

N. Apparatus and Equipment

General Background: Apparatus and Equipment

All Fire and Rescue Departments require effective equipment to fulfill their mission of protecting life and property. With many different types of apparatus and equipment available in the general marketplace, the National Fire Protection Association (NFPA) have established consensus standards for equipment and the staff qualifications to operate such equipment.

NFPA 1002 Standard for Fire Apparatus Driver/Operator Professional Qualifications, outline “the minimum job performance requirements” for operating a fire apparatus.⁹⁹ A key skill fire apparatus operators should have is “the ability to use hand tools, **recognize system problems**, and correct any deficiency noted according to policies and procedures.”¹⁰⁰ Similarly, NFPA 1071 Standard for Emergency Vehicle Technician Professional Qualifications establishes the General Skill Requirements for Emergency Vehicle Technician I and an Emergency Vehicle Technician II in inspecting emergency vehicle operation based on department standard operating procedures, manufacturer specifications.¹⁰¹

In addition to the operator and technician standards, NFPA has standards for the vehicle and equipment inspection and maintenance. NFPA 1911 Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicles, provides standards for routine vehicle inspection and criteria for placing apparatus out of service. For example, under Section 6.4.1. (2) an emergency vehicle will be taken out of service if the engine system “has Class 3 leakage of oil.”¹⁰² A Class 3 liquid leakage is one that is “great enough to cause drops to fall from the item being inspected.”¹⁰³ For routine inspection, NFPA 1911 requires “[a] visual and operational check of the apparatus...within 24 hours of a run or at least weekly.”¹⁰⁴ The standard also calls for maintaining a record of the visual and operational check.¹⁰⁵ Additionally, NFPA 1911 Chapter 21 provides standards for pump testing.¹⁰⁶

⁹⁹ National Fire Protection Association 1002 Standard for Fire Apparatus Driver/Operator Professional Qualifications (2017).

¹⁰⁰ National Fire Protection Association 1002 Standard for Fire Apparatus Driver/Operator Professional Qualifications Section 4.2.1(B) (2017)(emphasis added).

¹⁰¹ National Fire Protection Association 1071 Standard for Emergency Vehicle Technician Professional Qualifications (2016).

¹⁰² NFPA 1911 Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicles 6.4.1 (2017).

¹⁰³ NFPA 1911 Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicles 3.3.74 (2017).

¹⁰⁴ NFPA 1911 Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicles 7.1 (2017).

¹⁰⁵ NFPA 1911 Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicles 7.4.1 (2017).

¹⁰⁶ NFPA 1911 Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicles 21 (2017).

Similarly, NFPA Standard 1962 Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose Couplings, Nozzles, and Fire Hose Appliances outlines the testing and maintenance of all fire hose. Under this standard, in-service hose should have been manufactured after July 1987 and verified for serviceability by the service tests specified in NFPA 1961 Standard on Fire Hose Section 4.8.¹⁰⁷ Records associated with hose service tests should be established and maintained.¹⁰⁸ To best track hose serviceability, the standard calls for each length of hose to have an identifying number to use in recording its service life.¹⁰⁹ When a hose is removed from service, either for repair or because it has been condemned, it is to be distinctively tagged with the reason for removal noted on the tag.¹¹⁰ Additionally, NFPA 1962 requires that each hose nozzle be tested at least as frequently as the hose itself.¹¹¹

Many departments also use Thermal Imaging devices to aid in fire and rescue operations. NFPA Standard 1801 Standard on Thermal Imagers for the Fire Service specified “the design, performance, testing, and certification requirements for thermal imagers used by fire service personnel during emergency incident operations.”¹¹² Standards for training personnel and building competency in thermal imaging operations is outlined in NFPA 1408 Standard for Training Fire Service Personnel in the Operation, Care, Use, and Maintenance of Thermal Imagers.¹¹³

¹⁰⁷ NFPA 1962 Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances (2018).

¹⁰⁸ NFPA 1962 Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances 4.11.1.1 (2018).

¹⁰⁹ NFPA 1962 Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances 4.11.1.2 (2018).

¹¹⁰ NFPA 1962 Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances 4.11.3.6 (2018).

¹¹¹ NFPA 1962 Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances 5.3 (2018).

