,001 to 9,000
- d. Greater than 9,000

3. How many fire apparatus (pumpers and aerials only) do you maintain, both frontline and reserve?

**Note:** For this question, an *aerial fire apparatus* will be defined as a vehicle equipped with an aerial ladder, elevating platform, or water tower that is designed and equipped to support firefighting and rescue operations by positioning personnel, handling materials, providing continuous egress, or discharging water at positions elevated from the ground (NFPA 1901, 2016, p. 1901-10).

**Note:** For this question, a *pumper* will be defined as a fire apparatus with a permanently mounted water pump of at least 750 gpm (3000 L/min) capacity, water tank, and hose body whose primary purpose is to combat structural and associated fires (NFPA 1901, 2016, p. 1901-14).

- a. 4 or less
- b. 5
- c. 6
- d. 7 or more

4. Approximately how many miles per year does a primary fire apparatus travel? Do not consider reserve apparatus in your selection.

**Note:** for this question, a reserve fire apparatus is defined as a fire apparatus retained as a backup apparatus and used to replace a primary apparatus when the primary apparatus is out of service (NFPA 1911, 2012, p. 1911-11).

- a. Less than 4,000
- b. 4,000-5,999
- c. 6,000-7,999

- d. 8,000-9,999
- e. 10,000 or more

5. Who is responsible for fire apparatus maintenance?
- a. Fire department mechanic(s)
  - b. Other City department (Service, Motor Maintenance, etc.)
  - c. Private, third party mechanics not affiliated with the fire department
  - d. All of the above
  - e. None of the above
6. If applicable, which type of maintenance is done by private, third party mechanics not affiliated with the fire department?
- a. Pump (including preventive maintenance and pump testing)
  - b. Ladder (including testing and repairs)
  - c. Chassis preventive maintenance
  - d. Other (please specify):
  - e. Not applicable
7. What level of professional education do your mechanics maintain?
- a. Automotive Service Excellence (ASE) certified
  - b. Emergency Vehicle Technician (EVT) I (from an EVT certification program)
  - c. Emergency Vehicle Technician (EVT) II (from an EVT certification program)
  - d. Unknown
  - e. Other
  - f. None

8. How is preventive maintenance scheduled?

**Note:** *preventive maintenance* shall be defined as the act or work of keeping something in proper condition by performing necessary preventive actions in a routine manner to prevent failure or breakdown (NFPA 1911, 2012, p. 1911-11). In contrast, *maintenance* shall be defined as the act of servicing a fire apparatus or component in order to keep the vehicle and its components in proper operating condition (NFPA 1911, 2012, p. 1911-11).

- a. Road mileage
  - b. Engine hours
  - c. Out-of-service for other maintenance
  - d. Other (please specify):
9. How much of the total time spent maintaining a vehicle is spent on preventative maintenance, such as oil change and tune ups, rather than repairing a discovered problem?

- a. 0-25%
- b. 26-50%
- c. 51-75%
- d. 76-100%

10. What is your level of satisfaction with your maintenance program?

- a. Very unsatisfied
- b. Somewhat unsatisfied
- c. Neutral
- d. Somewhat satisfied
- e. Very satisfied



## APPENDIX C: CUYAHOGA COUNTY DATA

Table 5

*Alphabetical Analysis of Vehicle Maintenance Programs for Certain Cuyahoga County Fire Departments.*

<b>Fire Department</b>	<b>Notes</b>	<b>Total Annual Cost</b>
Bay Village	<p>Uses Service Department where two mechanics are EVT certified. They take care of two ambulances, two engines, one aerial, and four staff vehicles. All service performed by them other than a light bulb change. Occasional large repairs are sent to outside vendor.</p> <p>BVFD does not pay for Service Department mechanic pay. Budget of \$20,000 for outside repairs as needed. Must go to Village Council to increase if large repair is needed.</p>	\$20,000 for outside maintenance and does not include Service Department payroll.
Bedford Heights	Service Department does general maintenance, but any repairs are by outside vendors.	\$20,000 and does not include Service Department payroll.
Berea	Use Service Department and all EVT-related repairs go to outside shop. Have two ambulances, two engines, one aerial, and three staff vehicles.	\$30,000 and does not include Service Department payroll.
Cleveland Heights	One member (Battalion Chief) serves as the mechanic on an overtime basis, cost is about \$35,000 per year and is fully EVT certified. Most jobs done in house to include major repairs for two engines, two aerials, four ambulances, one pickup truck, five staff vehicles; cost for tools/materials per year is about \$34,000.	\$69,000
Fairview Park	All work sent out on two ambulances, one aerial, and one engine.	\$25,000
Highland Heights	All repairs sent out on two engines, one aerial, three ambulances, and four staff vehicles; budget is \$24,000 for repairs and \$16,000 for parts.	\$40,000
Mayfield Heights	Department officer handles minor issues and receives a \$1,000 stipend per year; all repairs are sent out; budget is \$15,000 parts and \$30,000 for maintenance.	\$45,000
Middleburg Heights	All repairs sent out; City mechanic only used in emergency.	\$50,000-\$65,000
North Royalton	All repairs sent out on three engines, four ambulances, and five staff units; budget is \$46,000 for all, but have exceeded budget in the past.	\$46,000
Parma	Department mechanic is EVT-certified and does all jobs from oil changes to full engine rebuilds. He handles six engines, one rescue, one aerial, two utility trucks, two pickups, and seven staff vehicles with a maintenance budget of \$200,000 which includes body work by outside vendors.	\$200,000 (unclear if this includes mechanic pay)
Parma Heights	Service Department handles maintenance. May use outside vendors for large or urgent jobs.	\$80,000 for outside repairs and does not

		include Service Department payroll
Solon	Service Department handles all maintenance and is EVT certified.	Unknown
South Euclid	Use Service Department and only pay for parts on in-house repairs; SEFD pays full bill for any outside repairs with a budget of \$20,000-\$30,000 for outside repairs.	\$20,000-\$30,000 and does not include Service Department payroll
Strongsville	Use Service Department who are EVT-certified; large jobs sent to outside vendor.	\$130,000
Westlake	Three members (one each shift) are paid five percent extra to be shift mechanic and perform general maintenance, oil change, lights, etc. Track work done by City Service Garage and outside vendors; cost for outside service on two engines, two aerials, four ambulances and six staff vehicles is about \$80,000 annually.	\$80,000 and \$10,500 for the extra five percent for shift mechanics; total is \$90,500.

*Note.* This information was current as of March 10, 2016, and may not reflect current expenses or processes.