¹¹² NFPA 1801 Standard on Thermal Imagers for the Fire Service 1.1.1 (2018).

¹¹³ NFPA 1408 Standard for Training Fire Service Personnel in the Operation, Care, Use, and Maintenance of Thermal Imagers (2015).

Policies and Standards Applicable to Howard County Department of Fire and Rescue Services: Apparatus and Equipment

Howard County Department of Fire and Rescue Services [General Order 500.01 Annual Service Testing and Inspection](#) sets the minimum standards for equipment testing and inspection. Under Section 2 of [General Order 500.01 Annual Service Testing and Inspection](#), Section 2, firehose inspection is to be conducted in accordance with NFPA 1962, Chapter 5. This requirement is further enforced through [Special Order 2018.30 Annual Hose Testing](#), which states that “all fire hose shall be tested annually, and records updated” as recommended by NFPA 1962. As dictated by the Special Order, testing was to be accomplished by July 01, 2018, with completed test records sent to the Bureau of Logistics via inter-office mail on or before that date. Should a hose fail inspection it is to be placed out-of-service immediately, the couplings cut off, and an “Equipment Help Desk” request submitted for pick-up of the damaged hose.¹¹⁴ Additionally, [Special Order 2018.30 Annual Hose Testing](#) includes a Nozzle Inspection check-list and [Special Order 2017.36 Pump Testing](#) aligns with NFPA 1911 standard for annual pump testing of all apparatus and equipment that include a fire pump.

Vehicle maintenance and repair policy for the Howard County Department of Fire and Rescue Services is established by [General Order 510.03 Vehicle Maintenance and Repair](#). [General Order 510.03 Vehicle Maintenance and Repair](#) requires daily and weekly status checks by a vehicle’s assigned driver/operator in accordance with state and federal safety regulations. To aid this process, the Howard County Department of Fire and Rescue Services has created a check sheet for inspections, located in attachments A through C to [General Order 510.03 Vehicle Maintenance and Repair](#).

These checks are to be recorded by personnel in the station where the apparatus is currently housed with proper records maintained for all county-owned apparatus.¹¹⁵ Records for vehicles assigned to the field shall be maintained and updated by the company captain or their designee.¹¹⁶ A file shall be maintained for each vehicle, including the vehicle specifications, purchasing information and maintenance and repair records. Specifically, maintenance records consist of:

- All daily and weekly check sheets for the past year.
- All damage reports and completed requests for repairs.
- Completed Maintenance and Repair Requests.
- Down time in one quarter days for the unit.

¹¹⁴ Howard County Department of Fire and Rescue Services, Special Order 2018.30 Annual Hose Testing, Appendix A (May 25, 2018).

¹¹⁵ Howard County Department of Fire and Rescue Services, General Order 510.03 Vehicle Maintenance and Repair 5.1 (March 7, 2002).

¹¹⁶ Howard County Department of Fire and Rescue Services, General Order 510.03 Vehicle Maintenance and Repair 5.3 (March 7, 2002).

- Monthly mileage on the vehicle.

Lastly, any work completed on a vehicle will be checked off by shop personnel and the associated form returned with the apparatus.

Howard County has twelve (12) Fire Stations: five (5) Career Stations and seven (7) combination career/volunteer stations. All career staffed apparatus is owned by the Howard County. A majority of the county owned apparatus is maintained by the county maintenance shop, located at 8800 Ridge Road Ellicott City, Maryland 21043. Apparatus that is unable to be repaired at the shop or under warranty is sent to the appropriate vendor for repairs. The Volunteer Fire Companies are responsible for the maintenance and repairs of apparatus owned by the Volunteer Companies. The Volunteer Fire Companies have the discretion to choose the vendor of choice, to include the Ridge Road Fire Shop (RRFS), when maintenance and repairs are needed. The Fifth District Volunteer Fire Department (FDVFD) employs a part-time certified mechanic to maintain and coordinate repairs on apparatus and assigned to the FDVFD.

Howard County Department of Fire and Rescue (HCDFRS) has uniformed and contingent employees assigned to the Ground Support Unit (GSU). The GSU is a division of the Bureau of Logistics. The GSU is responsible for apparatus maintenance and repairs. There is one uniformed employee at the rank of firefighter assigned to operate out of the RRFS. This firefighter is responsible for the scheduling and coordination of apparatus maintenance and repairs. The additional uniformed and contingent employees assigned to the GSU assist with additional apparatus responsibilities.

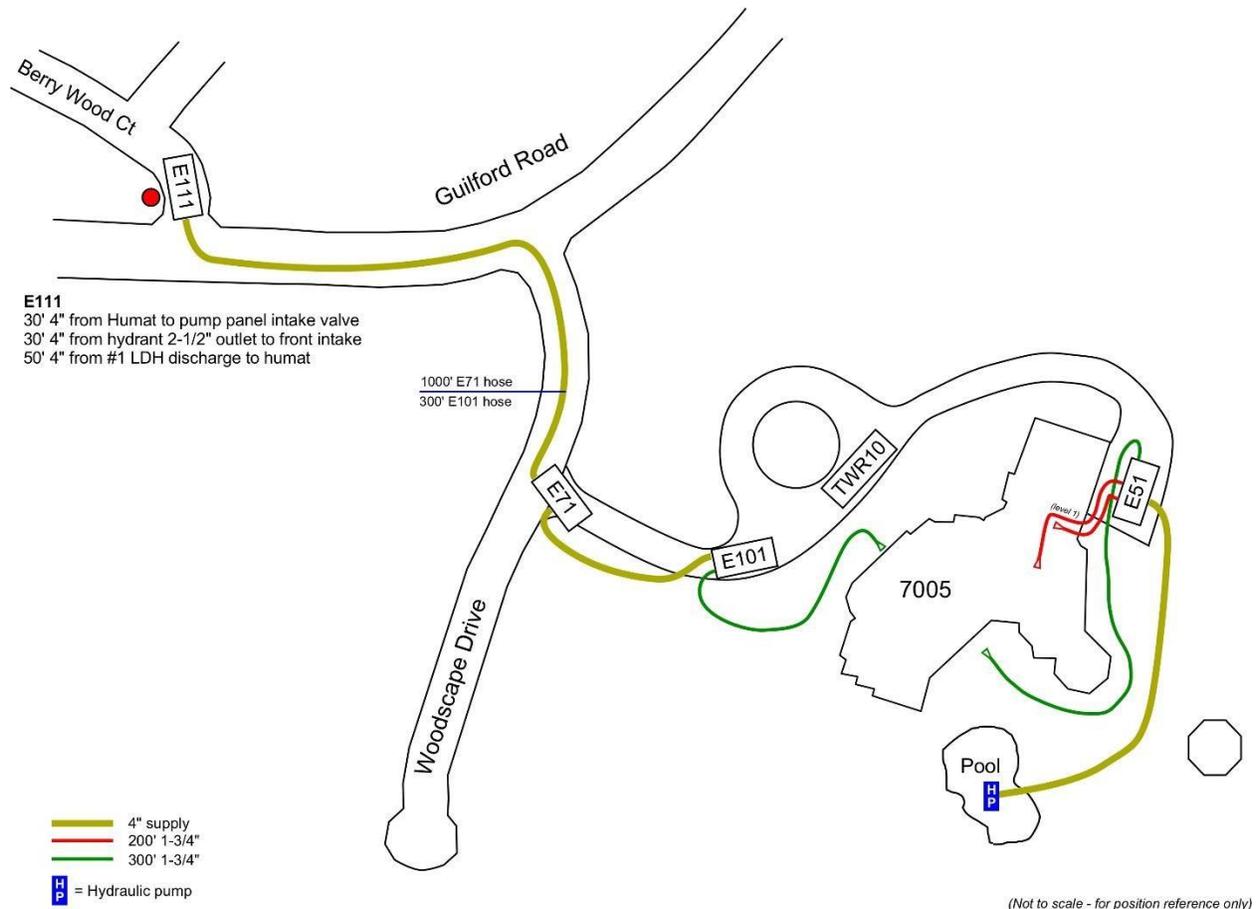
Howard County Government employs civilian mechanics to operate at the RRFS. The mechanics that work on the apparatus are certified Emergency Vehicle Technician (EVT) and Automotive Service Excellence (ASE) technicians. The uniformed and civilian employees at the RRFS work together to ensure maintenance and repairs are made.

The FDVFD employs an ASE certified Master Diesel Technician as a part-time mechanic to maintain the county and volunteer owned apparatus at the FDVFD. He is available the majority of the time twenty-four (24) hours a day, seven (7) days a week.

Woodscape Drive Incident Overview: Apparatus and Equipment: Apparatus and Equipment

During the incident at 7005 Woodscape Drive there were seven (7) engines, four (4) aerial apparatus, two (2) ambulances, and one Special Service unit on scene during the evaluated time period. Most units operated without issue, however three units had notable issues—Engine 51, Engine 22, and Engine 101—which are detailed below.

Hose Deployed At Time Of Mayday



Shortly after arrival at 7005 Woodscape Drive, Engine 51 repositioned to Side C from Side A. Battalion Chief 1 recommended to Engine 51's Officer to use the swimming pool on Side C for a water supply. Engine 51's driver repositioned the apparatus to Side C and attempted to deploy the hydraulic pump to the pool. The apparatus mounted main hydraulic hose came up short of the pool. The 25-foot extension lines were retrieved from Engine 51 to extend the hoses. The extension hoses were unable to connect to the main hydraulic hose due to corrosion on the couplings of the extension hoses. The HVO had to shut down pump operations to the fireground and move the Engine forward, closer to the pool. This caused a delay in water supply from the pool to Engine 51.

Additionally, Engine 51's driver noticed an odor of burning rubber coming from the engine compartment while engaged in pump operations. This resulted in Chief 5A calling FDVFD's mechanic at approximately 03:30 hours on July 23, 2018 via his cellular phone. Chief 5A advised the mechanic that Engine 51 was having a mechanical failure and requested that he respond to the scene. The mechanical failures will be discussed further in this chapter.

During this incident Reserve Engine 178—a 2006 Pierce Dash capable of carrying 750 gallons of water—was in-service at Fire Station 2 running as Engine 22. Reserve Engine 178 will be referred to as Engine 22 for the remainder of this section. E22 arrived on location and parked on Guilford Road near Woodscape Drive. Engine 22's crew, to include the driver, abandoned the apparatus and went to the fire scene at the direction of the Incident Commander. Engine 22's crew was assigned to augment the first RIC. The motor was left running once abandoned.

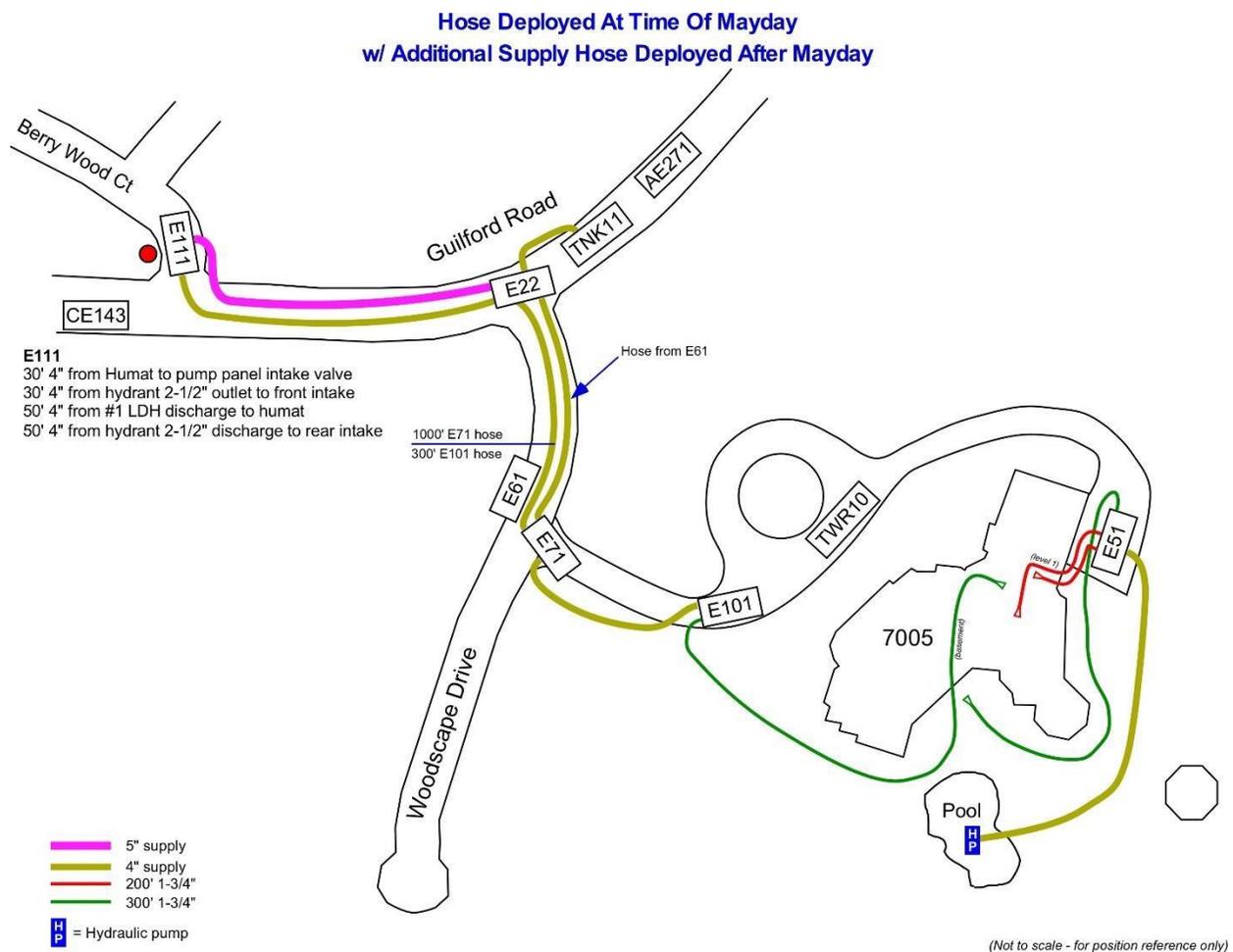


Figure 34 - Hose Deployed at time of MAYDAY and after MAYDAY

At an undetermined time and once RIC operations were completed, Engine 111's officer gave orders to Engine 111's firefighter to retrieve Engine 22 and place it between Engine 111 and Engine 71 as a relay pumper. Engine 111 was located on Berry Wood Court at the hydrant supplying the fireground. Engine 71 was located at the fireground supplying Engine 101. Engine

22 was placed in the water supply as a relay pumper to ensure maximum flow was delivered to the scene. Engine 22 was positioned in the relay at the intersection of Guilford Road and Woodscape Drive.

Sometime after 08:00 hours, Engine 22 shut down due to a malfunctioning coolant sensor. The mechanic from FDVFD, still on the location, evaluated Engine 22 and made temporary repairs allowing Engine 22 to resume relay operations. Engine 22 was placed out-of-service following the incident and sent to the Ridge Road Fire Shop to have repairs made.

A hose-line was deployed from Engine 101 around Side D to Side C, stretching the line to the first-floor deck and over the railing. At some point during operations the hose-line ruptured, causing the line to be shut down while the damaged section of hose was replaced. Engine 101 carries a standard 5-foot Clemens Pack containing two, 75-foot sections of lightweight hose. An engine crew deployed 100 feet of 3-inch hose as a leader line and connected 150-foot, 1³/₄-inch hose from the Clemens Pack.

Findings and Recommendations: Apparatus and Equipment

In evaluating apparatus and equipment used in the incident, the ISRB sent certain items out for independent review. One of these items was the nozzle of the hose line FF Flynn was operating on when he fell into the crawlspace. Additionally, a review of Mercury Associates, Inc. 'Optimal Vehicle Replacement Cycle Analyses,' which assessed nine asset classes of the Howard County Central Fleet, provides recommendations for equipment and apparatus replacement over the lifespan of the items.

First, the nozzle on the hose line FF Flynn was operating on when he fell through the crawlspace was an Elkhart Brass Chief Fixed Flow Combination Fog Nozzle Tip Model 4000-24. This nozzle was affixed to a model B-275A ball shutoff with a 1 3/8- inch waterway. Based on the independent testing the Nozzle was rated for 200 gpm at 75 psi. Nozzle was flow tested with results of output flow of 227 gpm at 75 psi exceeding the rated flow of the nozzle. The nozzle moved freely from straight stream to full fog and into the flush position without difficulty. The shutoff moved freely, and no leaks were observed when the nozzle was in the closed position with full pressure behind it. In short, the nozzle was fully functional and exceeded its rated capacity on a flow test. All components of the nozzle operated as designed.



Figure 35 – Nozzle FF Flynn had in hand just prior to falling into the crawlspace

Second, the Optimal Vehicle Replacement Cycle Analyses provided by Mercury Associates, Inc. provided recommendations for how long equipment should be retained. Reviewing the current apparatus in use by Howard County Department of Fire and Rescue Services the ISRB found that a quarter of all fire engines and more than half of all reserve engines in the Howard County Department of Fire and Rescue Services exceed the recommended fourteen (14) year lifespan. All reserve aerial apparatus exceed the twelve (12) year lifespan as recommended by the Mercury Report. Thirty-eight (38) percent of the ambulance fleet exceed the eleven (11) year lifespan as recommended by the Mercury Report and all reserve ambulances except for one

exceed the lifespan. The only HCDFRS vehicle asset that largely meets the recommended replacement cycle is staff vehicles. Most of those vehicles are support and administrative staff and do not have a routine emergency response role in the department.

Third, the couplings on Engine 51's 25-foot hydraulic extension hoses were corroded, resulting in a delay in accessing water supply from the pool. Engine 51 is equipped with a hydraulic submersible pump that can be used to supply apparatus or hose appliances with a continuous water supply. The hydraulic pump on Engine 51 is capable of flowing 650 gallons per minute (GPM) as long as the water source can support the demand. The pump is powered by an onboard hydraulic pump and a 165-foot apparatus mounted hydraulic hose line. Engine 51 is also equipped with two 25-foot extension hoses to extend the main hydraulic hose. The pump has a 4-inch storz coupling on the discharge of the pump. The hydraulic pump can be placed in a static water source and operated by the driver of the apparatus. A similar hydraulic pump and components are equipped on Engine 52, Squad 5, Engine 31 and Water Supply 3.



Figure 36 - Top view of corroded hydraulic coupling



Figure 37 - Side view of corroded hydraulic coupling

Prior to this incident, the hydraulic pump, main hydraulic line, and the 25-foot hydraulic extension lines were not a part of the HCDFRS daily/weekly check sheets. HCDFRS [General Order 510.03 Vehicle Maintenance and Repair](#), Section 1.1, states "[d]aily and weekly checks shall be performed by the vehicle's assigned driver/operator in accordance with the DOT and COMAR inspection standard and then recorded on the appropriate DFRS check sheet." To prevent interrupted water flow at future incidents, HCDFRS should revise its daily and weekly check sheets to include assessment of the hydraulic pump, its lines, and its 25-foot line extensions. The inspection of the hydraulic line extensions should include lubricating and exercising the couplings.

Fourth, Engine 51 also experienced mechanical problems during fireground operations and was only able to continue pump operations due to the arrival of FDVFD's mechanic. While Engine 51

was engaged in pump operations its driver noticed an odor of burning rubber emitting from the engine compartment. Notifying Chief 5A of the unusual odor the Chief contacted FDVFD's mechanic requesting him to respond to the scene. On inspection of the unit, the mechanic found that Engine 51's air conditioning compressor had locked up, causing it to overheat. Because the air condition belt operates other portions of the unit, this mechanical issue threatened pump operations.

Fortunately, the mechanic was able to repair Engine 51 without any interruption to pump operations. To do so, the mechanic first attempted to raise the cab of Engine 51 and disconnect the coil to free the compressor. After this attempt proved unsuccessful, he manually bent the clutch plate away from the flywheel to free the compressor. This temporarily fixed the mechanical problem and allowed Engine 51 to remain in service.



Figure 40 - Engine 51 after on-scene repair

Because FDVFD leadership had the availability of an on-call mechanic to respond to the scene, pump operations continued without interruption. Had Engine 51 been placed out-of-service for mechanical failure, the water supply from the swimming pool would have been lost and another engine driver would have had to pump through Engine 51 adding complexity to an already challenging incident. To avoid such an outcome at future incidents, HCDFRS should consider placing a Logistics representative and mechanic from the County Maintenance Facility to the on-call availability. Additionally, all HCDFRS apparatus purchases should be designed in a fashion so that critical apparatus functions run independently from internal climate control.

Fifth, on review of Engine 22's maintenance log the unit should have been placed out of service due to a persistent oil pressure and coolant sensor issue. Engine 22 shut down during water supply operations due to a malfunctioning coolant sensor. Fortunately, the mechanic from FDVFD was still on location and was able to make temporary repairs, allowing Engine 22 to resume relay operations. Engine 22 was placed out-of-service following the incident and sent to the Ridge Road Fire Shop to have repairs made.

On review of Engine 22's (E178) Fleet Help Desk Report the unit had the following maintenance reports sent between May 2018 and July 2018:

- May 3, 2018 – "When E178 started audible alarm sounding and yellow check engine light is on. Alarms for 30 seconds then goes away... Vehicle performed normally." Engine 178 went to the Ridge Road Fire Shop on May 7, 2018.
- May 10, 2018 – "Check engine light/audible coming on when vehicle is started. Will turn off after 1 minute on own...Was repaired at shop yesterday for protentional problem." Ridge Road Shop
- July 10, 2018 – "...Leaking oil above the power steering pump. Leaving a big oil spot on the floor every day. Check engine light and verbal alarm are constantly going off while driving. Drove to Ridge Road Shop to check alarm, could not find the problem. Mechanics think it is the anti-freeze sensor. Will repair it next time in shop.
- July 13, 2018 – Oil leak above the steering pump on driver's front of motor. Leaking oil every day. Anti-freeze sensor is producing a check engine light to come on. Added 2 quarts on Tuesday, shop looked at it this past Tuesday and they are aware of it. Fluctuating oil pressure while driving..."

Through the investigation and review process, the ISRB discovered that there was no county-owned apparatus available to replace E22 at the time. Although there was an equivalent volunteer apparatus available, E22 was not able to use that apparatus as a temporary replacement apparatus for E22 due to cultural practice. Mechanics assured the drivers and officers of E22 that the coolant sensor issue would not impact the operation of the unit.

Sixth, a portion of 1 ¾-inch hose-line ruptured during the incident, temporarily shutting down the attack line while the damaged hose was replaced. After the incident, the hose was returned to Station 10. The damaged section of hose was disposed of in the dumpster following the incident, however the proper paperwork and HELP Desk was not submitted. Additionally, there is no record of Station 10's testing either of the 75-foot sections of the Clemens pack. For future operations, all sections of fire-hose should be assigned an identification number and logged into a database to enable easy tracking of hose testing. Should a section of hose be taken out of service it should be accompanied by a Help Desk Submission and database note detailing the reason the hose is taken out of service.

Seventh, the ISRB determined that not all Howard County Fire Rescue- Vehicle Check Sheets were completed and/or recorded as stated in [Howard County Department of Fire and Rescue Services General Order 510.03 Vehicle Maintenance and Repair](#). The daily and weekly vehicle check-off sheets should be custom to the apparatus and completely filled out following inspection. A designee assigned by the station Captain should maintain the apparatus check sheets, repair receipts, and maintenance logs of apparatus housed in the station.

Eighth, although Howard County Department of Fire and Rescue Services adopted NFPA 1962 standards for nozzle inspections and testing, the standard is not reflected in the Nozzle and Appliance check sheet. Specifically, the check-sheet is missing verification that each nozzle is tested at least as frequently as the hose with which it is used and that each nozzle with a shutoff mechanism is hydrostatically tested as specified in the NFPA standard. This check-list should be revised to reflect the NFPA nozzle testing standard.

Lastly, HCDFRS owns several models of Bullard hand held thermal imagers but has not trained personnel on how best to operate the equipment. All HCDFRS County owned Engines and Special Services have Bullard hand held thermal imagers, either model T3, T4, or Eclipse. The Volunteer Fire Companies can purchase any make or model thermal imager at their discretion. Since there are no parameters set for the purchasing of thermal imagers, there are inconsistencies of thermal imagers throughout the County. Within 2018, the County had added integrated thermal imagers to the MSA G1 Self Contained Breathing Apparatus (SCBA). Each engine company, both career and volunteer, have 1 SCBA with integrated thermal imagers and each special service has two SCBA with integrated thermal imagers.

There were no reports of mechanical failure of any thermal imagers on scene. Tower 10A did, however, advise that he was unfamiliar with the current model of imager that he was using on Tower 10 due to being placed on the unit within days of incident. The HCDFRS Ground Support Unit delivered five new imagers to five different companies during the first and second week of July 2018. The older models they replaced were taken off the units at the same time for trade-in value. A user manual was given to Company officer, after a short class on the operations of the unit. Training would be the responsibility of each shift officer at the station. Currently HCDFRS does not have an order on operations or training of thermal imagers although NFPA 1408 specifies the design, performance, testing, and certification requirements for thermal imagers used by fire service personnel during emergency incident operations. Moving forward, HCDFRS should train personnel on the appropriate use of thermal imaging equipment before it is placed in service.

Findings	Recommendations
N.1. The age of many HCDFRS apparatus exceeds the recommended lifespan from the Optimal Vehicle	N.1.1 HCDFRS shall replace apparatus that exceeds the recommended lifespan from the Mercury Associates report.

Findings	Recommendations
Replacement Cycle Analyses conducted by Mercury Associates Inc.	
N.2. Engine 51's 25-foot hydraulic extension hose couplings were corroded.	N.2.1 HCDFRS must revise its Vehicle Check Sheet to include the Hydraulic pump, hydraulic lines, and the 25-foot hydraulic line extensions to the Weekly Check Sheet, including lubrication and exercise of the couplings.
N.3. Engine 51's air conditioning compressor locked up on the fireground, threatening pump operations. Operations were only able to continue thanks to FDVFD's mechanic responding to the scene and temporarily fixing the mechanical issue.	N.3.1 A Ground Support representative and a mechanic from the County Maintenance Facility must be added to the on-call availability. N.3.2 All HCDFRS apparatus purchases should be designed in a fashion so that critical apparatus functions run independently from internal climate control.
N.4. Engine 22 (Reserve Engine 178) experienced mechanical failure during the incident, placing the unit out of service.	N.4.1 All completed repairs and maintenance must be documented, with a copy of the documentation returned with the apparatus. N.4.2 Units must be placed out of service if there are persistent mechanical issues that may impact critical apparatus functions.
N.5. Engine 22 should have been placed out of service prior to the incident due to recurrent issues--regarding the coolant sensor, oil pressure and an oil leak—that met the NFPA 1911 standard for taking a unit out of service.	See Recommendations N.4.1 & 4.2
N.6. The 75-foot, 1 ¾-inch hose from Engine 101's Clemens Pack failed during the incident. There is no record of the hose being inspected, as required by Special Order 2018.30 , and no record of the damaged hose's disposal.	N.6.1 Each section of hose must be assigned an identification number in accordance with NFPA 1962 4.11.1.2 and logged into a database, so it can be easily tracked for hose testing and out of service documentation. A section of hose that is taken out of service should be followed

Findings	Recommendations
	<p>up with a Help Desk submission and entered in to the database with its reason for being taking out of service.</p>
<p>N.7. Not all Howard County Fire Rescue-Vehicle Check Sheets were completed and/or recorded as required by General Order 510.03.</p>	<p>N.7.1 Apparatus Daily and Weekly check off sheets must be custom to that piece of Apparatus.</p> <p>N.7.2 Each check off sheet must be filled out to include the date, unit number, and FAICS number.</p> <p>N.7.3 A designee assigned by the station Captain must maintain the apparatus check sheets, repair receipts and maintenance logs.</p> <p>N.7.4 HCDFRS should evaluate technology solutions to aid in maintenance, inspection, and inventory check sheets. Ideally, this electronic system will be compatible with smartphones and station computers.</p>
<p>N.8. HCDFRS has adopted NFPA 1962 standards for nozzle testing, but not all tests from the standard are reflected in inspection checklists.</p>	<p>N.8.1 HCDFRS Nozzle and Appliance Inspection Checklist, found in Appendix B of Special Order 2018.30, should be amended to include service testing of Nozzles as recommended by NFPA 1962 5.3.</p>
<p>N.9. HCDFRS has neither standardized thermal imaging devices deployed in the field, nor established training for thermal imaging devices.</p>	<p>N.9.1 Prior to placing thermal imagers in service, training shall be implemented. Including, but not limited to, operation, application, use, and limitations as stated in NFPA 1408. All training shall be documented and placed in the training log.</p>